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Pre-Insulated FRP (Bondstrand) Installation Instructions

INS-BSI

Revised 08/16/23

This instruction manual will give you all the information needed in terms of techniques, tools, and accessories required to install ROVANCO's pre-insulated FRP piping system. Thank you for showing your confidence in ROVANCO by purchasing its products. We sincerely appreciate your business and we will provide you with quality products with a fair price and "great" service to deserve your future business. Please consult your local ROVANCO Manufacturer's Representative for in-formation about all of the products provided by ROVANCO.

INSPECTION

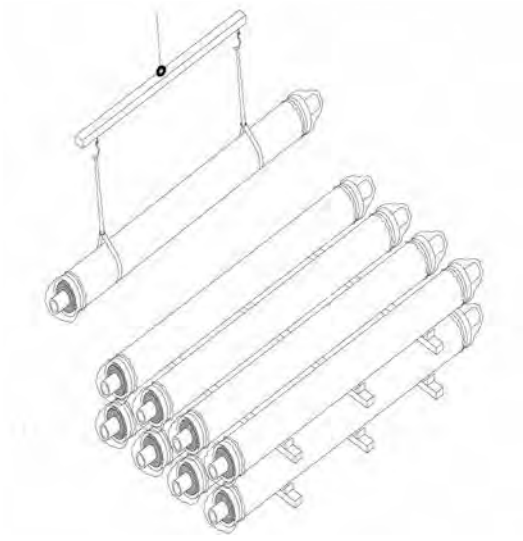
Inspect all shipments on receipt. Examine all pipe and accessories as they are unloaded. Check to insure that every item on the packing list is received. Check the contents of the cartons to insure that the materials have arrived safely. Do not throw the cartons from the vehicle. Handle all materials carefully. Have the freight carrier make out a damage or short receipt if any discrepancies are found. Keep a signed copy of this receipt and notify ROVANCO immediately. All spool pieces shipped have individual part numbers labeled on each end. Refer to your packing list to be sure you have all spool pieces shown. With your paperwork, you will receive two copies of the installation drawings. These drawings will show the location of each piece of ROVANCO FRP piping system.

UNLOADING

ROVANCO FRP piping system are manufactured to withstand normal field handling but, like any piping material, damage can occur from careless handling. The spool pieces should be unloaded from the truck using a cherry picker or other suitable equipment. Lift the pieces with nylon slings and spreader bars so as not to damage the polyethylene jacket. Do not use chains or chokers in direct contact with the polyethylene jacket. Do not drop spool pieces because this can damage the insulation or the polyethylene jacket.

STORAGE

Use dunnage material under the pipe and between successive layers to protect the casing from foreign objects. Do not stack more than four layers high to avoid excessive weight on the bottom layer. Prior to installation cover the pipe ends with a white tarp or white visqueen to keep out water, excessive dust and debris. If the pipe will be stockpiled in direct sunlight or at temperatures exceeding 90°F, cover the entire system with a white tarp or white visqueen. Do not use opaque, clear or any other color other than white. If these steps are not taken, warranty will be void. There should be a layer of wood dunnage between the pipe and visqueen. Cartons of material (i.e. glue, foam kits, fiberglass adhesives, etc.) should be stored in a dry area at 60° to 80°F. Liquid foam has a shelf life of 6 months after delivery. Freezing or high temperatures may affect the product's ability to perform their functions. IF these steps are not taken, warranty will be void.



TESTING

All carrier pipe must either be air or hydro tested per specifications prior to insulating, pouring thrust blocks, anchors or backfilling the system. Failure to comply with testing procedures will void warranty. Plastic carrier pipe must be hydro tested only, do not air test.

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For Leak Detection Installation Instructions, contact Rovanco for INS-RAT

Section 1: Factory Ends

The pipe can come Plain End, Shaved End, Tapered End or Bell End

The BONDSTRAND 2000 pipe has always been provided Bell End by Shaved End. The manufacturer changed over to no shave Ends for the 2", 3", 4" and 6" sizes in the fall of 1999. This pipe is provided in 20' or 40' lengths **not** 30' as the Bell x Shaved End was supplied.

The 3000A or 3000L pipe is provided as Plain End or Tapered End. Determine what type of pipe and what factory end you have.

Section 2: End Prep

NO SHAVE 2000 PIPE AND SHAVED END 2000 PIPE

The no shave pipe ends have to be sanded the same as the bell x shaved end or the tapered end pipe. Using 40 to 120 grit sand paper, sand the first 2 to 3 inches from the end of the pipe as well as the quick-lock socket of the fitting to be bonded. There should be no glossy areas left on the bond area of the pipe.

NOTE: Do Not use power tools for sanding the pipe. The O.D. of the 2000 no shave pipe is very close to the O.D. of the 2000 Bell x Shaved end pipe. The same 2000 fittings are used for either shaved 2000 pipe or no shave 2000 pipe. The 2000 and 3000 fittings **are not** interchangeable.

PLAIN END 3000 and TAPERED END 3000:

The pipe can be provided either way. The tapered ends are very susceptible to damage so some projects are provided without the ends tapered.

Section 3: Shaving Tools

For 2" thru 6" 2000 Bell x Shaved end pipe either a B-1F Pipe Shaver or a M-74 Pipe shaver with the appropriate size arbor can be used to prep the pipe ends. For pipe 8" through 16" an M-80 Pipe Shaver with the appropriate size arbor is used to prep the pipe ends.

For 3000 Pipe a unique tapering tool Model 010 or similar is used to taper the pipe ends. Tapered Bell end fittings are used for 3000A and 3000L pipe.

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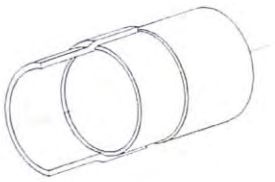


Ameron B-1F Pipe End Preparation Tool

for Quick-Lock® bell x spigot joints in 1- through 8-inch diameters

Introduction

The B-1F pipe end tool is used to prepare the straight spigot end on Bondstrand fiberglass pipe employing the Quick-Lock adhesive-bonded joint. The tool is available for all Bondstrand pipe sizes from 1 through 8 inches in diameter. The tool is designed so that all critical dimensions such as spigot length and spigot outside diameter are preset.

The 1- through 4-inch tools are designed to cut Bondstrand PSX™•JF pipe in two stages. The tools are delivered with only one cutting insert located on the arm marked ***Spigot***.

Advantages

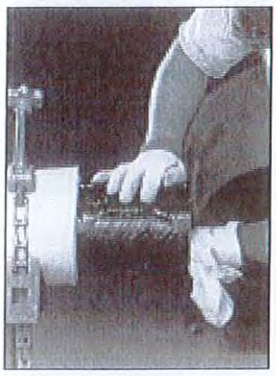
The B-1F tool offers the following advantages over previous end preparation tools from Ameron and end preparation methods offered by competitive manufacturers:

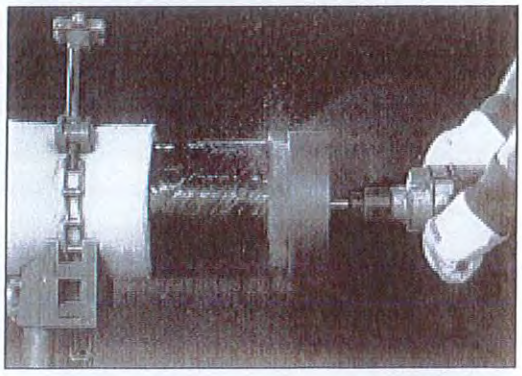
- Requires no adjustment: spigot length and diameter preset to Ameron tolerances
- Requires no special tools: uses ordinary power drills with ½-inch chuck
- Compact: can use on installed buried pipe with minimal excavation
- Reduces field labor time
- Requires minimal set-up
- Light weight for ease of use: 4-inch tool weighs only 9 pounds

Operating Instructions

1) Clean the inside of the pipe to remove all dirt, sand or foreign objects. Clean tool of any large particles or shavings from previous use.
2) Inspect the cutter on tool. If worn, remove and rotate for new cutting edge; replace if all edges are worn. If cutter is loose, tighten with an Allen wrench.

The B-1F tool is available in 1 though 8-inch sizes for preparing spigot ends for the Quick-Lock joint. Spigot length and diameter are preset for each pipe size. To use the tool, one need only make sure that the inside of the pipe is clean (left) and then insert the tool (right).





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Operating Instructions (cont'd)

3) For preparing Bondstrand PSX™•JF, first remove the cutter from the area marked ***Spigot*** with an Allen wrench and place it on the arm marked ***Jacket***.The cutter in this position will remove the external jacket.

4) Mount tool in chuck of ½-inch drill motor and tighten chuck securely. For best results use a drill motor with side handles and a spade grip. **Important: The shaft on the B-1F tool is round without flats. The round shaft allows the chuck to rotate on the shaft if the cutters bind. This safety feature should not be modified.**

5) Except when working on installed pipe, hold the pipe securely, preferably in a pipe vise. **Use a 1/4-inch thick rubber pad between the clamps and the pipe to protect the pipe. Warning: Avoid inhaling dust produced by cutting. Wear an OSHA-approved dust mask.**

6) Insert the spindle of the tool into the pipe so that the cutter remains away from the end of the pipe. Grip the drill motor firmly and switch to ***on***. Slowly feed the tool into the pipe until the tool bottoms. Too fast a feed (on the final spigot cut) can produce high and low spots. Remove the tool from the pipe. **Note: Spindle is held in tool by set screws. If spindle rotates in tool, retighten set screws.**

7) For Bondstrand PSX™•JF, once the jacket is removed, place the cutter on the arm marked ***Spigot*** for the final cut. ***See note below.***

8) Inspect the cut surface to determine that all 'glazed' or resin-covered areas have been removed. If such areas remain, sand by hand until the entire surface is without a resin gloss.

Note: If several spigots are to be made, it may be more efficient to shave all the jackets first, then shave all the spigots. Two separate tools, one with the cutter on ***Jacket*** and one with the cutter on ***Spigot*** may also be used for large installations.

The cutter on the B-1F tool is designed to cut when the tool is rotating in the clockwise direction. Attempts to cut with the tool in counterclockwise rotation will bend the cutter and reduce the effectiveness of the tool. Similarly, when withdrawing the tool after completing a cut, stop the drill motor and simply pull the tool out of the pipe. Do not reverse the drill rotation when withdrawing as this will also tend to bend the cutter.

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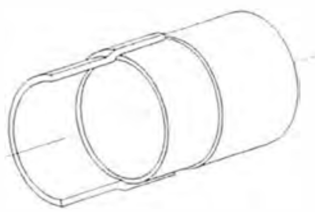

Bondstrand M80 Pipe Shaver

for Quick-Lock® bell x spigot joints in 8- through 16-inch diameters

Introduction

The M80 pipe shaver is designed to prepare Quick-Lock spigot ends on Bondstrand pipe as described in the Bondstrand Assembly Instructions, FP170. Pipe is shipped from the factory with prepared spigot ends, but pipe cut to length on the jobsite must be provided with a new spigot end before assembly. Spigot ends can be prepared on 10 through 16-inch pipe of any Bondstrand series with the Quick-Lock joint using the M80 tool. The M80 tool can also be used to shave 8-inch Quick-Lock spigots and is to be preferred to the B-1 tool when preparing 8-inch Bondstrand Series 2000M and 7000M marine pipe that have greater wall thicknesses than Bondstrand industrial pipe.

The M80 pipe shaver requires a different arbor for each pipe size. The expanding arbor slips into the pipe and the O-rings expand to grip the inside pipe surface when the tie bar is tightened. As the frame is rotated around the feed tube, the cutting tools advance and shave a cylindrical surface (spigot) on the pipe. When adjusted and used as described in these instructions, the shaver prepares an excellent bonding surface with a controlled diametral tolerance.

This unit can be rotated by hand or with a portable power drive such as is used for threading ⅛ to 2-inch steel pipe. A key in the portable power drive engages a keyway in the power drive seat to rotate the unit.

Operating instructions

1) **Check your shaver** – If this is your first use of the M80 pipe shaver, check to see that all parts are included or available. The following parts are included with the M80 pipe shaver and case:

a) Shaving tool complete with two cutting tool assemblies.

b) Pipe shaver gauge (BB) with 0.015-inch feeler gauge attached.

c) Two turning handles (U) and attaching cap screws (AD). These are not needed if a power drive is used.

d) Six Allen wrenches, sizes 5/32, 3/32, 3/16, 1/4, 5/16 and 1/8 inch.

e) Arbors (Q) complete with O-rings are available separately (See drawing on page 3).

f) In addition, you will need the equipment listed in the Bondstrand Quick-Lock Assembly Instructions, FP170. A wrench fitting a 1⅛ inch hex head will also be required. A portable power drive is not required but it makes the job much easier. Contact the manufacturers or their representatives for information on the following portable power drives:

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FP515B (9/96)

Operating instructions (cont.)

shaver is handled with care at all times, and not dropped, hit or abused in any way that might cause a change in setting. After extensive use, the cutting inserts (W) may get dull or show wear. Simply loosen socket head cap screws (AF) using 1/32 inch Allen wrench and rotate both inserts 90° to obtain a new pair of cutting edges. Readjust to obtain correct shaving diameters. Ameron stocks replacement cutting inserts (W) for your convenience: simply order Ameron Commodity Code 00250400.

9) Reset for different pipe diameter

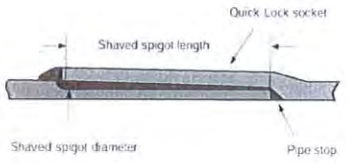
You will have to repeat these steps each time a change in pipe diameter is made. Minimizing the number of diameter changes made on the shaver will expedite your project.

Store the shaver in a dry location, protected from moisture, as you would any machine tool.

Nominal Pipe Size		Item Q - M80 Pipe Tool Arbors			
(in)	(mm)	Arbor Part Number[1]	O-Ring Model	O-Ring Part Number	Quantity
8	200	80220401	AN6227-70	80020400	2
10	250	A0220401	AN6227-75	A0020400	2
12	300	B0220401	AN6227-79	B0020400	2
14[2]	350	C0220401	AN6227-82	C0020400	2
16[2]	400	D0220401	AN6227-85	D0020400	2

1) Arbor includes two (2) O-rings.
2) Consult Ameron for availability of arbors for shaving 14 and 16-inch Bondstrand marine pipe.

Standard spigot dimensions



Nominal Pipe Size		Shaved Diameter Inches		Shaved Diameter Millimeters		Shaved Length Inches		Shaved Length Millimeters	
(in)	(mm)	(min)	(max)	(min)	(max)	(min)	(max)	(min)	(max)
8	200	8.547	8.563	217.0	217.4	2 1/2	2 5/8	64	67
10	250	10.682	10.698	271.3	271.7	2 3/4	2 7/8	70	72
12	300	12.684	12.700	322.2	322.6	3	3 1/8	75	79
14	350	13.929	13.945	353.8	354.2	3 1/2	3 5/8	89	92
16	400	15.909	15.925	404.1	404.5	4	4 1/8	102	105

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Operating instructions (cont.)

The shaver is a precision tool and must be handled with care.

Before handling the shaver, engage knurled slide sleeve (G) by sliding it fully forward under the power drive seat. Handling the shaver with slide sleeve disengaged may cause injury.

Caution: Do not reverse power drive to return cutting head to starting position. Do not use power drive to advance cutting head beyond maximum pointer depth (about 3 inches). Shaver will jam at end of travel, possibly causing injury. When using shaver to make nipples, avoid possible injury when advancing cutting head by turning shaver manually.

These tools fit a power drive seat 3.62 inches (91.9 millimeters) in diameter.

Porta-Thread	Greenlee Tool Co. Rockford, IL	Model 440	120 VAC
Amaz-O-Thread	Collins Machinery Corp. Monterey Park, CA	PN13800 PN14300	120 VAC Compressed air
Ridgid	Ridgid Tool Co. Elyria, OH	Model 700	120 VAC
Port-A-Pony	Curtis Tools St. Louis, MO.	PN24446 PN24445 PN20690	120 VAC 240 VAC Compressed air 90 psi @ 100 cfm

2) Locate cutting tool assemblies

Locate cutting tool assemblies in the appropriate slots in frame B for the desired pipe size, and assemble slide plate (K), washer (T) and socket head cap screw (AE) on each assembly, and tighten screws (AE) with ⅛-inch Allen wrench.

3) Adjust cutting edges

a) Disengage slide sleeve (G) by sliding it fully out from under the power drive seat and draw tie bar (D) back so that feed tube (C) is fully back into frame (B), and reengage slide sleeve (G). Remove nut (H) from tie bar (D), remove arbor (Q) if one is on tie bar, and slip pipe shaver gauge (BB) onto feed tube (C).

b) With the 5/64-inch Allen wrench, slightly loosen socket head cap screw (AG) on one cutting tool assembly. Adjust form tool (P) in toward or out from pipe shaver gauge (BB) with adjusting screw (AA) until cutting insert (W) is separated from pipe shaver gauge (BB) by the thickness of the 0.015-inch feeler gauge. Lock form tool (P) in place by tightening socket head cap screw (AG). Recheck position of cutting insert (W) after the form tool (P) is locked in place, and readjust if necessary. Repeat procedure to set second form tool (P).

c) Remove gauge (BB) and slip arbor (Q) over feed tube (C). Turn nut (H) onto tie bar (D) so that key on nut (H) will engage slot in arbor (Q). *Nut (H) will be tightened later.*

4) Mount shaver in end of pipe

With the Bondstrand pipe cut to length and firmly held in position (See photos of padded vise in the Bondstrand Assembly Instructions), you are now ready to mount the shaver on the end of the pipe. Disengage slide sleeve (G) and slide arbor (Q) and feed tube (C) forward, away from frame (B) and re-engage slide sleeve (G). Slip arbor (Q) into Bondstrand pipe until the end of arbor (Q) nearest to frame (B) is flush with end of pipe. Now with a 1⅛-inch wrench, tighten tie bar (D) (looking toward frame [B], turn hex head clockwise) so that arbor (Q) is locked firmly inside pipe. Again disengage the slide sleeve (G), slide frame (B) toward pipe until cutting inserts (W) are nearly touching the end of pipe, and re-engage the slide sleeve.

5) Shave the spigot

If a portable power drive is used, slide the drive onto the power drive seat. If you are going to turn the shaver by hand, attach handles (U). Begin turning shaver frame clockwise (looking toward pipe), and continue turning and shaving pipe surface until desired spigot length is cut (See table on page 4).

6) Check shaved diameter

a) After shaving one inch of the first spigot, you will need to check the shaved diameter. First, disengage the slide sleeve (G), slide frame (B) away from pipe until cutting inserts (W) are at the starting position, and re-engage the slide sleeve (G). With the arbor (Q) still firmly in place, measure the shaved diameter of the new spigot using a circumferential wrap tape such as a Pi Tape® with a vernier reading to 0.001 inch (0.02 millimeter) on diameter. See table on page 4 for tolerance range on spigot diameters. If your measured diameter falls well within this tolerance range, you may proceed to Step 7.

Operating instructions (cont.)

b) If the diameter measured in Step 6a was borderline or outside the recommended tolerance range, a slight adjustment of the two form tools (P) is required. Loosen socket head cap screw (AG) slightly and adjust screw (AA) as required on both tools. A quarter turn of adjusting screw (AA) will change the diameter of spigot by 0.020 inch (0.50 millimeter).

c) If the spigot is too small, go to Step 7 and cut off and discard the shaved spigot. Reposition arbor (Q) in pipe end and shave new spigot after adjustment, repeating Steps 4, 5 and 6 until the proper diameter is obtained.

d) Spigot too large—after adjustment, repeat Step 6 until proper diameter is obtained.

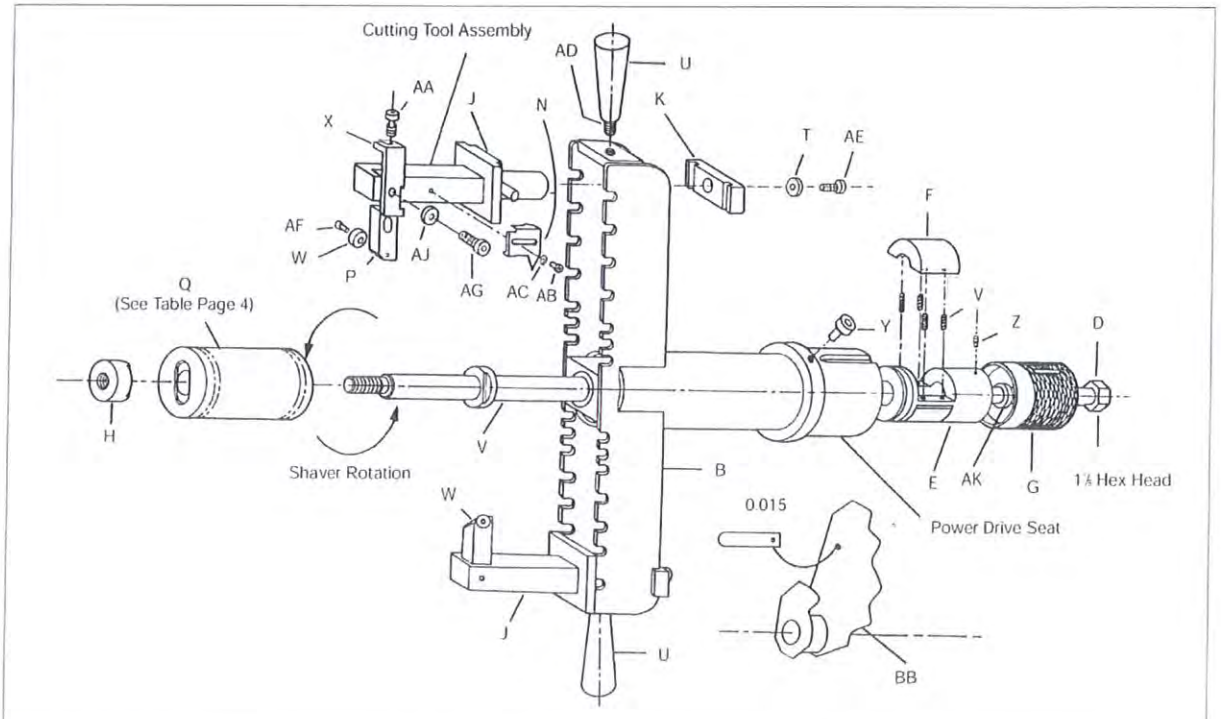
Shaving a spigot in one pass produces a slightly larger diameter than is produced by shaving thin cuts on repeated passes. To shave acceptable diameters on one pass, you must adjust the shaver based on measurements of spigots made in a single pass.

7) Remove shaver from pipe

To remove arbor (Q) from pipe, loosen tie bar (D) using a 1⅛ inch wrench (looking toward frame [B], turn hex head counterclockwise). With slide sleeve (G) engaged, slide arbor (Q) out of the pipe.

8) Recheck adjustment for wear or abuse

Once the shaver has been properly adjusted for a given pipe size, you will usually need to check spigot diameters only at the beginning and middle of each shift, provided the



Item	Description
B	Frame
C	Feed tube
D	Tie bar
E	Half nut
F	Half nut detail (2)
G	Slide sleeve
H	Nut
I	Tool retainer (2)
K	Slide plate (2)
N)	Indicator
P)	Form tool (2)
T)	¼ Standard flat washer (2)

Item	Description
U)	Carr Lane No. CL-2-SH steel handle with ⅜-16 NC thread (2)
V)	McMaster Carr No. 9641P16 comp spring - cut to length (4)
W)	Kennametal No. RD8P K-11 cutting insert (2)
X)	Tool retainer clamp (2)
Y)	5/16-18 NC x 1¼ long socket head cap screw
Z)	No. 10-24 NC x ¾ long Nylok socket head cap screw
AA)	Adjusting screw (2)

Item	Description
AB)	1¼ -28 NF x ½ long socket head cap screw (2)
AC)	¼ Standard flat washer (2)
AE)	¼-20 NF x 1½ long socket head cap screw (2)
AF)	No. 4-40 NC x ¼ long socket head cap screw (2)
AG)	⅜-16 NC x 1½ long socket head cap screw (2)
AJ)	⅛ S.A.E. flat washer (2)
AK)	Carr Lane No. CL-4-FW hardened flat washer
BB)	Pipe shaver gauge

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Installation Guide

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Unique Tapering Tool* Model 010

for fiberglass pipe 2- through 6-inch diameters

General

The Unique Tapering Tool Model 010 is designed to cut up to 3.5° taper angles on fiberglass pipe. It can be operated manually with the ratchet included or by an optional electric power drive.

The base tool is factory assembled with a 2-inch high pressure collet and also includes:

- a combination 2-inch low pressure and 2.5-inch high pressure collet,
- manual ratchet drive,
- ¾-inch wrench,
- nipple bar,
- ring gauge
- operating instructions, and
- metal carrying case.

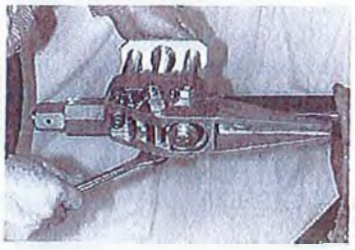
Collets for 3- and 4-inch high pressure pipe and for 3-, 4- and 6-inch low pressure pipe are available and may be ordered from Ameron.

Electric Power Drive

The tool can be driven by Power Drive Ridgid™ No. 700 with Ridgid No. 772 adapter or equivalent. Power drives should be purchased locally but are available on special order from Ameron.

Calibration

Numbers refer to parts diagram on page 4.



Before using always check the tool for correct alignment of the 2-inch high pressure collet and cones. These are the base for all other collets.

Cones (19) and (28) and one segment of the 2-inch high pressure collet are marked by a drilled hole. These marks must line up at all times. Handling can cause segments to become either slightly or one full turn out of alignment.

Contract the collet completely, making the cone (19) as close as possible to the hub (5). Then use the ring gauge (59) to calibrate the tool. The tool is properly calibrated when the ring gauge fits both ends of the collet with the same clearance.

1. Slide the ring gauge to hub end of collet.
2. Expand collet slightly by turning torque knob (1) clockwise while holding the collet until ring gauge is snug.
3. Slide ring gauge to opposite end of collet. If the ring gauge has approximately the same clearance as in Step 1, the tool is properly calibrated.
4. If the ring is loose, remove ring gauge. Turn the cone (28) clockwise one full turn, while holding the collet stationary, until marks are aligned. Repeat Steps 1 through 3.

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* U.S. Patent No. 3720121

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Calibration (cont'd.)

Numbers refer to parts diagram on page 4.

5. If the ring gauge will not slide to the other end of the collet, remove ring gauge and turn cone (28) counterclockwise one full turn until marks are aligned. Repeat Steps 1 through 3.

Pipe Cutting

For all cutting and tapering, the pipe must be held securely. Before clamping, always wrap the pipe with protective (rubber) material to prevent damage to the pipe. Use a wrap around to assist in marking the pipe cut line. It is important to make a square cut. Cut end cannot be more than 3/16-inch out of square.

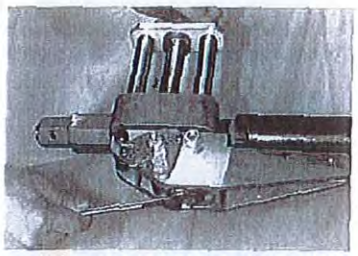
Pipe may be cut manually with a fine-tooth hacksaw or with a circular saw with an abrasive cutting wheel.

Note: Protective masks or respirators should be worn when cutting and shaving fiberglass pipe.

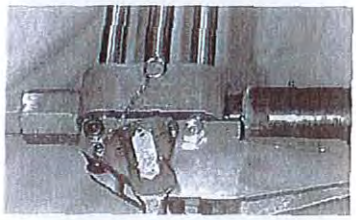
Taper Angle & R Collets

To change the taper angle, use the following procedure.

- Loosen hex head bolt (39) and hex nut (47) on rear of cam shaft (41).
- Pull lock pin (45) and turn indicator to desired angle position. Reinsert lock pin.



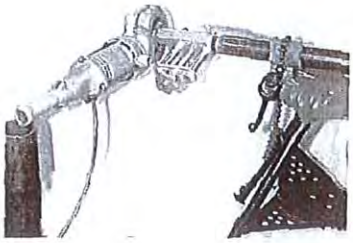
- Retighten nut (47).



- Tighten bolt (39) with 3/4-inch open end wrench by first snugging up with wrench, then tighten one-quarter turn more. ***Do not overtighten bolt (39).*** This can damage the tool and cause false taper angle settings.

- Adjust the height of the head (36) to the diameter of the pipe to be tapered by turning the hex head bolt (14).
- Slip additional collet(s) onto the tool to match the diameter of the pipe.

Tapering The Pipe



Always make a trial taper to assure proper adjustment and tapering procedure.

- Insert contracted collet into pipe until rear end of collet is flush with pipe end.
- Expand collet by turning the torque knob (1) clockwise. ***(Note: overtorquing in either direction can lead to a chipped taper or damaged tool threads.)***
- Mark the appropriate taper length on the pipe.
- Lower head to cutting level by turning bolt (14) in feed post assembly. Keep the cutting depth to a minimum at beginning of taper.
- Rotate the tool in a clockwise direction only. After the first few rotations, the cutting depth can be increased by approximately one-quarter turn on bolt (14). Too much force applied to bolt can damage pipe and/or result in an incorrect taper angle. Continue rotating tool and lowering head until reaching taper length mark.

Taper Lengths and Angles for Bondstrand 3000A, 3200 Pipe

Nominal Pipe Size (in./mm)		Taper Angle (degrees)	Taper Length (in./mm)	
2	50	1.50	2.37	60.20
3	80	1.75	3.87	98.30
4	100	1.87	4.12	104.65
6	150	2.75	4.25	107.95

- Lift the head with the cutting blade away from the taper by turning bolt (14) in a counter-clockwise direction. Loosen the collet by turning torque knob (1) in a counter-clockwise direction and remove the tool.

Check Trial Taper

Measure the dimensions of the trial taper and check against the dimensions given in the taper length and angle table, above. Check the dry insertion fit of the trial taper into the bell end of an Ameron component. The fit should be snug and without clearance. If the component can be rocked while on tapered end of the pipe, the taper angle is incorrect and must be adjusted. Tapered pipe should fit to approximately $^3/_8$ inch from the end of a component.

If necessary, fine adjustments to the taper angle can be made by setting the indicator between the angle markings on the angle scale (42) and not inserting lock pin (45).

After having made a correct trial taper, the Tapering Tool is now correctly adjusted to taper the particular pipe size for which you have set the tool.

Fabrication of Short Nipples

To make a short nipple that is not long enough to be held in a pipe vise or clamp, the nipple bar (29) should be used. With this extension, the tool can be held in a vise and operated as described.

Changing Carbide Blade

When the four-edged carbide blade produces only dust and no shavings, it is dull and will increase cutting time. The blade can be repositioned to a new cutting edge.

- Loosen bolts (35),
- Reposition carbide blade (33) to another cutting surface, and
- Tighten the bolts. Note: be sure to use blade washers (34) and keep the blade snug against the step when retightening bolts (35).

Spare and Replacement Parts, Repairs

Carbide blades, additional collets and other replacement parts, or repairs can be ordered directly from:

B & B Enterprises Unique
421 N.E. 31st Street
Grand Prairie, Texas 75050
972/262-2301

Pot life and cure time (cont'd.)

Ambient Temperature[1]		Adhesive Pot Life	Minimum Joint Cure Time[2]	Minimum Time to Move[2]
(°F)	(°C)	(minutes)	(hours)	(hours)
40	5	70	12	11
60	16	40	7	6
70	21	30	5	4
80	27	20	4	3
100	38	8	3	2

1) At temperatures below 40°F (5°C), an external heat source must be used to force cure the adhesive. The adhesive and the bonding surfaces should be warmed to 70°F (21°C) before mixing and applying the adhesive. Adhesive may be force cured using an Ameron-approved electric heating blanket. When using adhesive at ambient temperatures above 100°F (38°C), make provisions to keep adhesive cool to extend pot life.

2) Times indicate when cure is sufficient to permit moving the bonded joint. The minimum joint cure time must elapse prior to hydrotesting.

Adhesive kit sizes and bonds per kit

PSX•34 adhesive kits are available in 3 oz., 5 oz. and 8 oz. sizes. The values in this table are based on the quantity of adhesive required by an experienced crew working at a temperature of 80°F (27°C). All sizes available in 6-packs.

Bonds per Kit	Kit Size	Nominal Pipe Size (in/*mm*)											
	(fl oz)	1/25	1.5/40	2/50	3/80	4/100	5/125	6/150	8/200	10/250	12/300	14/350	16/400
Quick-Lock® Joints	3	10	6	4	3	2	1	1	½	½	½	–	–
	5	–	10	7	5	3	2	1	1	1	1	½	½
	8	–	–	10	8	6	5	3	2	2	1	1	1
Taper-Taper Joints	3	–	–	7	5	4	–	2	1	1	–	–	–
	5	–	–	12	8	6	–	3	2	2	2	1	1
	8	–	–	–	14	9	–	4	3	3	3	2	2

Storage

Do not store kits in areas above 100°F (38°C) or below 32°F (0°C), or in the direct sunlight in warm weather. In cold weather warm the resin to at least 60°F (16°C) but not above 100°F (38°C) to permit good mixing and easier application. Do not use adhesive past its expiration date.

Toxicity and precautions

Hardener: The hardener is irritating to skin, eyes and respiratory tract. It is toxic orally and may cause sensitization. Avoid contact with eyes, skin or clothing. Avoid breathing vapors. Wear rubber gloves, protective apron and NIOSH-approved respirator. Wash thoroughly after handling.

Resin: The resin may be mildly irritating to skin, eyes and respiratory tract. Avoid contact with eyes, skin or clothing. Avoid breathing vapors. Wear rubber gloves and eye protection. Wash thoroughly after handling.

First aid

In case of contact

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

Skin: Wash skin with soap and water.

Clothing: Remove contaminated clothing and wash before reuse.

Inhalation: Remove to fresh air. Give oxygen or artificial respiration if necessary.

Ingestion: If catalyst is swallowed and person is conscious, give plenty of water or milk to drink. **Do not induce vomiting.** Call a physician. If resin is swallowed, give 100 grams (about ¼ lb) activated charcoal slurry in water. **Do not induce vomiting.** Call a physician.

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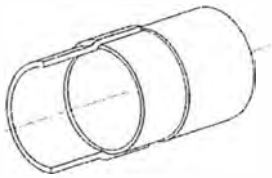

PSX™•34 Adhesive Kit

Epoxy siloxane adhesive for bonding fiberglass pipe and fittings

Description

The PSX•34 epoxy adhesive kit contains an adhesive resin, hardener, mixing spatula, brush and assembly instructions. The adhesive resin is a dark red paste with sand. The adhesive hardener is a white paste. The mixed adhesive color is red. PSX•34 is a two-part epoxy siloxane adhesive formulated for permanently bonding Quick-Lock® joints on Ameron fiberglass-reinforced pipe and fittings. PSX•34 can be used to connect all epoxy and phenolic piping systems, and most vinyl ester systems.

Listings and approvals

Underwriters Laboratories Inc.®

Ameron PSX•34 adhesive is listed by Underwriters Laboratories (UL) under File MH 9162 for use in Nonmetallic Underground Piping for Flammable Liquids and with Underwriters' Laboratories of Canada under File CMH 715. PSX•34 adhesive is Listed by the National Sanitation Foundation under NSF Standard 61 - Drinking Water System Components - Health Effects for use in Potable Water Service and Commercial Hot Water Applications.

Instructions

Prior to handling, read all Toxicity, Precaution and First Aid information below. Before mixing the adhesive, insure that the bonding surfaces are correctly prepared and are clean and dry. Open the resin and hardener containers. Using the mixing spatula, scrape all of the hardener into the resin container. Mix the resin and the hardener with the spatula for at least 60 seconds. Scrape the sides, bottom and lid of the resin container occasionally to get all of the hardener into the mix. Never attempt to split a kit. The resin and the hardener have been packaged at the correct ratio for optimum adhesive performance.

Apply a uniform coat of the mixed adhesive to both bonding surfaces and draw the parts firmly together. Detailed joint assembly instructions may be found in Quick-Lock Installation Instructions, FP170.

Pot life and cure time

For installations with service temperatures below 180°F (82°C) and pressures below 150 psi (1.03 MPa), PSX•34 bonds can be put into service with ambient temperature cures as indicated in the table (See page 2 of this section.). However, it is highly recommended that an external heat source be used to force cure the adhesive. The adhesive and bonding surfaces should be warmed to 70°F (21°C) prior to mixing and applying the adhesive. Adhesive may be force cured using an Ameron-approved heating blanket. The table also indicates the pot life (working time) of the adhesive at various temperatures. The pot life is the time from the initial mixing of the resin and hardener until the adhesive in the container begins to thicken and is no longer usable.

For systems with anticipated service temperatures above 180°F (82°C) or operating pressures over 150 psi (1.03 MPa), or when installing any system at ambient temperatures below 40°F (5°C), the adhesive joint must be cured with an external heat source. A heat cure using an Ameron-approved electric heating blanket is recommended. The heat cure may be applied at any time after the bond is made and before the line is tested or put into service. The heat may be applied immediately after making the bond while the adhesive is still liquid or after it has gelled to a solid.

Minimum cure times of 30 minutes for 1- through 6-inch pipe and 45 minutes for 8- through 16-inch lines are recommended. Even after the adhesive has solidified at ambient temperatures, heat curing will enhance the chemical cross-linking of the adhesive, increasing the strength, temperature resistance and corrosion resistance of the adhesive.

Pot life and cure time (cont'd.)

Ambient Temperature[1]		Adhesive Pot Life	Minimum Joint Cure Time[2]	Minimum Time to Move[2]
(°F)	(°C)	(minutes)	(hours)	(hours)
40	5	70	12	11
60	16	40	7	6
70	21	30	5	4
80	27	20	4	3
100	38	8	3	2

1) At temperatures below 40°F (5°C), an external heat source must be used to force cure the adhesive. The adhesive and the bonding surfaces should be warmed to 70°F (21°C) before mixing and applying the adhesive. Adhesive may be force cured using an Ameron-approved electric heating blanket. When using adhesive at ambient temperatures above 100°F (38°C), make provisions to keep adhesive cool to extend pot life.

2) Times indicate when cure is sufficient to permit moving the bonded joint. The minimum joint cure time must elapse prior to hydrotesting.

Adhesive kit sizes and bonds per kit

PSX•34 adhesive kits are available in 3 oz., 5 oz. and 8 oz. sizes. The values in this table are based on the quantity of adhesive required by an experienced crew working at a temperature of 80°F (27°C). All sizes available in 6-packs.

Bonds per Kit	Kit Size	Nominal Pipe Size (in/mm)											
	(fl oz)	1/25	1.5/40	2/50	3/80	4/100	5/125	6/150	8/200	10/250	12/300	14/350	16/400
Quick-Lock® Joints	3	4	4	3	3	1	1	1	½	–	–	–	–
	5	–	–	6	5	2	1	1	1	½	½	–	–
	8	–	–	–	–	5	2	2	2	1	½	½	½
Taper-Taper Joints	3	–	–	5	4	3	–	1	1	½	–	–	–
	5	–	–	10	7	5	–	2	1	1	½	–	–
	8	–	–	–	–	8	–	3	2	1	1	½	½

Storage

Do not store kits in areas above 100°F (38°C) or below 32°F (0°C), or in the direct sunlight in warm weather. In cold weather warm the resin to at least 60°F (16°C) but not above 100°F (38°C) to permit good mixing and easier application. Do not use adhesive past its expiration date.

Toxicity and precautions

Hardener: The hardener is irritating to skin, eyes and respiratory tract. It is toxic orally and may cause sensitization. Avoid contact with eyes, skin or clothing. Avoid breathing vapors. Wear rubber gloves, protective apron and NIOSH-approved respirator. Wash thoroughly after handling.

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First aid

In case of contact

Eyes: Immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

Skin: Wash skin with soap and water.

Clothing: Remove contaminated clothing and wash before reuse.

Inhalation: Remove to fresh air. Give oxygen or artificial respiration if necessary.

Ingestion: If catalyst is swallowed and person is conscious, give plenty of water or milk to drink. Do not induce vomiting. Call a physician. If resin is swallowed, give 100 grams (about ¼ lb) activated charcoal slurry in water. Do not induce vomiting. Call a physician.

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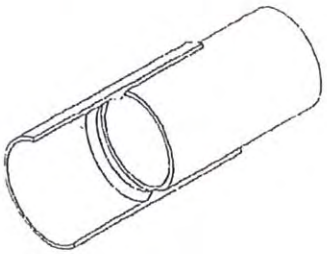

Adhesive-bonded Bell and Spigot Joints

for Bondstrand no-shave pipe

Installation

1. Cut pipe to length as shown in FP170D QUICK-LOCK® ADHESIVE-BONDED BELL AND SPIGOT JOINTS.
2. Using 40 to 120 grit sandpaper, sand the first 2" to 3" of the end of pipe and the Quick-Lock® socket of the fitting to be bonded. Don't forget to sand the end of the pipe. There should be no glossy areas left on the bond area of the pipe.

   Note: DO NOT USE TRADITIONAL SHAVING TOOLS FOR SANDING THE PIPE. FLAPPER SANDERS ARE ACCEPTABLE
3. All bonding surfaces must be clean and dry and must be sanded within two hours of assembly. Sanded surfaces should show a dull, fresh finish, not a polished look.
4. Wipe the sanded surfaces thoroughly with a clean, dry cloth, or use a duster brush to remove dust particles. If surfaces become wet, warm with a Bondstrand® heating blanket or hot air gun until dry, then resand. Protect the bonding surfaces from moisture during bad weather by tenting over the working area. Do not touch the prepared surfaces with bare hands or soiled gloves that would leave an oily film.
5. Mark spigot insertion depth according to FP170D QUICK-LOCK® ADHESIVE-BONDED BELL AND SPIGOT JOINTS and follow the remaining instructions for alignment, adhesive application, joint assembly and force curing.

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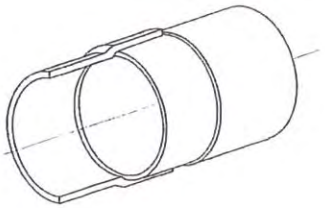


Quick-Lock® Adhesive-bonded Bell and Spigot Joints

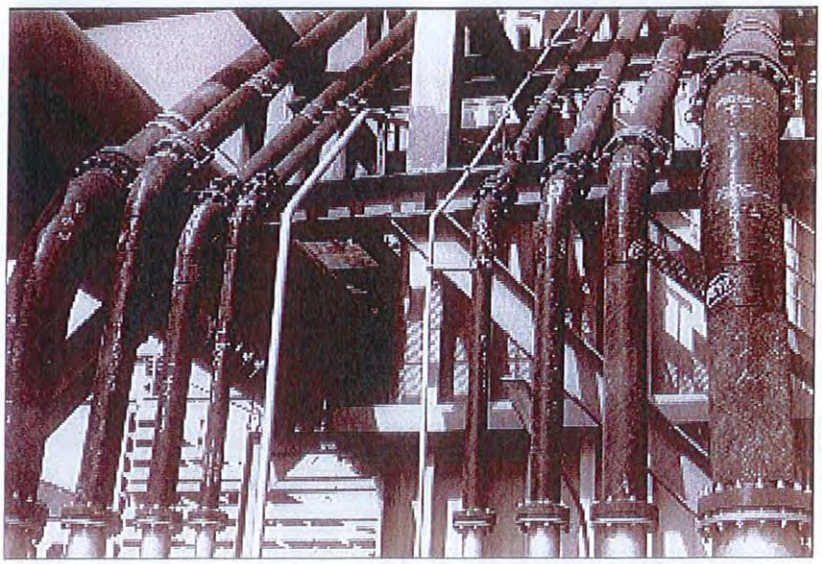
for Bondstrand fiberglass piping systems

Introduction

Follow these instructions to make the Quick-Lock bell and spigot joint for Bondstrand pipe and fittings using Ameron epoxy or vinylester adhesives. The instructions show you how to cut the pipe, prepare the pipe ends, mix and apply the adhesive, make the joint and cure the adhesive.

To determine the appropriate Bondstrand adhesive for your installation, consult *Bondstrand Chemical Resistance Guide*, FP132. FP132 is available from Ameron or your Bondstrand supplier.

Complete usage instructions for the adhesives are contained in each adhesive kit. Store adhesives at temperatures below 100°F (38°C). Use adhesives before the date stamped on the adhesive kit package.



The Quick-Lock joint has been used successfully in Bondstrand fiberglass piping systems throughout the world for over thirty-five years. Typical of Bondstrand installations is this vacuum unit drain piping in a Saudi Arabian desalination plant.

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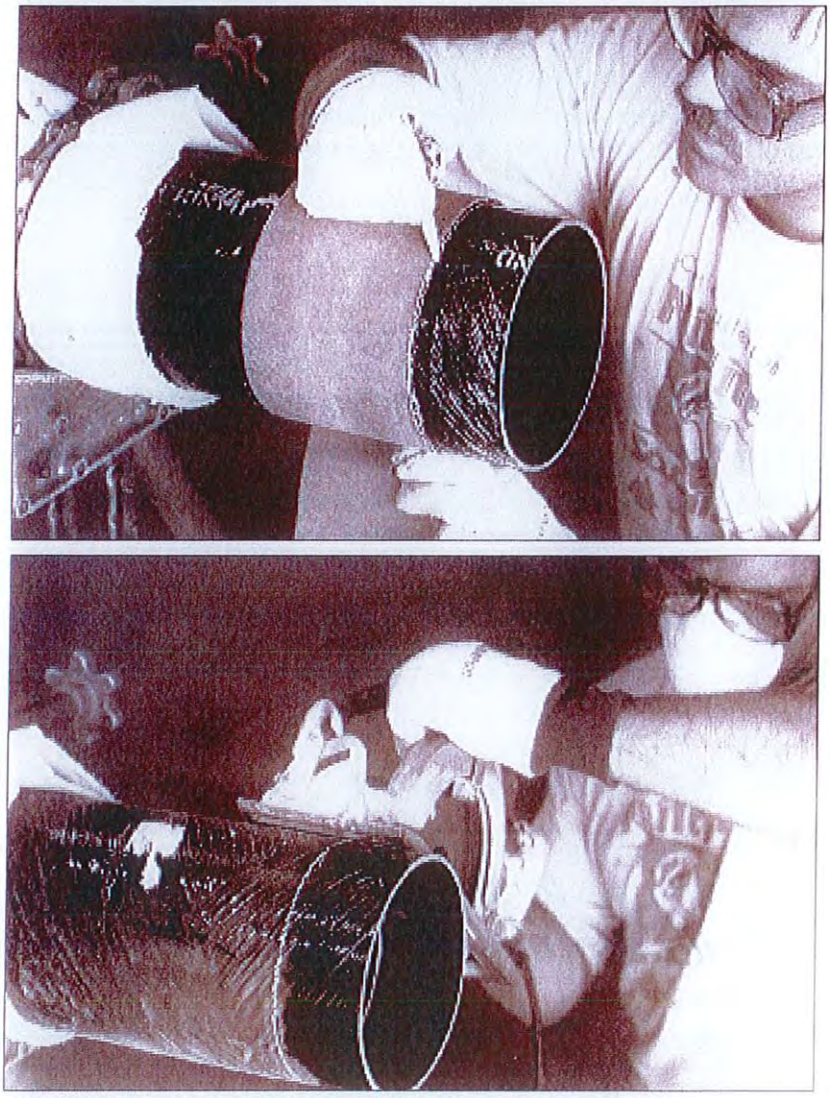
Cutting pipe

Measure the desired length and scribe the pipe using a pipefitter's wraparound or heating blanket. When holding the pipe in a vise, use a ¼-inch (6 mm) thick rubber pad (or equal) to protect the pipe from damage. Use a hacksaw or power saw with abrasive wheel to cut the pipe. Check the squareness of cut. Pipe up to 4 inches (100 mm) should be square to within 1/16 inch (1.5 mm); larger pipe to within 1/8 inch (3 mm). Use a disc grinder or file to correct squareness.

Danger! Do not inhale dust produced by cutting and grinding. Provide adequate ventilation or wear OSHA-approved dust mask.



Scribe the pipe with chalk or a white marker to assure squareness of cut (top). Bondstrand pipe may be cut using a fine-tooth hacksaw or a power saw with abrasive wheel (bottom). See FP811 AMERON RECOMMENDED SAFETY PRACTICES *for proper personal protective equipment.*

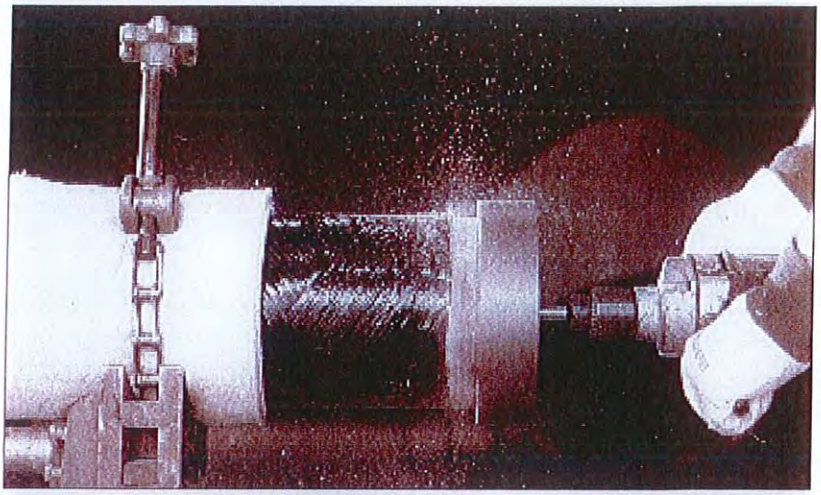
End preparation

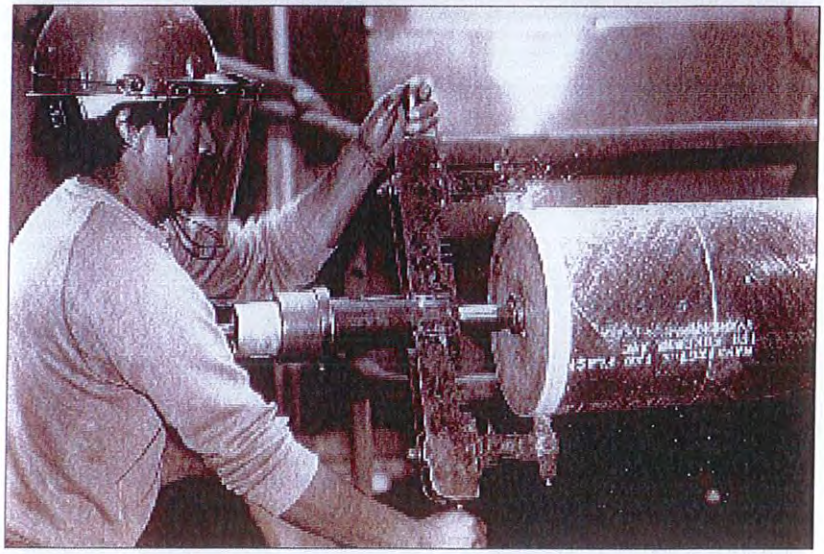
Use the Bondstrand B-1 end preparation tool for 2 through 8-inch sizes. For 10-inch pipe and larger, several shavers are available from Ameron and are referenced in the equipment list at the end of these instructions. Instructions for adjusting and operating the end preparation tools are provided with the tools. The instructions may also be obtained from your local Bondstrand representative.

End preparation (continued)

End preparation tools can be used manually, but a portable power drive is advisable if preparing a number of joints. Check the OD of the prepared end with a Pi Tape to ensure the following dimensions are obtained:

The cutter wheels on the B-1 tool are designed to cut when the tool is rotating in the clockwise direction. Attempts to cut with the tool in counterclockwise rotation will bend the cutter wheels and reduce the effectiveness of the tool. Similarly, when withdrawing the tool after completing a cut, stop the drill motor and simply pull the tool out of the pipe. Do not reverse the drill rotation when withdrawing as this will also tend to bend the cutter wheels.





The B-1 tool (top) requires no adjustment and is used to prepare pipe ends in sizes to 8 inches. Pipe ends in 10 and 12 inch sizes are prepared with the M74 tool. The M80 tool (not shown) is used for larger sizes.

Nominal Pipe Size		Prepared Spigot Diameter			
		maximum		minimum	
(in)	(mm)	(in)	(mm)	(in)	(mm)
1	25	1.29	32.9	1.28	32.5
1.5	40	1.88	47.8	1.87	47.5
2	50	2.35	59.6	2.33	59.2
3	80	3.47	88.0	3.45	87.6
4	100	4.45	112.9	4.43	112.5
5	125	5.51	139.9	5.49	139.5
6	150	6.56	166.6	6.54	166.2
8	200	8.56	217.4	8.54	217.0
10	250	10.70	271.7	10.68	271.3
12	300	12.70	322.6	12.68	322.2
14	350	13.95	354.2	13.93	353.8
16	400	15.93	404.5	15.91	404.1

All bonding surfaces must be clean and dry and must be sanded within two hours of assembly. Sand the bonding surfaces with a 1/4-inch drill motor and flapper sander. See the equipment list at the end of these instructions for drill motor and flapper sander specifications. Sanded surfaces should show a dull, fresh finish, not a polished look. Don't forget to sand the end of the spigot.

End preparation (continued)

Wipe the sanded surfaces thoroughly with a clean, dry cloth, or use a duster brush to remove dust particles. If surfaces become wet, warm with Bondstrand heating blanket or hot air gun until dry, then resand. Protect the bonding surfaces from moisture during bad weather by tenting over the working area. Do not touch the prepared surfaces with bare hands or soiled gloves that would leave an oily film.

Caution: Clean and dry sanded surfaces are required for proper bonding.

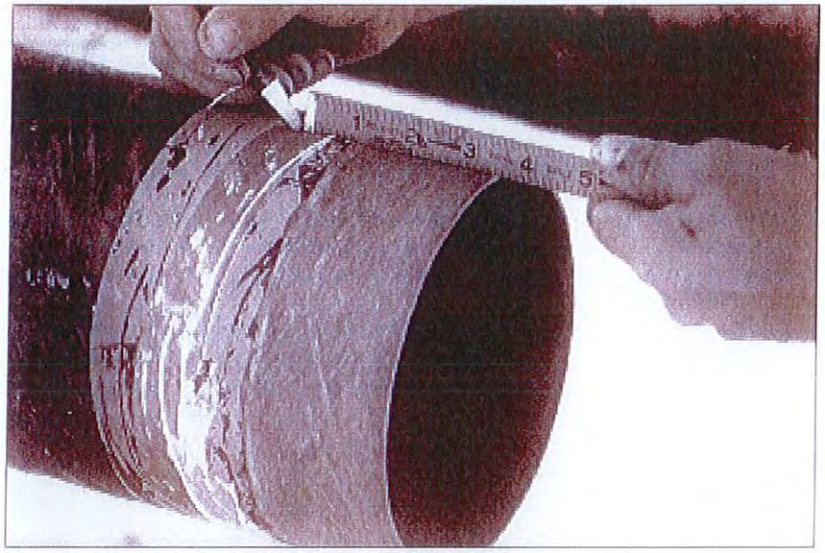
When using pneumatic tools, the air supply must be dry and oil-free as moisture or oil on bonding surfaces will interfere with the adhesive.

Check the outside diameter of the prepared pipe end with a Pi Tape (left). Permissible diameter ranges are marked on the tape and must conform to the values tabulated on the previous page. Sand all bonding surfaces within two hours of applying adhesive: the inside of the fitting (top right), the cut end of the pipe (center left), and the outside of the spigot (bottom left). Remove dust from all sanded surfaces with a clean rag (bottom right).

Spigot insertion depths and diameters

Measure back from the end of the spigot the distance shown in the following table and scribe a line using a white grease pencil or soapstone. When the spigot is bottomed to the pipe stop in the bell, the scribed line will be 1 inch (25 mm) from the end of the bell.

Nominal Pipe Size		Mark in from spigot end	
(in)	(mm)	(in)	(mm)
1	25	2 1/16	52
1.5	40	2 1/4	57
2	50	2 13/16	71
3	80	2 13/16	71
4	100	2 13/16	71
5	125	3 1/4	82
6	150	3 1/4	82
8	200	3 1/2	89
10	250	3 3/4	95
12	300	4	101
14	350	4 1/2	114
16	400	5	127



Before applying adhesive, put an insertion depth reference mark on the spigot by measuring back from the pipe end by the amount tabulated above. After joining, the reference mark should be 1 inch from the end of the bell.

Alignment of fittings

To ensure proper alignment of fittings, matchmark the mating pieces before applying adhesive. Taking care to avoid contaminating the bonding surfaces, dry fit the pieces, then mark each piece for subsequent realignment.

Assure proper alignment of fittings by matchmarking the mating pieces while dry fitting.

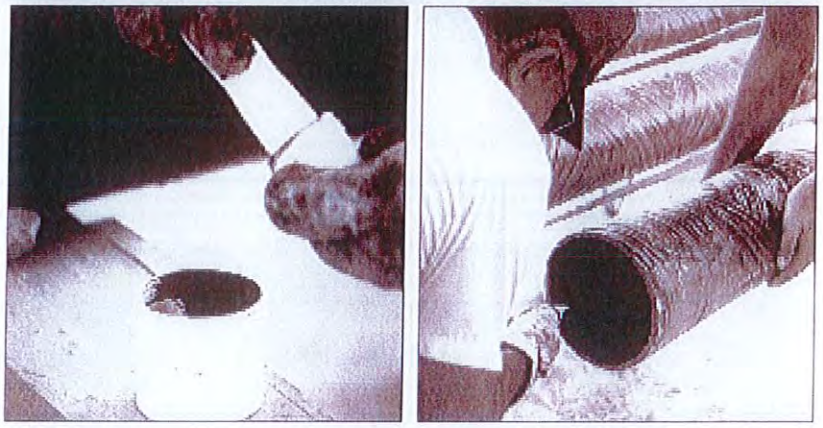
Applying the adhesive

Select the adhesive kit per the following table:

Bonds per Kit

Kit Size	Nominal Pipe Size (in/*mm*)											
(fl oz)	1/25	1.5/40	2/50	3/80	4/100	5/125	6/150	8/200	10/250	12/300	14/350	16/400
3	10	6	4	3	2	1	1	1/2	1/2	–	–	–
5	–	10	7	5	3	2	1	1	1	1/2	1/2	–
8	–	–	10	8	6	5	3	2	1	1/2	1/2	1/2

Important: Be aware of the working time available after the adhesive has been mixed. It may not be possible to achieve the listed number of bonds in the smaller sizes because of the available working time (pot life) of the adhesive. See the adhesive kit package for the approximate working times.



Add all of the hardener to the resin (left). After mixing thoroughly, apply a thin layer to the inside of the bell (right).

When the joint is ready to be bonded, add the curing agent to the resin. Stir thoroughly for at least one minute or until no streaks are visible. Apply the mixed adhesive to the bonding surfaces immediately.

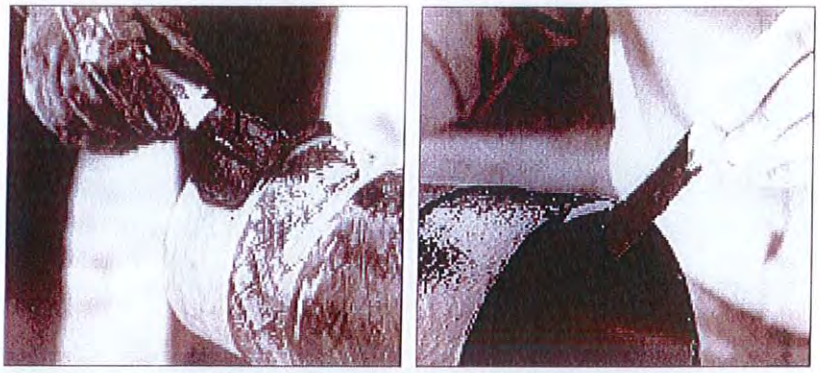
If the mix has started to gel in the container, discard and start a new kit. Appearance of gelled or lumpy material indicates that the mix has started to cure.

Use the disposable spatula supplied in the kit to apply a thin layer (1/32 inch or 1 mm) of adhesive to the surface of the bell including the pipe stop. Excess adhesive in the bell will restrict flow inside the joint. Apply adhesive liberally to the entire spigot surface and a thin layer to the cut end of the pipe. Excess adhesive on the spigot surface will be forced out when the bell and the spigot are joined.

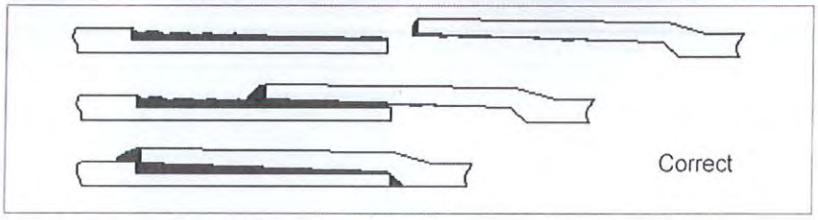
Proper adhesive application

In a properly made joint, the adhesive applied to the bell is pushed to the inside of the joint where it forms a bead that protects the cut edge of the pipe. Excess adhesive applied to the pipe spigot is pushed to the outside of the joint and can be easily removed.

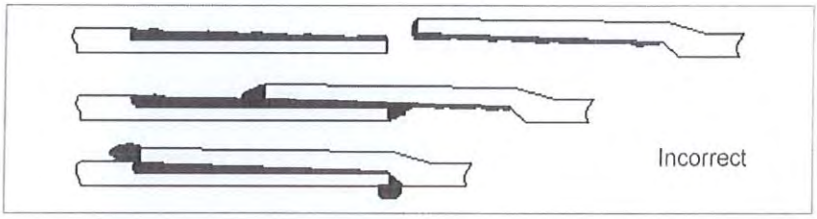
Too much adhesive in the bell may restrict flow through the pipe.



Apply a generous layer of adhesive to the outside of the spigot (left). In addition, apply a thin layer of adhesive to the cut end of the pipe (right).



When the joint is assembled, some of the adhesive in the bell is pushed to the inside by the end of the spigot. When correctly applied, a thin layer of adhesive in the bell (center) forms a small bead that will protect the cut end of the pipe.



Too much adhesive in the bell may restrict flow inside the pipe (bottom).

Joint assembly

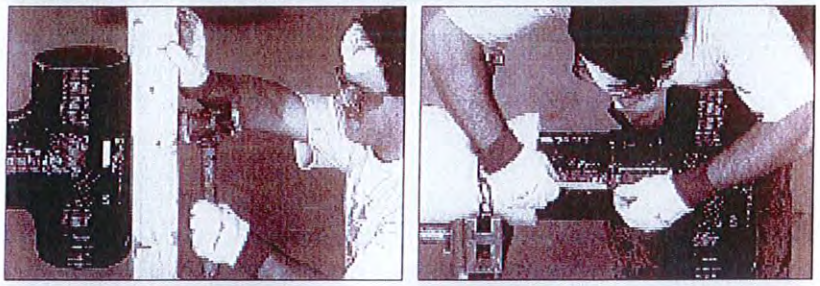
Without rotating the spigot, insert it into the bell until it rests firmly against the pipe stop. For 6-inch (150 mm) pipe and larger, use a comealong to seat the joint and hold it in place. Support the bands on wooden blocks on each side of the joint so the comealong can remain snug while the heating blanket is wrapped around the joint and the joint is cured. Joints 6 inches or less in size may be made by tapping on a wooden block placed over pipe end to seat the spigot in bell.

Before joining the pipe, align the faces of the bell and spigot parallel with one another (left). When making large-diameter joints, use a comealong to join the pipe (right) and to hold the joint together during the cure.

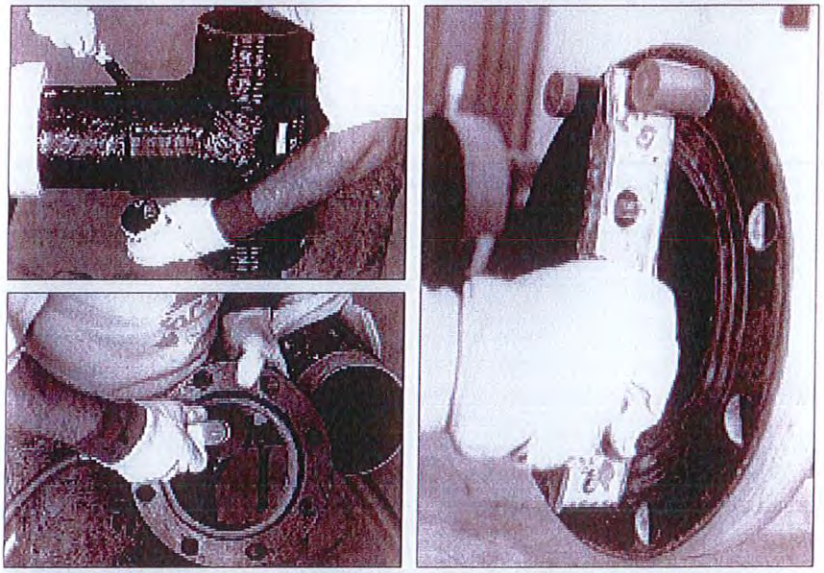
Joint assembly (continued)

Join fittings to pipe using one of the two methods described above. It may be necessary to back up an elbow, tee, lateral, etc., with a sandbag or similar shock absorber while tapping pipe spigots into fittings.

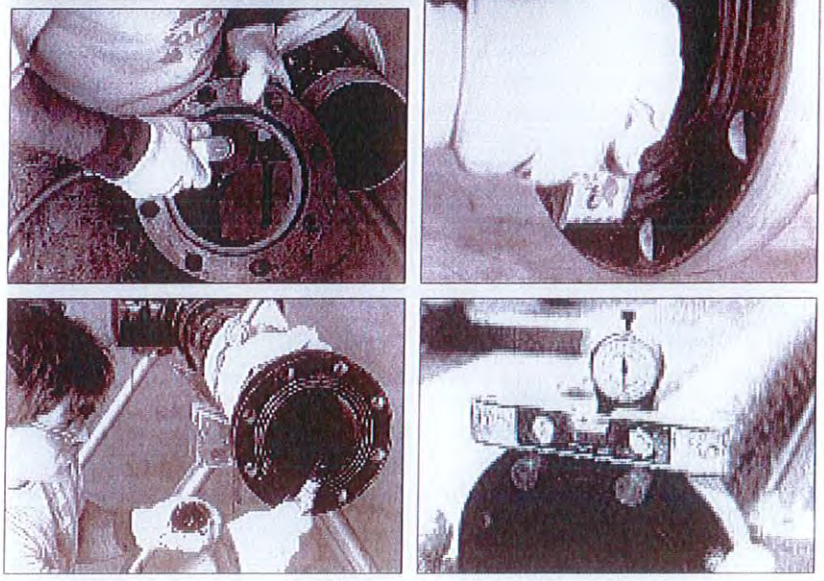
Caution: Never use a metal hammer directly on Bondstrand pipe or fittings.



Joints in the small diameters can be made up with a rubber mallet (or equal) and a block of wood (left). Never strike pipe or fittings directly with a hammer or mallet. Check the insertion depth after making the joint (right). The reference mark should be 1 inch from the end of the bell.



When mounting a flange, make sure that the vertical (center left) and rotational alignment (bottom right) meet the requirements stated in the text.



Remove excess adhesive for good appearance (second from top left). Sand the inside of the flange before applying adhesive (second from bottom left). Clean excess adhesive where the flange lip contacts the spigot to avoid contamination of the flange face (bottom left).

Align flanges, tees and other fittings to the matchmarks as you make the joint to avoid rotating the part while assembling. Check rotational alignment of flange bolt holes and squareness of flange faces. Flanges with bolt holes more than $^1/_{16}$ inch (1.5 mm) out of rotational alignment, or faces more than $^1/_{16}$ inch out of square across the flange face, or any angular errors of more than $^1/_2°$ in the axial or rotational alignment of bell and spigot are likely to cause subsequent assembly problems. If the joint is misaligned, pull it apart, remove adhesive from the pipe stop area, reapply adhesive and rejoin before adhesive starts to set up.

Force curing adhesive joints

When force curing the adhesive, place the thermostat end of the Bondstrand heating blanket against the assembled joint with the thermostat side facing out. Wrap the remainder of the blanket around the joint so that any overlap covers the thermostat. Tie the blanket in place with any nonconducting tie.

In general, Ameron recommends the use of insulation around the heating blanket. This is essential when the air temperature is below 40°F (4°C). Fiberglass insulation backed with aluminum foil generally works well. Insulation should overlap the blanket sides about 4 inches (100 mm) each way and be tied down near the edges to trap the heat.

Turn on the heating blanket and mark the starting time on the pipe. Check the blanket after a short period to assure it is heating.

A 30-minute cure is recommended for joining pipe and mounting flanges and a 45-minute cure for joining fittings.

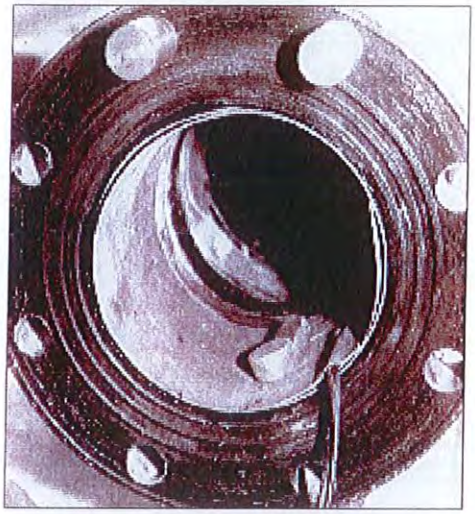
Position the heating blanket with the thermostat facing out (left). Wrap the loose end of the blanket over the thermostat and secure with an electrically nonconductive tie (right).

Mark the starting time for the cure on the pipe (center right). If the temperature might drop below 40°F (4°C), insulate the blanket with fiberglass insulation backed with aluminum foil or the equivalent (bottom right).

Caution: Do not move, vibrate, or otherwise disturb the joint during cure.

Force curing flanges

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



When curing a flange, place the heating blanket inside the pipe so that the thermostat faces the center of the pipe. Insulate the space inside the blanket.

Equipment list

The following tools are recommended for installing Bondstrand pipe:

(a) B-1 end preparation tool (1 to 8 inch) (FP376 B-1 TOOL INSTALLATION GUIDE)
M80 pipe shaver and arbors (10 to 16 inch) (FP515 M80 PIPE SHAVER INSTRUCTIONS)
Note: M74 pipe shaver can be used for (2 to 12 inch)

(b) Hacksaw or power saw with abrasive wheel

(c) Half-inch heavy-duty drill operating at 450 to 600 rpm; preferably with pistol grip, spade grip and side handles (Black and Decker Model 1321)

(d) Pipe vise (Pilot No. 20) and 1/4-inch (6 mm) thick elastomeric pads

(e) Flapper wheel sander (available from Ameron) with electric or air drill motor with 1/4-inch (6 mm) drive, 1700-2200 rpm (faster drills will produce a polished surface)

(f) Rubber mallet, 2 lb (1 kg), Shore Durometer A 70-80, 2 1/2 to 3 inch diameter

(g) Comealong for 6-inch (150 mm) pipe and larger, Dayton No. 2Z614

(h) Heating blankets (four sizes available from Ameron)

(i) Pipefitter's wraparound, level and white grease pencil or soapstone

(j) Duster brush and clean rags

(k) Dust mask, eye protection and gloves

(l) Folding rule, 10 ft (3 m)

(m) Tape , 50 ft (15 m)

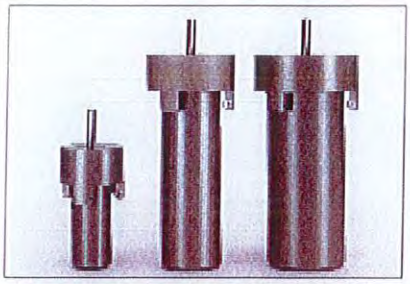
(n) Portable power drive, Ridgid® No. 700 or Amaz-O-Thred® 181D for M74 and M80 pipe shavers

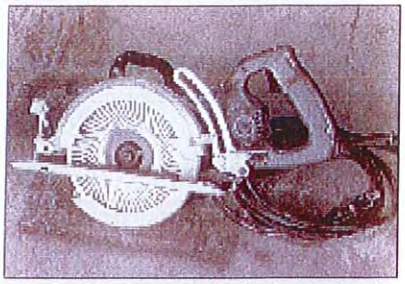
(o) Pi Tape® measuring tape

(p) Disc grinder or file (optional)

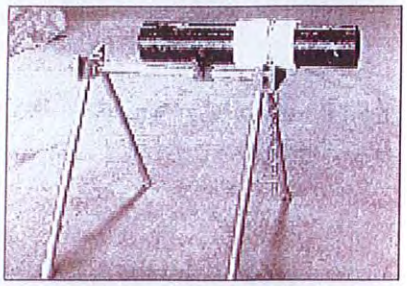
When using pneumatic tools, the air supply must be dry and oil-free as moisture or oil on bonding surfaces will interfere with the adhesive.

Equipment list (continued)

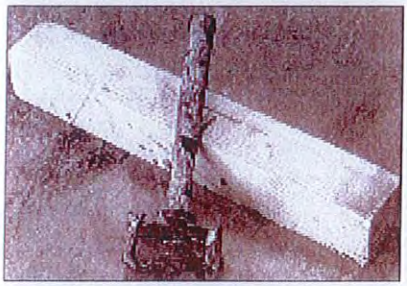




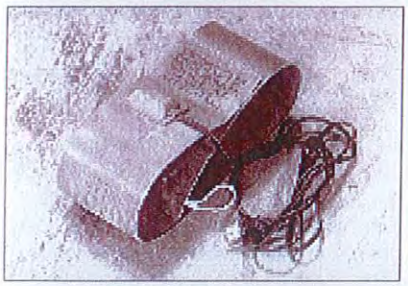
The B-1 pipe tool is available in sizes from 1 through 8 inches. Tools for the 2, 3 and 4-inch sizes are seen here (left). Pipe is most easily cut using a power saw with abrasive wheel (right).



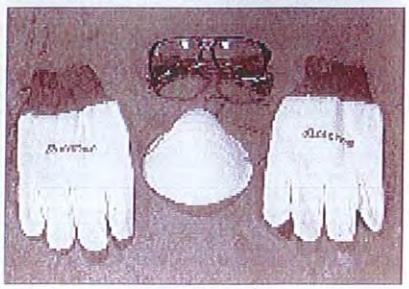
The B-1 pipe tool requires a ½ inch drill motor with handles on both sides (left), and, preferably, a spade grip. A pipe vise and ¼-inch rubber pads (or equal) are highly recommended for cutting, end preparation and spool work (upper right). Bonding surfaces must be sanded using a 40-grit flapper sander (lower right).



Small-diameter joints may be made up with a rubber mallet (or equal) and wooden block (left). Large-diameter joint make-up requires comealongs (right).



Adhesives for the Quick-Lock joint are force-cured with Ameron electric heating blankets (left). An ample supply of clean rags and dust brushes is required to keep all bonding surfaces clean (right).



A pipefitter's wraparound, a level and a grease pencil are suggested for alignment and marking (left). Essential safety wear includes eye protection, dust mask and clean cotton gloves (right).

Conversions

1 psi = 6895 Pa = 0.07031 kg/cm^2
1 bar = 10^5 Pa = 14.5 psi = 1.02 kg/cm^2
1 MPa = 10^6 Pa = 145 psi = 10.2 kg/cm^2
1 GPa = 10^9 Pa = 145,000 psi = 10,200 kg/cm^2
1 in = 25.4 mm
1 ft = 0.3048 m
1 lb·in = 0.113 N·m
1 in^4 = 4.162 x $10^{-7}m^4$
°C = 5/9 (°F - 32)

Important Notice

This literature and the information and recommendations it contains are based on data reasonably believed to be reliable. However, such factors as variations in environment, application or installation, changes in operating procedures, or extrapolation of data may cause different results. Ameron makes no representation or warranty, express or implied, including warranties of merchantability or fitness for purpose, as to the accuracy, adequacy or completeness of the recommendations or information contained herein. Ameron assumes no liability whatsoever in connection with this literature or the information or recommendations it contains. Product specifications are subject to change.

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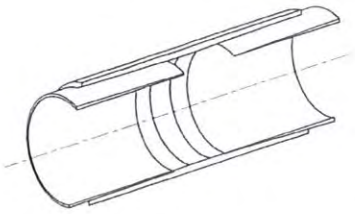
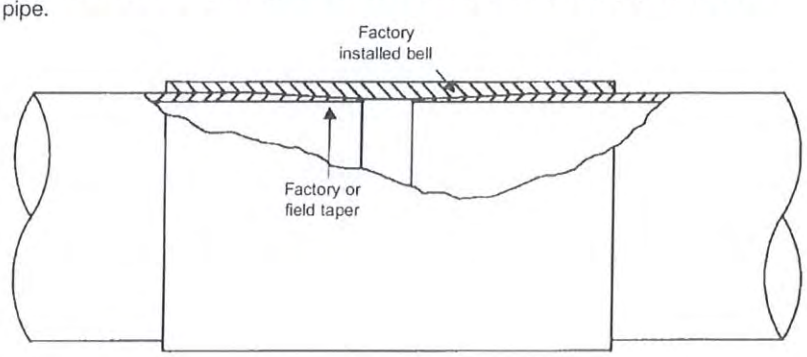


Adhesive-bonded Bell x Spigot Joints

for Series 3000A & 3200A

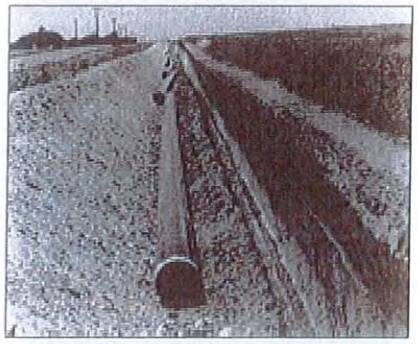
General

The bell and spigot joint is made by the adhesive bonding of a tapered spigot into a tapered bell. The tapers machined in the bell and on the spigot end are "matching tapers" of a pre-determined angle, 1¾° (2"-6") and 2° (8"-16"). Each length of bell and spigot pipe will have a factory-tapered spigot on one end and a tapered bell attached to the other end. Fittings are manufactured to accept the tapered spigot end of the pipe.



Installation Preparation

a. String the pipe along the right-of-way.



b. After insuring that the tapered bell & spigot end are **clean** and **dry**, the end caps should be replaced until the joint is ready to be made.

c. Make a thorough inspection of the pipe wall and tapered spigot end for any signs of cracking or impact damage.

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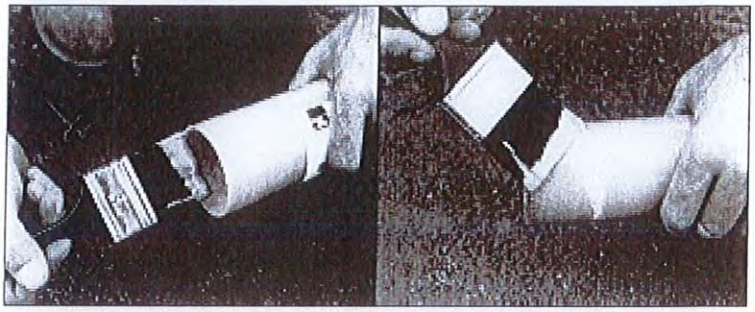
Adhesive Mixing & Application

a. Insure that the taper and bonding surfaces are clean. If the surfaces are oily or greasy, they should be cleaned by sanding or with cleaner (not supplied). It is imperative that the bonding surfaces be clean and dry before adhesive application. A light sanding to "freshen" the surfaces should be done.

b. Mix adhesive according to directions taking careful notice of the working life. Please review adhesive kit instructions prior to mixing.

c. Apply a thin coating of adhesive to both spigot and bell bonding surfaces. Enough adhesive should be used to form a bead surrounding the pipe when insertion has been completed. Only enough adhesive to wet the surfaces is needed. More is not better.

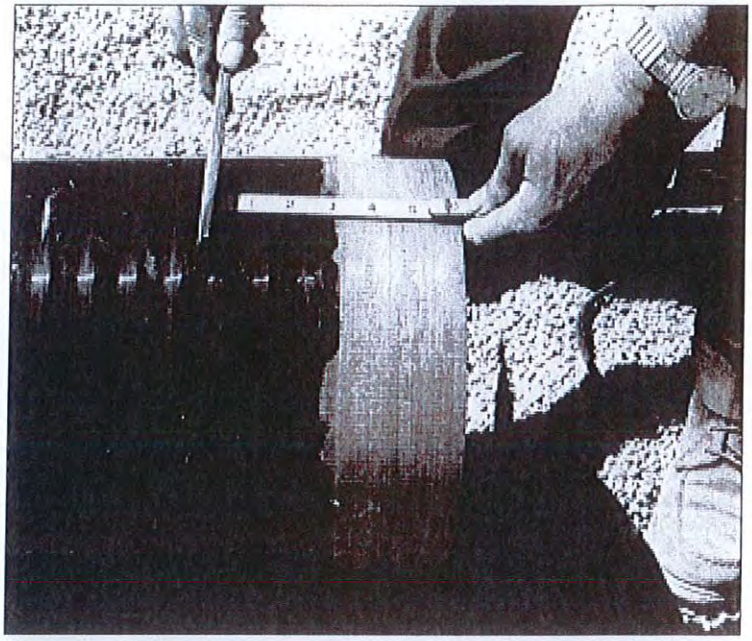


2"-6" Pipe

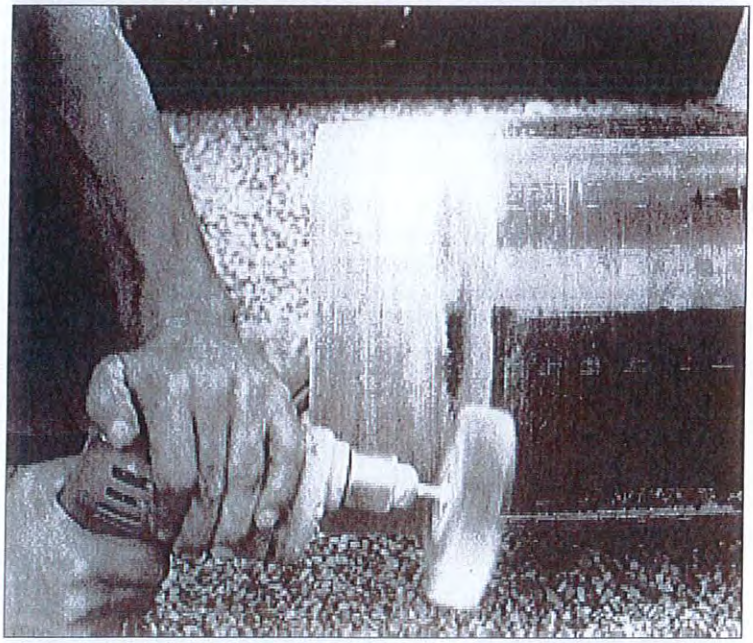
The spigot end should be inserted without rotation until contact of the matching taper in the bell is felt. At this point, the spigot end should be rotated while applying force to the joint. A slight reverse twist (1/4 turn) will "lock" the joint. The rotation of the spigot end will redistribute the adhesive evenly and work any air out of the joint.

8"-16" Pipe

a. Insert dry, then measure and mark the insertion depth of the spigot end on the exterior pipe wall. (See Tables 1, 2 & 3 for insertion depths in pipe and fittings, respectively.)



b. Remove the exterior gloss up to the recorded insertion depth using a flapper sander or sandpaper. A light sanding of the spigot (if factory made) should also be done.

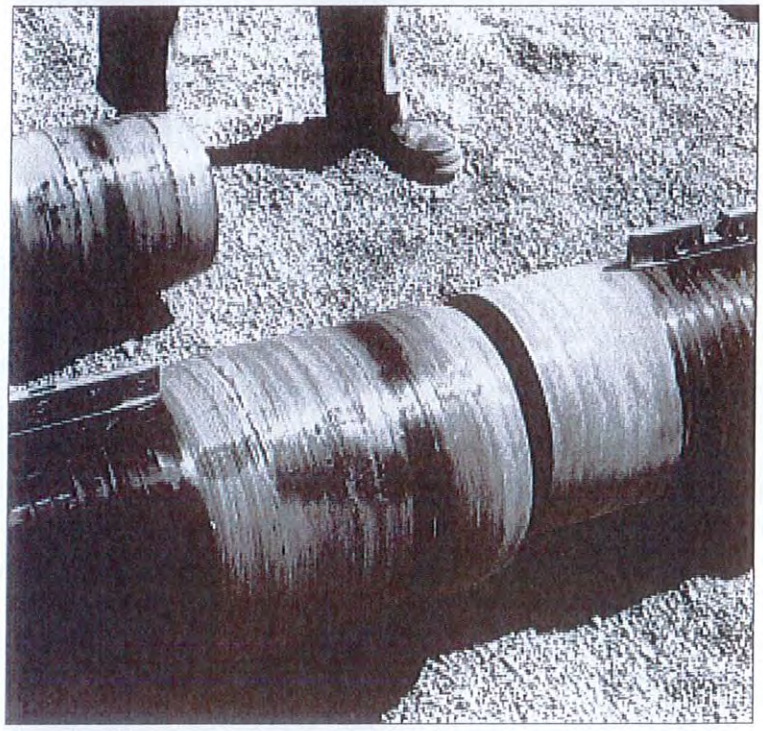


8"-16" Pipe (cont'd)

c. A second mark, 3 inches past the original measurement, should be made in order to double check the insertion depth upon final joint makeup.

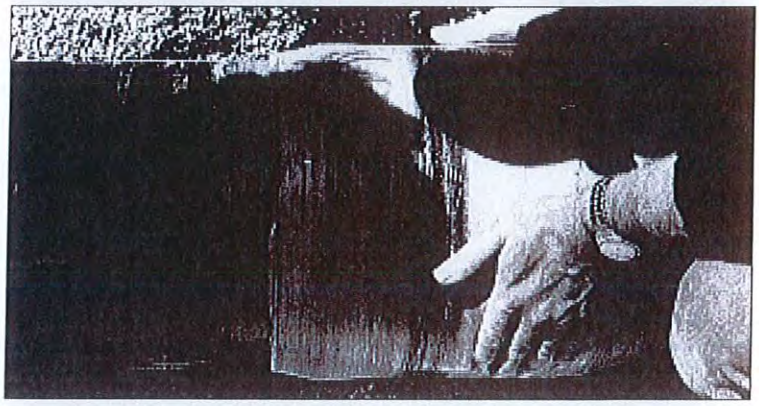
d. Buff up the interior of the bell and remove any rough edges using a flapper sander or sandpaper.

e. Align the mating surfaces so that they may be brought together in a straight, even line.

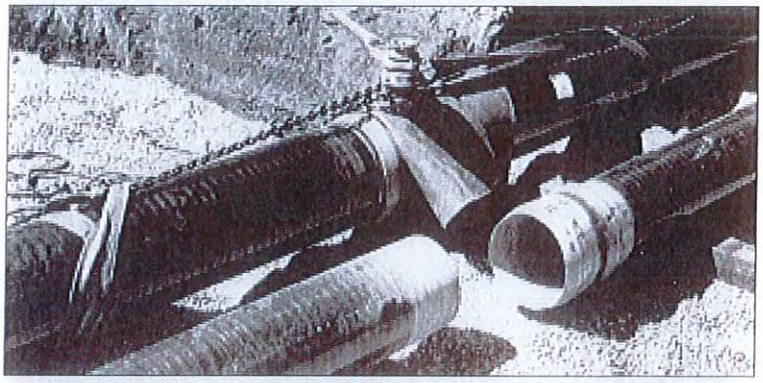


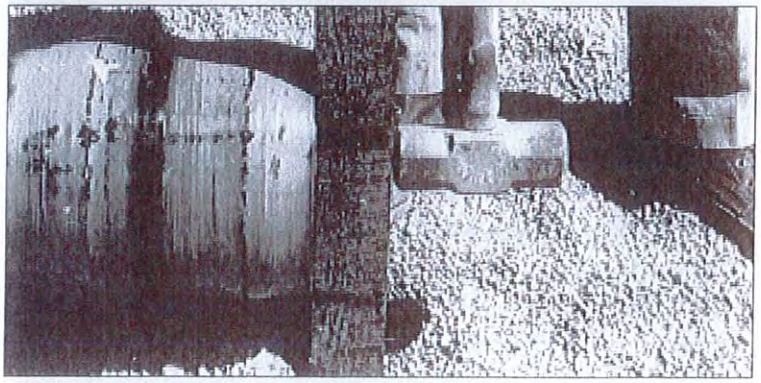
8"-16" Pipe (cont'd)

f. Apply properly mixed adhesive to both the bell and spigot bonding surfaces.



g. The spigot end should be inserted in an uncocked position without rotation. After initial insertion has been made, a come-a-long should be used to insure that the proper insertion depth has been obtained. Use 5/8" (16mm) or larger manila rope with the come-a-long, taking careful notice to protect pipe with padding where the come-a-long is fastened. Take up the come-a-long slowly and work joint together taking care to maintain alignment. Tap a wooden block held against the next bell end of the pipe, to be sure the spigot end has been fully inserted. Never do this against a pipe spigot.





General Considerations

a. ***Do not use excessive force.*** Over insertion should be avoided because it can crack the spigot end and result in a faulty joint.

b. After proper insertion has been accomplished, check for possible backout at the joint, by momentarily reducing tightness of come-along.

c. If joint separates more than 1/8 inch, too much adhesive has been used. Joint should be disassembled, cleaned and reassembled using proper amount of adhesive.

d. If temperature is below 40°F (5°C), heat assist methods such as a heat blanket **must** be used in order for the adhesive to cure.

e. Do not pressurize the line until adhesive has fully cured. Curing time at various temperatures are shown in the adhesive kit instructions.

Safety Recommendations

Engineering Controls:

- A fabrication area should be set up in which to perform as much of the fabrication work as is practical or possible.
- Ventilation of the work area should be controlled. This can be done by means of fans or dust collectors.
- Work area should be kept clean, including floor or other horizontal surfaces. Rinsing with water or sweeping with brushes or brooms (using floor sweep) is recommended. ***Never*** use compressed air to clean area or to remove dust for personal cleaning. Brushes should be used to remove residue from shaved surfaces.

Personal Protection:

- Barrier creme should be applied to the skin in areas which may be exposed to shavings prior to beginning work.
- Clean clothes should be worn each day. Do not wear clothing that has not been laundered to begin a work shift. More frequent changing may be required by conditions.
- Long sleeved shirts or worksuits should be used. Tape should be used at sleeve opening.
- Cotton or flannel shirts under workshirts may be worn to prevent rubbing of skin at opening of worksuit.
- Gloves with elastic cuff should be worn at all times. Replace worn or contaminated gloves as necessary. Gloves with flared, stiff cuffs act as a gathering funnel for shavings.
- Pant legs should be worn outside work boots. If necessary for safety purposes, the pant legs can be taped to fit closely to the boot. Over-the-calf socks can be used to prevent chafing of the boot on the skin.
- Wristbands and watches should be removed to prevent rubbing or accumulation of particles on skin underneath the band.
- Dust masks and face shields should be used as necessary and practical. Contact points with the skin should be kept free of dust to prevent dust from being imbedded into skin from movement of the mask during normal use.

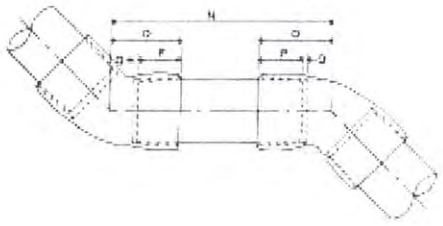
Personal Hygiene:

- Wash exposed skin with soap solution (liquid soap preferred) and cool water.
- Use washcloth with "brushing" motion to remove dust or fibers. ***Do not*** scrub the skin. This could result in the fibers being imbedded into the skin.
- Rinse thoroughly with clean, cold water.
- Apply lotion or creme to skin (non-detergent formulas such as baby lotion) to soothe irritation or prevent further immediate irritation.

Insertion Depths

The following tables outline the recommended centerline to centerline measurement procedure for Bell x Spigot pipe. The dimension values are subject to manufacturing tolerance and should be double-checked to insure an exact fit.

Table 1.



Bell & Spigot Elbows Centerline to Centerline 2"-6"				
Pipe Size (inches)	O (90°) (inches)	O (45°) (inches)	P (inches)	Q (inches)
2	3 3/4	3 1/8	2 3/8	1/8
3	5 3/4	4 3/4	3 7/8	1/8
4	7	5 3/4	4 1/2	1/8
6	9	7 1/8	5 1/2	1/4

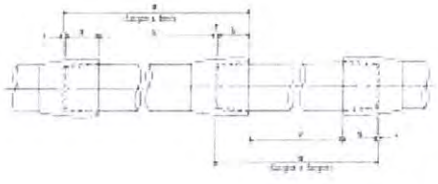
Table 2.

Bell & Spigot Elbows Centerline to Centerline 8"-16"								
Pipe Size (inches)	O (90°) (inches)	O (60°) (inches)	O (45°) (inches)	O (30°) (inches)	O (22 1/2°) (inches)	O (11 1/4°) (inches)	P (inches)	Q (inches)
8	13	9 3/4	8 1/4	7	6 1/2	5 3/4	4 3/4	1/4
10	15 1/2	11	9 1/4	7 3/4	7	6	5	1/4
12	17 3/4	12 1/2	10 1/2	8 3/4	8	6 3/4	5 1/4	1/4
14	20 3/4	14 3/4	12 1/2	10 1/2	9 1/2	8 1/4	6 1/2	3/8
16	23	16 1/4	13 3/4	11 1/4	10 1/4	8 1/2	6 3/4	3/8

N = Centerline to Centerline Dimension
O = Centerline to Face of Fittings
P = Dry Insertion Depth
Q = Lubrication Factor

Formula:
N - (O+O) + (P+P) + (Q+Q) = Length of Pipe to Cut

Table 3.



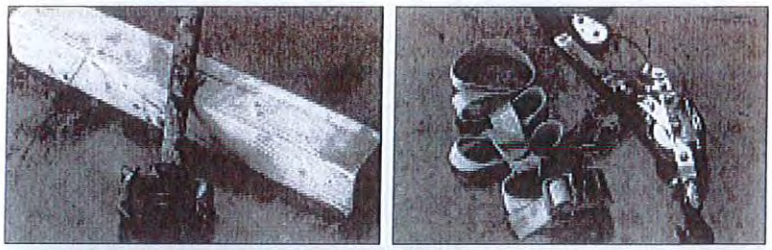
Bell & Spigot Face to Face Centerline to Centerline 2"-16"			
Pipe Size (inches)	S (inches)	T (inches)	X (inches)
2	2.05	1/8	1 1/2
3	2.32	1/8	1 3/4
4	3.15	1/8	2
6	4.00	1/4	2 3/4
8	5.00	1/4	2 5/8
10	5.00	1/4	3 1/4
12	5.55	1/4	3 3/4
14	6.80	3/8	4 1/2
16	7.00	3/8	5

Equipment List

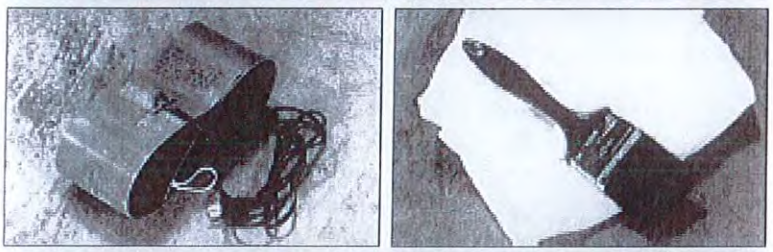
The following tools are recommended for installing Bonsdtrand pipe Series 3000A & 3200A:

a. Unique Tool® or Taper Tool® II
b. Hacksaw or power saw with abrasive wheel
c. Pipe vise (Pilot No. 20) and 1/4" (6 mm) thick elastomeric pads
d. Flapper wheel sander (available from Ameron) with electric or air drill motor with 1/4" (6 mm) drive, 1700-2200 rpm (faster drills will produce a polished surface
e. Rubber mallet, 2 lb. (1 kg), Shore Durometer A 70-80, 2 1/2 to 3" diameter
f. Comealong for 6" (150 mm) pipe and larger, Dayton No. 2Z614
g. Heating blankets or Chem Cure Paks®
h. Pipefitter's wraparound, level and white grease pencil or soapstone
i. Duster brush and clean rags
j. Dust mask, eye protection and gloves
k. Folding rule, 10 ft. (3 m)
l. Tape, 50 ft. (15 m)
m. Disc grinder or file (optional)

When using pneumatic tools, the air supply must be dry and oil-free as moisture or oil on bonding surfaces will interfere with the adhesive.



Small-diameter joints may be made up with a rubber mallet (or equal) and wooden block (left). Large-diameter joint make-up requires comealongs (right).



Adhesives for the Bell x Spigot tapered joint can be force-cured with Ameron electric heating blankets (left) or Chem Cure Paks® (2"-6"). An ample supply of clean rags and dust brushes is required to keep all bonding surfaces clean (right).

A pipefitter's wraparound, a level and a grease pencil are suggested for alignment and marking (left). Essential safety wear includes eye protection, dust mask and clean cotton gloves (right).

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AMERON INTERNATIONAL

Installation Guide

FIBERGLASS - COMPOSITE PIPE GROUP

Heat Blankets

for heat-curing adhesive joints in Bondstrand® & Dualoy® pipe and fittings.

General

Heating blankets are specially designed to heat-cure adhesive joints in Bondstrand and Dualoy pipe and fittings. Available for 120-volt or 220-volt alternating current, the blankets are quickly and easily applied. They provide thermostatically controlled heat, helping to assure maximum joint strength and reliability.

Blankets are available in five sizes and two voltages as follow:

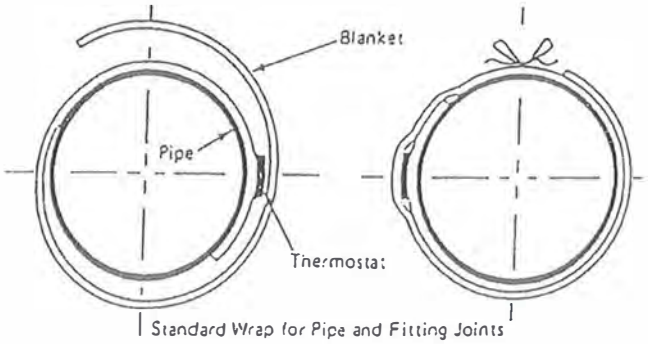
Sizes and Voltages for Bondstrand & Dualoy Heat Blankets

For Pipe Sizes		Volts	Width		Length		Commodity Code
(mm)	(in)	(ac)	(mm)	(in)	(mm)	(in)	
25-50	1-2	120	50	2*	305	12	12180400
50-100	2-4	120	102	4	508	20	24410400
75-100	3-4	120	50	2*	508	20	34180400
150-200	6-8	120	124	4⅞	813	32	68180400
250-300	10-12	120	149	5⅞	1270	50	AB180400
350-400	14-16	120	175	6⅞	1651	65	CD180400
450-500	18-20	120	254	10	2083	82	EF180400
50-100	2-4	220	102	4	508	20	24420400
150-200	6-8	220	124	4⅞	813	32	68190400
250-300	10-12	220	149	5⅞	1270	50	AB190400
350-400	14-16	220	175	6⅞	1651	65	CD190400
450-500	18-20	220	254	10	2083	82	EF190400

*For use with Dualoy 3000/L or 3000/LCX only

Using the Blanket

Place the thermostat end of the heating blanket against the assembled joint with the thermostat facing out from the joint. Wrap the remainder of the blanket around the joint so that overlap, if any, will cover the thermostat. Tie the blanket in place with any temperature resistant tie or velcro strap. Use caution when removing to avoid burns.



Standard Wrap for Pipe and Fitting Joints

ISO-9001

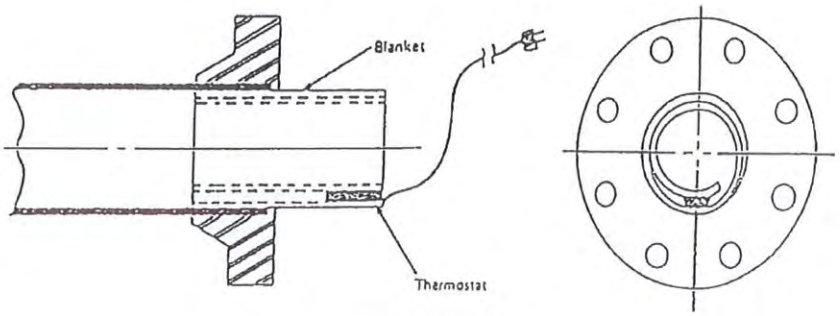
DNV CERTIFICATED FIRM

Insulation

It is always a good idea to insulate around the heating blanket and to close the pipe ends. This is essential when it is windy or when air temperature is below 40° F. Fiberglass insulation backed with aluminum foil generally works well. Insulation should overwrap the blanket sides about 4 inches (100 mm) each way and be tied down near the edges to trap the heat. **Caution:** *Joint must not be moved, vibrated or otherwise distributed during cure of adhesive.*

Flange Mounting

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 only to the depth of the fresh joint, leaving the cord and part of the blanket exposed as shown. Fill the space inside the rolled blanket with fiberglass insulation or some other heat-resistant material to ensure that the blanket remains snugly against the inside joint surface.



Special Wrap for Flange Mounting

Curing the Joint

Determine the required cure time from the Bondstrand assembly instructions found in the adhesive kit.

Warning: Before applying power, inspect the blanket and cord for loose wire connections and bare wires. Do not plug cord into live power source when standing in water or on wet surfaces.

Apply alternate current (ac) at the voltage marked on the heating blanket. Do not use direct current (dc) power supply. Mark the start-up and disconnect time on the pipe with a white grease pencil and you will have a record of cure for each joint in the system. Be sure all electrical connections are good and that the blanket actually heats up each time.

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PI Tape

We recommend the use of PI Tape for measuring the shaved ends to insure the dimensions in Table I of the Bondstrand Assembly Instructions.

If you cannot find a PI Tape locally then contact the factory direct at the number shown below.

CERTIFICATE OF CALIBRATION

Pi Tape #__47495__ Size__2" - 12" O.D.__ Diameter

Tape Reads:__8.9975__ Over__8.9972__ Gage

All scribing and gaging equipment used to fabricate and inspect Pi Tapes is certified traceable to National Bureau of Standards, Washington, D. C. The precision lead screw used in our equipment for locating and scribing increments is accurate to within .0003" overall in one Pi Foot.
Pi Tapes are calibrated and inspected under 6 pound tension at 68° F.

Inspected by Harry Hadley Date 12/27/79

PI TAPE
P. O. Box 397
Lemon Grove, Calif. 92045
Phones Area 714 (19
466-2255 466-0678 286-2021

Flapper Sanding Wheels

The factory recommends 40 - 60 (medium) grit. These are generally available in most hardware stores. If you are unable to find the flapper wheels, or require a large quantity, here are two manufacturers that you can contact: Norton (New York) 800-225-7330 or Standard Abrasives (California) 213-349-5650.
Flapper Wheels should be 40 - 60 (medium) grit aluminum oxide abrasive wheel

2" x 1" Flapper Wheel - Approximate amount of joints:
2" - 11 joints
3" - 10 joints
4" - 9 joints
6" - 6 joints

6" x 2" Flapper Wheel - Approximate amount of joints:
6" - 10 joints
8" - 8 joints
10" - 6 joints
12" - 3 joints
14" - 2 joints
16" - 1 joint

Flapper wheel must be used on a 1700 to 2000 RPM drill. Keep clean and dry to get maximum life expectancy of the wheel.

Bondstrand Fittings Engineering Guide

Ameron offers a complete line of filament-wound pipe, fittings and flanges in both epoxy and vinylester resin systems, in diameters from 2 to 12 inches. Alternative molded flanges and fittings are available in several configurations. Refer to the Bondstrand Chemical Resistance Charts, BC-1 and BC-2, to determine the Bondstrand product series which best meets your needs.

This bulletin gives dimensions and approximate weights of stock and made-to-order products. Pressure ratings are given for water service at various temperatures.

How Field Joints are Made

Bondstrand pipe and fittings are joined using a Quick-Lock bonded joint, a flanged connection or a suitable mechanical joint. Quick-Lock joints are assembled using the appropriate Bondstrand thermosetting adhesives. The most widely used Bondstrand adhesive, RP-34, has been qualified by an independent testing laboratory to comply with the requirements of U.S. Military Specification MIL-P-28584 and is approved by the National Sanitation Foundation (NSF) for use in potable water systems.

Sockets include a "pipe stop" or self-centering shoulder which ensures predictable laying lengths for piping assemblies. Laying lengths of Quick-Lock fittings match those of ANSI Standard B16.9 for steel buttwelding fittings.

Bondstrand "ANSI" flanged fittings are flanged to meet center-to-face or face-to-face dimensions of ANSI Standard B16.5 for 150 psi ratings. These ANSI parts may be interchanged with flanged steel fittings for convenient repair, provided the design accounts for the weights and thrusts of steel parts or assemblies.

Bondstrand combination coupled ANSI fittings are offered, providing factory-mounted Quick-Lock sockets for bonded joints and Bondstrand 150 psi flanges for flanged connections on Ameron's standard filament-wound ANSI body in a variety of combinations. The center-to-contact surface dimension of the flanged end is the same as ANSI Standard B16.5, 150 psi rating.

Combination coupled fittings help to minimize the number of flanged joints in piping systems where the Quick-Lock joint is preferred but where connections to valves and equipment must be made.

Installation of Bondstrand fittings and flanges is fast and easy; just carefully follow the complete instructions for bonding joints and mounting flanges which are included in every adhesive kit. Instructions for bolting up flanges and for mounting saddles are included with each shipment in addition to appearing in the appendices.

Ratings of Fittings for Pressure and Temperature

Bondstrand Series 1600, 2000, 4000 and 5000 piping systems are generally designed for water at 150 psi sustained pressures and 225 psi pressures under surge or transient conditions. Ratings of these Bondstrand parts are based on a minimum hydrostatic safety factor of 3 to leakage at 70°F when tested in accordance with ASTM Method D 1599 using free-end closures which apply full stress to the part due to hydrostatic end thrust. All Bondstrand Series 1600, 2000, 4000 and 5000 parts are thereby rated for water service at 150 psi or higher pressures.

as noted herein except for certain diameters of filament-wound crosses, and molded reducer bushings and fittings plugs. The rated pressure of the system must not exceed the lowest rated pressure of the individual fittings used.

Series 6000 piping systems joined with Bondstrand RP-34 Epoxy Adhesive are rated for water at 175 psi sustained pressures and 265 psi pressures under surge or transient pressure conditions at 70°F. Rating is based on a minimum hydrostatic safety factor of 4 to leakage when tested in accordance with Factory Mutual procedures using free-end closures which apply full stress to the part due to hydrostatic end thrust.

Rated pressures are reduced and limited for elevated temperature service as shown in Table 1. Systems joined using RP-105 adhesive are further limited to pressures not greater than 50 percent of the pipe rating in the Series 5000 Pipe Engineering Guide

What if Special Adhesives are Needed?

Factory assemblies of epoxy products are made using RP-34, and factory assemblies of polyester products are made using RP-48. If the use of Bondstrand RP-105 polyester adhesive or Bondstrand RP-6A epoxy adhesive (for food handling) is dictated by the service according to the Bondstrand Chemical Resistance Chart, factory assemblies must be specially ordered and the proper adhesive noted on the purchase order.

Published Information

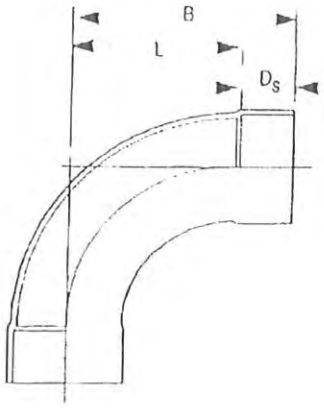
Bondstrand engineering guides, assembly instructions and other publications provide the technical data needed for optimum performance and safety. Design, specification, assembly and installation requirements are presented in detail to provide you with the latest developments in the most efficient use of Bondstrand pipe and fittings

Table 1
Rated Pressure of Bondstrand Products at Elevated Temperatures as a Percent of Rated Pressure at 70°F

Bondstrand Series	Fluid Temperature (°F)		
	200[1]	250	300
1600[2]	100	—	—
2000[3]	100	85	50
4000[3]	100	85	50
5000[4]	100	—	—
6000[3]	100	85	50

1. Systems joined using either RP-105 or RP-6A adhesives are not recommended for temperatures above 200°F.
2. Not recommended for temperatures above 210°F.
3. Not recommended for temperatures above 300°F.
4. Not recommended for temperatures above 200°F.

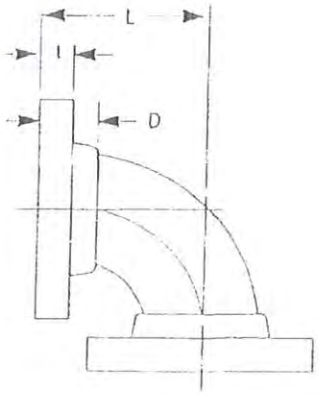
90° elbows



Fittings are filament wound unless otherwise indicated. Fittings marked with an asterisk (*) are molded.

Nom Pipe Size	Laying Length (L)	Overall Length (B)	Socket Depth (D_S)	Approx Wt
in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*	lb.• *kg*
1 *25*	2.56 *65*	3.62 *92*	1.06 *27*	1 *0.5*
1½ *40*	3.19 *81*	4.44 *113*	1.25 *32*	1 *0.5*
2 *50*	3.00 *76*	4.82 *122*	1.82 *46*	1 *0.5*
	2.01* *51*	3.83 *97*	1.82 *46*	1 *0.5*
3 *80*	4.50 *114*	6.32 *161*	1.82 *46*	3 *1.4*
	2.61* *66*	4.43 *113*	1.82 *46*	2 *0.9*
4 *100*	6.00 *152*	7.82 *199*	1.82 *46*	4 *1.8*
	3.69* *94*	5.51 *140*	1.82 *46*	3 *1.4*
6 *150*	9.00 *229*	11.25 *286*	2.25 *57*	8 *3.6*
	5.25* *133*	7.50 *191*	2.25 *57*	7 *3.2*
8 *200*	12.00 *305*	14.50 *368*	2.50 *64*	15 *6.8*
10 *250*	15.00 *381*	17.75 *451*	2.75 *70*	25 *11.3*
12 *300*	18.00 *457*	21.00 *533*	3.00 *76*	41 *18.6*
14 *350*	14.12 *359*	17.62 *448*	3.50 *89*	37 *16.8*
16 *400*	15.62 *397*	19.62 *498*	4.00 *102*	68 *30.8*

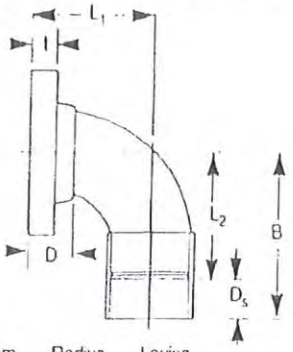
90° flanged elbows



Flanged 90° elbows feature filament-wound bodies and filament-wound (f/w) or molded (m) flanges. They are available in ANSI short-radius (s/r) or long-radius (l/r) laying lengths. Flanged short-radius elbows meeting ANSI laying lengths are not available in 1, 1½, 14 or 16 inch sizes. Fittings marked with two asterisks (**) are available only with filament-wound flanges.

Nom Pipe Size	Radius Type	Laying Length (L)	Flange Thickness At Face (t)	Flange Thickness At Hub (D)	Approx Wt Flange Type (m)	Approx Wt Flange Type (f/w)
in.• *mm*		in.• *mm*	in.• *mm*	in.• *mm*	lb.• *kg*	lb.• *kg*
1 *25*	l/r	5.00** *127"*	1.13 *29*	1.13 *29*	– –	1 *0.5*
1½ *40*	l/r	6.00** *152*	1.38 *35*	1.38 *35*	– –	1 *0.5*
2 *50*	s/r	4.50 *114*	1.00 *25*	2.00 *51*	5 *2.3*	4 *1.8*
	l/r	6.50 *165*	1.00 *25*	2.00 *51*	5 *2.3*	5 *2.3*
3 *80*	s/r	5.50 *140*	1.13 *29*	2.00 *51*	8 *3.6*	7 *3.2*
	l/r	7.75 *197*	1.13 *29*	2.00 *51*	9 *4.1*	8 *3.6*
4 *100*	s/r	6.50 *165*	1.25 *32*	2.00 *51*	11 *5.0*	10 *4.5*
	l/r	9.00 *229*	1.25 *32*	2.00 *51*	13 *5.9*	12 *5.4*
6 *150*	s/r	8.00 *203*	1.75 *44*	2.38 *60*	22 *10.0*	18 *8.2*
	l/r	11.50 *292*	1.75 *44*	2.38 *60*	26 *11.8*	22 *10.0*
8 *200*	s/r	9.00 *229*	2.00 *51*	2.63 *67*	35 *15.9*	29 *13.2*
	l/r	14.00 *356*	2.00 *51*	2.63 *67*	41 *18.6*	37 *16.8*
10 *250*	s/r	11.00 *279*	2.00 *51*	2.88 *73*	50 *22.7*	43 *19.5*
	l/r	16.50 *419*	2.00 *51*	2.88 *73*	57 *25.9*	54 *24.5*
12 *300*	s/r	12.00 *305*	2.13 *54*	3.13 *80*	82 *37.2*	77 *34.9*
	l/r	19.00 *483*	2.13 *54*	3.13 *80*	91 *41.3*	86 *39.0*
14 *350*	l/r	21.50** *546*	2.81 *71*	3.81 *97*	– –	150 *68.0*
16 *400*	l/r	24.00** *610*	3.25 *83*	4.25 *108*	– –	180 *81.6*

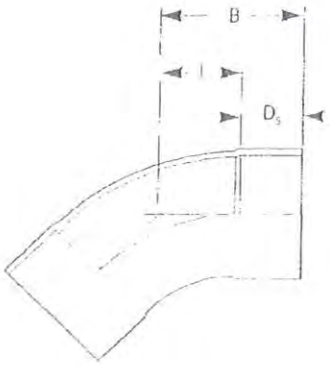
90° combination elbows



Only center-to-flange-face dimensions correspond to ANSI laying lengths. The fitting body is filament wound; flanges are available in molded (m) or filament-wound (f/w) variants. Dimensions marked with an asterisk (*) indicate molded flanges. Fittings marked with two asterisks (**) are available only with filament-wound flanges.

Nom Pipe Size		Radius Type	Laying Length (L_1)		Flange Thickness At Face (I)		At Hub (D_f)		Overall Length (B)		Laying Length (L_2)		Socket Depth (D_S)		Approx Wt Flange Type (m)		(f/w)	
in.•	*mm*		in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*	lb.•	*kg*
1	*25*	Vr	5.00	*127*	1.13**	*29*	1.13	*29*	3.37	*86*	2.31	*59*	1.06	*27*	–	–	2	*0.9*
1½	*40*	Vr	6.00	*152*	1.38**	*35*	1.38	*35*	4.44	*113*	3.19	*81*	1.25	*32*	–	–	3	*1.4*
2	*50*	s/r	4.50	*114*	1.00	*25*	2.00	*51*	6.56	*167*	4.75	*121*	1.81	*46*	4	*1.8*	3	*1.4*
		Vr	6.50	*165*	1.00	*25*	2.00	*51*	8.56	*217*	6.75	*171*	1.81	*46*	4	*1.8*	4	*1.8*
3	*80*	s/r	5.50	*140*	1.13	*29*	2.00	*51*	7.56	*192*	5.75	*146*	1.81	*46*	6	*2.7*	5	*2.3*
		Vr	7.75	*197*	1.13	*29*	2.00	*51*	9.81	*249*	8.00	*203*	1.81	*46*	6	*2.7*	6	*2.7*
4	*100*	s/r	6.50	*165*	1.25	*32*	2.00	*51*	8.56	*217*	6.75	*171*	1.81	*46*	8	*3.6*	8	*3.6*
		Vr	9.00	*229*	1.25	*32*	2.00	*51*	11.31	*287*	9.25	*235*	2.06	*52*	10	*4.5*	10	*4.5*
6	*150*	s/r	8.00	*203*	1.75	*44*	2.38	*60*	10.50	*267*	8.25	*210*	2.25	*57*	16	*7.3*	14	*6.4*
		Vr	11.50	*292*	1.75	*44*	2.38	*60*	14.00	*356*	11.75	*298*	2.25	*57*	20	*9.1*	18	*8.2*
8	*200*	s/r	9.00	*229*	2.00	*51*	2.63	*67*	11.75	*298*	9.25	*235*	2.50	*64*	26	*11.8*	23	*10.4*
		Vr	14.00	*356*	2.00	*51*	2.63	*67*	16.75	*425*	14.25	*362*	2.50	*64*	32	*14.5*	31	*14.1*
10	*250*	s/r	11.00	*279*	2.00	*51*	2.88	*73*	14.00	*356*	11.25	*286*	2.75	*70*	38	*17.2*	34	*15.4*
		Vr	16.50	*419*	2.00	*51*	2.88	*73*	19.50	*495*	16.75	*425*	2.75	*70*	45	*20.4*	45	*20.4*
12	*300*	s/r	12.00	*305*	2.13	*54*	3.13	*80*	15.25	*387*	12.25	*311*	3.00	*76*	61	*27.7*	61	*27.7*
		Vr	19.00	*483*	2.13	*54*	3.13	*80*	22.25	*565*	19.25	*489*	3.00	*76*	70	*31.8*	70	*31.8*
14	*350*	Vr	21.50	*546*	2.88**	*73*	3.75	*95*	17.62	*448*	14.12	*359*	3.50	*89*	–	–	85	*38.6*
16	*400*	Vr	24.00	*610*	3.25**	*83*	4.25	*108*	19.62	*498*	15.62	*397*	4.00	*102*	–	–	104	*47.2*

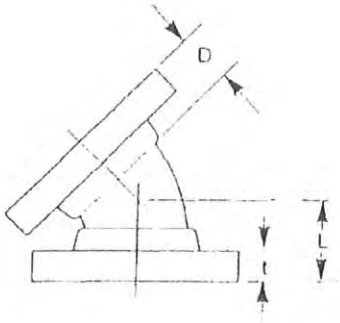
45° elbows



Fittings are filament wound unless otherwise designated. Fittings marked with an asterisk (*) are molded.

Nom Pipe Size		Laying Length (L)		Overall Length (B)		Socket Depth (D_S)		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
1	*25*	0.88	*22*	1.94	*49*	1.06	*27*	1	*0.5*
1½	*40*	1.12	*28*	2.37	*60*	1.25	*32*	1	*0.5*
2	*50*	1.38	*35*	3.20	*81*	1.82	*46*	1	*0.5*
		1.38*	*35*	3.20	*81*	1.82	*46*	1	*0.5*
3	*80*	2.00	*51*	3.82	*97*	1.82	*46*	2	*0.9*
		1.62*	*41*	3.43	*87*	1.82	*46*	2	*0.9*
4	*100*	2.50	*64*	4.32	*110*	1.82	*46*	3	*1.4*
		2.42*	*61*	4.23	*107*	1.82	*46*	3	*1.4*
6	*150*	3.75	*95*	6.00	*152*	2.25	*57*	5	*2.3*
		3.31*	*84*	5.56	*141*	2.25	*57*	8	*3.6*
8	*200*	5.00	*127*	7.50	*191*	2.50	*64*	9	*4.1*
10	*250*	6.25	*159*	9.00	*229*	2.75	*70*	16	*7.3*
12	*300*	7.50	*191*	10.50	*267*	3.00	*76*	26	*11.8*
14	*350*	4.69	*119*	8.19	*208*	3.50	*89*	38	*17.2*
16	*400*	5.38	*137*	9.38	*238*	4.00	*102*	45	*20.4*

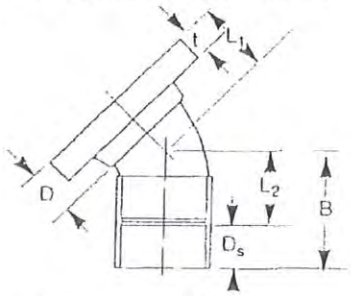
45° flanged elbows



Flanges are filament wound unless otherwise designated. Fittings marked with an asterisk (*) have molded flanges. Laying lengths meet ANSI criteria.

Nom Pipe Size		Laying Length (L)		Flange Thickness At Face (t)		Flange Thickness At Hub (D)		Approx Wt (m)		Approx Wt (f/w)	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*	lb.•	*kg*
02	*50*	2.50	*64*	1.00	*25*	2.00	*51*	5	*2.3*	04	*1.8*
03	*80*	3.00	*76*	1.13	*29*	2.00	*51*	7	*3.2*	06	*2.7*
04	*100*	4.00	*102*	1.25	*32*	2.00	*51*	10	*4.5*	10	*4.5*
06	*150*	5.00	*127*	1.75	*44*	2.38	*60*	21	*9.5*	17	*7.7*
08	*200*	5.50	*140*	2.00	*51*	2.63	*67*	32	*14.5*	29	*13.2*
10	*250*	6.50	*165*	2.00	*51*	2.88	*73*	50	*22.7*	47	*21.3*
12	*300*	7.50	*191*	2.13	*54*	3.13	*80*	76	*34.5*	70	31.8
14	*350*	12.25**	*311*	2.81	*71*	3.81	*97*	–	–	59	26.8
16	*400*	13.94**	*354*	3.25	*83*	4.25	*108*	–	–	77	34.9

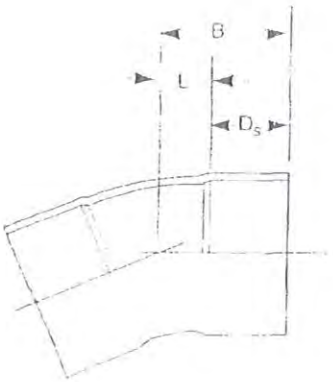
45° combination elbows



Flanges are available in molded (m) or filament-wound (f/w) construction. Dimensions marked with an asterisk (*) indicate molded flanges.

Nom Pipe Size		Laying Length (L_1)		Flange Thickness At Face (t)		Flange Thickness At Hub (D)		Overall Length (B)		Laying Length (L_2)		Socket Depth (D_s)		Approx Wt Flange Type (m)		Approx Wt Flange Type (f/w)	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*	lb.•	*kg*
*2	*50*	2.50	*64*	1.00	*25*	2.00	*51*	4.56	*116*	2.75	*70*	1.82	*46*	3	*1.4*	*3	*1.4*
*3	*80*	3.00	*76*	1.13	*29*	2.00	*51*	5.06	*129*	3.25	*83*	1.82	*46*	5	*2.3*	*4	*1.8*
*4	*100*	4.00	*102*	1.25	*32*	2.00	*51*	6.06	*154*	4.25	*108*	1.82	*46*	7	*3.2*	7	*3.2*
*6	*150*	5.00	*127*	1.75	*44*	2.38	*60*	7.50	*191*	5.25	*133*	2.25	*57*	15	*6.8*	13	*5.9*
*8	*200*	5.50	*140*	2.00	*51*	2.63	*67*	8.25	*210*	5.75	*146*	2.50	*64*	23	*10.4*	23	*10.4*
10	*250*	6.50	*165*	2.00	*51*	2.88	*73*	9.50	*241*	6.75	*171*	2.75	*70*	38	*17.2*	38	*17.2*
12	*300*	7.50	*191*	2.13	*54*	3.13	*80*	10.75	*273*	7.75	*197*	3.00	*76*	55	*24.9*	54	*24.5*
14	*350*	12.25**	*311*	2.81	*71*	3.81	*97*	16.00*	*406*	12.50**	*318*	3.50	*89*	63	*28.6*	60	*27.2*
16	*400*	13.94**	*354*	3.25	*83*	4.25	*108*	18.20*	*462*	14.20**	*361*	4.00	*102*	69	*31.3*	66	*29.9*

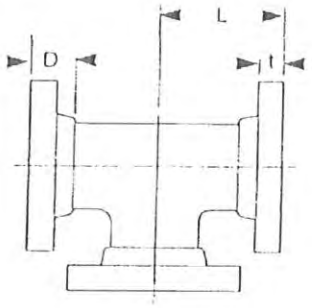
22½° elbows



Fittings feature filament-wound Quick-Lock bell ends. Elbows with angles such as 11¼°, 30°, 60° and 75° and other special angles are available. Consult your Ameron representative.

Nom Pipe Size		Laying Length (L)		Overall Length (B)		Socket Depth (D_s)		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
1	*25*	0.38	*10*	1.44	*37*	1.06	*27*	0.3	*0.1*
1½	*40*	0.38	*10*	1.63	*41*	1.25	*32*	0.5	*0.2*
2	*50*	0.81	*21*	2.62	*67*	1.82	*46*	0.7	*0.3*
3	*80*	1.00	*25*	2.81	*71*	1.82	*46*	1.3	*0.6*
4	*100*	1.12	*28*	2.94	*75*	1.82	*46*	2.0	*0.9*
6	*150*	1.12	*28*	3.38	*56*	2.25	*57*	4.0	*1.8*
8	*200*	2.25	*57*	4.63	*118*	2.50	*64*	7.0	*3.2*
10	*250*	2.62	*67*	5.38	*137*	2.75	*70*	13.0	*5.9*
12	*300*	3.00	*76*	6.00	*152*	3.00	*76*	16.0	*7.3*
14	*350*	3.25	*83*	6.75	*171*	3.50	*89*	26.0	*11.8*
16	*400*	3.50	*89*	7.50	*191*	4.00	*102*	30.0	*13.6*

Flanged tees

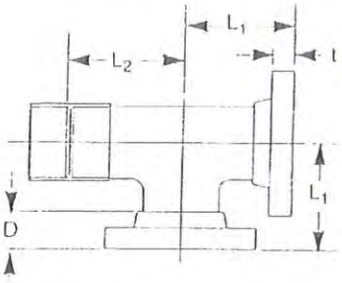


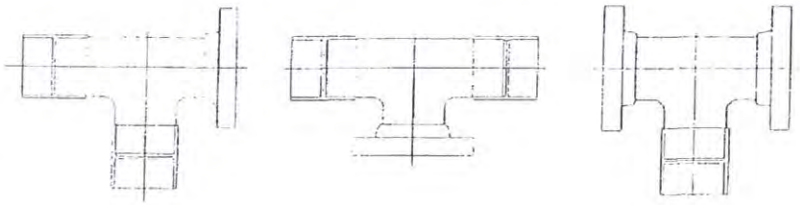
Flanges are filament wound unless otherwise noted. Molded flanges available in 2- through 12-inch sizes. Fittings noted with an asterisk (*) do not meet ANSI laying lengths. Flange thickness with double asterisk (**) represents molded flange dimension.

Nom Pipe Size		Laying Length (L)		Flange Thickness At Face (t)		Flange Thickness At Hub (D)		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
1	*25*	3.50	*89*	1.13	*29*	1.13	*29*	2	*0.9*
1½	*40*	4.00	*102*	1.38	*35*	1.38	*35*	3	*1.4*
2	*50*	4.50	*114*	1.00	*25*	2.00	*51*	7	*3.2*
3	*80*	5.50	*140*	1.13	*29*	2.00	*51*	11	*5.0*
4	*100*	6.50	*165*	1.25	*32*	2.00	*51*	17	*7.7*
		6.50	*165*	1.56**	*40*	–	–	17	*7.7*
6	*150*	8.00	*203*	1.75	*44*	2.38	*60*	32	*14.5*
8	*200*	9.00	*229*	2.00	*51*	2.63	*67*	47	*21.3*
10	*250*	11.00	*279*	2.00	*51*	2.88	*73*	70	*31.8*
12	*300*	12.00	*305*	2.13	*54*	3.13	*80*	114	*51.7*
14	*350*	18.00*	*457*	2.81	*71*	3.81	*97*	220	*99.8*
16	*400*	20.00*	*508*	3.25	*83*	4.25	*108*	280	*127.0*

Combination tees

Flanges are filament wound unless otherwise noted. Molded flanges are available in 2- through 12-inch sizes. Any combination of flanged or Quick-Lock ends is available. Fittings noted with an asterisk (*) do not match ANSI laying length dimensions. Quick-Lock bell ends in 14- and 16-inch sizes are integrally wound.

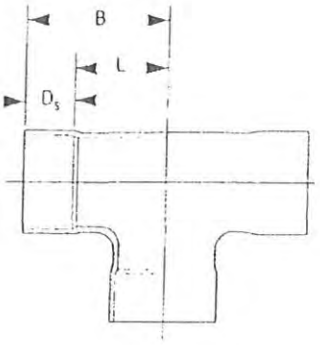




Nom Pipe Size		Laying Length (L_1)		Laying Length (L_2)		Flange Thickness At Face (t)		Flange Thickness At Hub (D)		Approx Wt 1 cplg 2 flgs		Approx Wt 2 cplg 1 flg	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*	lb.•	*kg*
1	*25*	3.50	*89*	1.06	*27*	1.13	*29*	1.13	*29*	3	*1.4*	3	*1.4*
1½	*40*	4.07	*103*	1.19	*30*	1.38	*35*	1.38	*35*	4	*1.8*	4	*1.8*
2	*50*	4.50	*114*	1.75	*121*	1.00	*25*	2.00	*51*	6	*2.7*	5	*2.3*
3	*80*	5.50	*140*	5.75	*146*	1.13	*29*	2.00	*51*	10	*4.5*	8	*3.6*
4	*100*	6.50	*165*	6.75	*171*	1.25	*32*	2.00	*51*	14	*6.4*	12	*5.4*
6	*150*	8.00	*203*	8.25	*210*	1.75	*44*	2.38	*60*	28	*12.7*	24	*10.9*
8	*200*	9.00	*229*	9.25	*235*	2.00	*51*	2.63	*67*	41	*18.6*	35	*15.9*
10	*250*	11.00	*279*	11.25	*286*	2.00	*51*	2.88	*73*	61	*27.7*	52	*23.6*
12	*300*	12.00	*305*	12.25	*311*	2.13	*54*	3.13	*80*	98	*44.5*	82	*37.2*
14	*350*	18.00*	*457*	10.50	*267*	2.81	*71*	3.81	*97*	130	*59.0*	120	*54.4*
16	*400*	20.00*	*508*	11.50	*292*	3.25	*83*	4.25	*108*	145	*65.8*	130	*59.0*

Tees

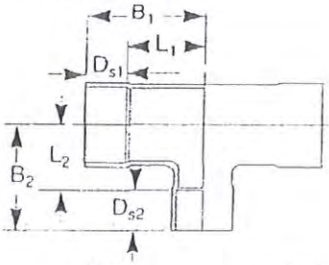
Fittings are filament wound unless otherwise noted. Molded fittings are indicated with an asterisk (*).



Nom Pipe Size		Laying Length (L)		Overall Length (B)		Socket Depth (D_S)		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
1	*25*	1.06	*27*	2.12	*54*	1.06	*27*	1	*0.5*
1½	*40*	1.19	*30*	2.44	*62*	1.25	*32*	1	*0.5*
2	*50*	2.00*	*51*	3.81	*97*	1.82	*46*	3	*1.4*
		2.50	*64*	4.32	*110*	1.82	*46*	2	*0.9*
3	*80*	2.69*	*68*	4.50	*114*	1.82	*46*	5	*2.3*
		3.38	*86*	5.20	*132*	1.82	*46*	4	*1.8*
4	*100*	3.69*	*94*	5.50	*140*	1.82	*46*	7	*3.2*
		4.12	*105*	5.94	*151*	1.82	*46*	5	*2.3*
6	*150*	5.25*	*133*	7.50	*191*	2.25	*57*	14	*6.4*
		5.62	*143*	7.87	*200*	2.25	*57*	11	*5.0*
8	*200*	7.00	*178*	9.50	*241*	2.50	*64*	18	*8.2*
10	*250*	8.50	*216*	11.25	*286*	2.75	*70*	32	*14.5*
12	*300*	10.00	*254*	13.00	*330*	3.00	*76*	46	*20.9*
14	*350*	10.50	*267*	14.00	*356*	3.50	*89*	65	*29.5*
16	*400*	11.50	*292*	15.50	*394*	4.00	*102*	97	*44.0*

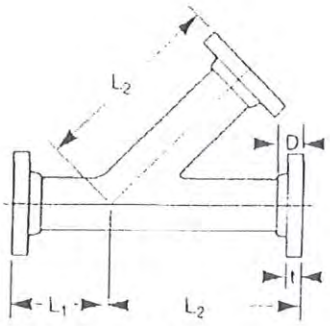
Reducing tees

Fittings are filament wound



Nom Pipe Size		Laying Length (L_1)		Laying Length (L_2)		Overall Length (B_1)		Overall Length (B_2)		Socket Depth (D_{S1})		Socket Depth (D_{S2})		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
2x2x1	*50x50x25*	2.50	64	2.25	*57*	4.31	*109*	3.31	*84*	1.81	*46*	1.06	*27*	3	*1.4*
3x3x2	*80x80x50*	3.38	86	3.00	*76*	5.19	*132*	4.81	*122*	1.81	*46*	1.82	*46*	4	*1.8*
4x4x2	*100x100x50*	4.12	105	3.50	*89*	5.93	*151*	5.31	*135*	1.81	*46*	1.82	*46*	5	*2.3*
4x4x3	*100x100x80*	4.12	105	3.88	*99*	5.93	*151*	5.68	*144*	1.81	*46*	1.82	*46*	5	*2.3*
6x6x2	*150x150x50*	5.62	143	4.50	*114*	7.87	*200*	6.31	*160*	2.25	*57*	1.82	*46*	8	*3.6*
6x6x3	*150x150x80*	5.62	143	4.88	*124*	7.87	*200*	6.69	*170*	2.25	*57*	1.82	*46*	9	*4.1*
6x6x4	*150x150x100*	5.62	143	5.12	*130*	7.87	*200*	6.93	*176*	2.25	*57*	1.82	*46*	10	*4.5*
8x8x3	*200x200x80*	7.00	178	5.88	*149*	9.50	*241*	7.69	*195*	2.50	*64*	1.82	*46*	14	*6.4*
8x8x4	*200x200x100*	7.00	178	6.12	*155*	9.50	*241*	7.94	*202*	2.50	*64*	1.82	*46*	15	*6.8*
8x8x6	*200x200x150*	7.00	178	6.62	*168*	9.50	*241*	8.87	*225*	2.50	*64*	2.25	*57*	17	*7.7*
10x10x4	*250x250x100*	8.50	216	7.25	*184*	11.25	*286*	9.06	*230*	2.75	*70*	1.81	*46*	20	*9.1*
10x10x6	*250x250x150*	8.50	216	7.62	*194*	11.25	*286*	9.87	*251*	2.75	*70*	2.25	*57*	24	*10.9*
10x10x8	*250x250x200*	8.50	216	8.00	*203*	11.25	*286*	10.50	*267*	2.75	*70*	2.50	*64*	28	*12.7*
12x12x4	*300x300x100*	10.00	254	8.12	*206*	13.00	*330*	9.93	*252*	3.00	*76*	1.81	*46*	30	*13.6*
12x12x6	*300x300x150*	10.00	254	8.62	*219*	13.00	*330*	10.87	*276*	3.00	*76*	2.25	*57*	34	*15.4*
12x12x8	*300x300x200*	10.00	254	9.00	*229*	13.00	*330*	11.50	*292*	3.00	*76*	2.50	*64*	38	*17.2*
12x12x10	*300x300x250*	10.00	*254*	9.50	*241*	13.00	*330*	12.25	*311*	3.00	*76*	2.75	*70*	42	*19.1*
14x14x6	*350x350x150*	10.50	*267*	9.62	*244*	14.00	*356*	11.87	*301*	3.50	*89*	2.25	*57*	45	*20.4*
14x14x8	*350x350x200*	10.50	*267*	10.00	*254*	14.00	*356*	12.50	*318*	3.50	*89*	2.50	*64*	50	*22.7*
14x14x10	*350x350x250*	10.50	*267*	10.50	267	14.00	*356*	13.25	*337*	3.50	89	2.75	*70*	55	*24.9*
14x14x12	*350x350x300*	10.50	*267*	11.00	279	14.00	*356*	14.00	356	3.50	*89*	3.00	*76*	60	*27.2*
16x16x6	*400x400x150*	11.50	*292*	10.38	264	15.50	*394*	12.63	*321*	4.00	*102*	2.25	*57*	70	*31.8*
16x16x8	*400x400x200*	11.50	*292*	10.75	273	15.50	*394*	13.25	*337*	4.00	*102*	2.50	*64*	75	*34.0*
16x16x10	*400x400x250*	11.50	*292*	11.12	282	15.50	*394*	13.87	352	4.00	*102*	2.75	*70*	80	*36.3*
16x16x12	*400x400x300*	11.50	*292*	11.62	295	15.50	*394*	14.62	*371*	4.00	*102*	3.00	*76*	85	*38.6*
16x16x14	*400x400x350*	11.50	*292*	11.50	292	15.50	*394*	15.00	*381*	4.00	*102*	3.50	*89*	90	*40.8*

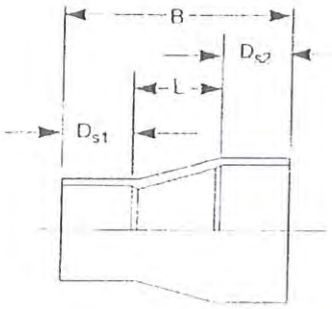
45° flanged laterals



Flanges are filament wound and meet ANSI B16.5 Cl 150 requirements.

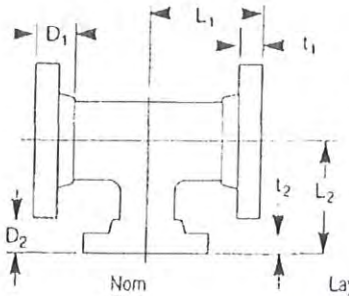
Nom Pipe Size		Laying Length (L_1)		Laying Length (L_2)		Flange Thickness At Face (t)		Flange Thickness At Hub (D)		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
2	*50*	6.44	*164*	11.94	*303*	1.00	*25*	2.00	*51*	9	*4.1*
3	*80*	6.94	*176*	13.94	*354*	1.13	*29*	2.00	*51*	14	*6.4*
4	*100*	6.94	*176*	15.94	*405*	1.25	*32*	2.00	*51*	20	*9.1*
6	*150*	8.25	*210*	19.25	*489*	1.75	*44*	2.38	*60*	34	*15.4*
8	*200*	9.76	*248*	22.75	*578*	2.00	*51*	2.63	*67*	57	*25.9*
10	*250*	10.75	*273*	26.25	*667*	2.00	*51*	2.88	*73*	89	*40.4*
12	*300*	11.75	*298*	30.75	*781*	2.13	*54*	3.13	*80*	136	*61.7*
14	*350*	13.06	*332*	32.00	*813*	2.81	*71*	3.81	*97*	201	*91.2*
16	*400*	14.00	*356*	33.00	*838*	3.25	*83*	4.25	*108*	269	*122.0*

Tapered body reducers



Nom Pipe Size		Overall Length (B)		Laying Length (L)		Socket Depth (D_{S1})		Socket Depth (D_{S2})		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
1½x1	*40x25*	3.56	*90*	1.25	*32*	1.06	*27*	1.25	*32*	0.4	*0.2*
2x1	*50x25*	5.38	*137*	2.50	*64*	1.06	*27*	1.82	*46*	0.6	*0.3*
2x1½	*20x40*	4.32	*110*	1.25	*32*	1.25	*32*	1.82	*46*	1.0	*0.5*
3x2	*80x50*	5.75	*146*	2.12	*54*	1.82	*46*	1.82	*46*	1.4	*0.6*
4x2	*100x50*	6.62	*168*	3.00	*76*	1.82	*46*	1.82	*46*	2.0	*0.9*
4x3	*100x80*	6.50	*165*	2.88	*73*	1.82	*46*	1.82	*46*	2.0	*0.9*
6x3	*150x80*	7.88	*200*	3.81	*97*	1.82	*46*	2.25	*57*	4.0	*1.8*
6x4	*150x100*	7.75	*197*	3.69	*94*	1.82	*46*	2.25	*57*	4.0	*1.8*
8x4	*200x100*	9.75	*248*	5.44	*138*	1.82	*46*	2.50	*64*	7.0	*3.2*
8x6	*200x150*	8.63	*219*	3.88	*99*	2.25	*57*	2.50	*64*	7.0	*3.2*
10x6	*250x150*	9.62	*244*	4.62	*117*	2.25	*57*	2.75	*70*	9.0	*4.1*
10x8	*250x200*	9.37	*238*	4.12	*105*	2.50	*64*	2.75	*70*	8.0	*3.6*
12x8	*300x200*	11.38	*289*	5.88	*149*	2.50	*64*	3.00	*76*	14.0	*6.4*
12x10	*300x250*	11.12	*282*	5.38	*137*	2.75	*70*	3.00	*76*	13.0	*5.9*
14x10	*350x250*	13.50	*343*	7.25	*184*	2.75	*70*	3.50	*89*	36.0	*16.3*
14x12	*350x300*	13.50	*343*	7.00	*178*	3.00	*76*	3.50	*89*	37.0	*16.8*
16x12	*400x300*	13.50	*343*	6.50	*165*	3.00	*76*	4.00	*102*	54.0	*24.5*
16x14	*400x350*	13.50	*343*	6.00	*152*	3.50	*89*	4.00	*102*	57.0	*25.9*

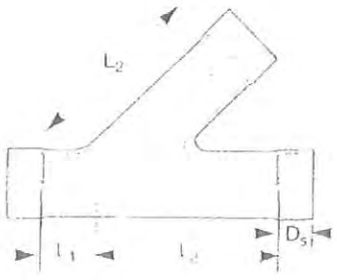
Flanged reducing tees



Flanges are filament wound unless otherwise noted. Molded flanges available in 2- through 12-inch sizes. Fittings with asterisk (*) do not meet ANSI laying lengths. Flange thicknesses with double asterisk (**) represent molded flange dimensions.

Nom Pipe Size		Laying Length (L_1)		Laying Length (L_2)		Flange Thickness At Face (t_1)		Flange Thickness At Hub (D_1)		Flange Thickness At Face (t_2)		Flange Thickness At Hub (D_2)		Approx Wt	
in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		lb • *kg*	
3x3x2	*80x80x50*	5.50	*140*	5.50	*140*	1.13	*29*	2.00	*51*	1.00	*25*	2.00	*51*	10	4.5
4x4x2	*100x100x50*	6.50	*165*	6.50	*165*	1.25	*32*	2.00	*51*	1.00	*25*	2.00	*51*	15	6.8
		6.50	*165*	6.50	*165*	1.56**	*40*	2.00	*51*	1.00	*25*	2.00	*51*	15	6.8
4x4x3	*100x100x80*	6.50	*165*	6.50	*165*	1.25	*32*	2.00	*51*	1.13	*29*	2.00	*51*	16	7.3
		6.50	*165*	6.50	*165*	1.56**	*40*	2.00	*51*	1.13	*29*	2.00	*51*	16	7.3
6x6x2	*150x150x50*	8.00	*203*	8.00	*203*	1.75	*44*	2.38	*60*	1.00	*25*	2.00	*51*	25	11.3
6x6x3	*150x150x80*	8.00	*203*	8.00	*203*	1.75	*44*	2.38	*60*	1.13	*29*	2.00	*51*	27	12.2
6x6x4	*150x150x100*	8.00	*203*	8.00	*203*	1.75	*44*	2.38	*60*	1.25	*32*	2.00	*51*	29	13.2
		8.00	*203*	8.00	*203*	1.75	*44*	2.38	*60*	1.56**	*40*	2.00	*51*	29	13.2
8x8x3	*200x200x80*	9.00	*229*	9.00	*229*	2.00	*51*	2.63	*67*	1.13	*29*	2.00	*51*	32	14.5
8x8x4	*200x200x100*	9.00	*229*	9.00	*229*	2.00	*51*	2.63	*67*	1.25	*32*	2.00	*51*	37	16.8
8x8x6	*200x200x150*	9.00	*229*	9.00	*229*	2.00	*51*	2.63	*67*	1.75	*44*	2.38	*60*	42	19.1
		9.00	*229*	9.00	*229*	2.00	*51*	2.63	*67*	1.56**	*40*	2.00	*51*	43	19.5
10x10x4	*250x250x100*	11.00	*279*	11.00	*279*	2.00	*51*	2.86	*73*	1.25	*32*	2.00	*51*	50	22.7
		11.00	*279*	11.00	*279*	2.00	*51*	2.88	*73*	1.56**	*40*	2.00	*51*	50	22.7
10x10x6	*250x250x150*	11.00	*279*	11.00	*279*	2.00	*51*	2.88	*73*	1.75	*44*	2.38	*60*	57	25.9
10x10x8	*250x250x200*	11.00	*279*	11.00	*279*	2.00	*51*	2.88	*73*	2.00	*51*	2.00	*51*	64	29.0
12x12x4	*300x300x100*	12.00	*305*	12.00	*305*	2.13	*54*	3.13	*80*	1.25	*32*	2.00	*51*	75	34.0
		12.00	*305*	12.00	*305*	2.13	*54*	3.13	*80*	1.56**	*40*	2.00	*51*	75	34.0
12x12x6	*300x300x150*	12.00	*305*	12.00	*305*	2.13	*54*	3.13	*80*	1.75	*44*	2.38	*60*	85	38.6
12x12x8	*300x300x200*	12.00	*305*	12.00	*305*	2.13	*54*	3.13	*80*	2.00	*51*	2.63	*67*	95	43.1
12x12x10	*300x300x250*	12.00	*305*	12.00	*305*	2.13	*54*	3.13	*80*	2.00	*51*	2.88	*73*	105	47.6
14x14x6	*350x350x150*	18.00*	*457*	14.39	*366*	2.81	*71*	3.81	*97*	1.75	*44*	2.38	*60*	155	70.3
14x14x8	*350x350x200*	18.00*	*457*	15.25	*387*	2.81	*71*	3.81	*97*	2.00	*51*	2.63	*67*	170	77.1
14x14x10	*350x350x250*	18.00*	*457*	16.25	*413*	2.81	*71*	3.81	*97*	2.00	*51*	2.88	*73*	185	83.9
14x14x12	*350x350x300*	18.00*	*457*	17.25	*438*	2.81	*71*	3.81	*97*	2.13	*54*	3.13	*80*	200	90.7
16x16x6	*400x400x150*	20.00*	*508*	15.12	*384*	3.25	*83*	4.25	*108*	1.75	*44*	2.38	*60*	200	90.7
16x16x8	*400x400x200*	20.00*	*508*	16.00	*406*	3.25	*83*	4.25	*108*	2.00	*51*	2.63	*67*	215	97.5
16x16x10	*400x400x250*	20.00*	*508*	16.88	*429*	3.25	*83*	4.25	*108*	2.00	*51*	2.88	*73*	230	104.3
16x16x12	*400x400x300*	20.00*	*508*	17.88	*454*	3.25	*83*	4.25	*108*	2.13	*54*	3.13	*80*	245	111.1
16x16x14	*400x400x350*	20.00*	*508*	19.06	*484*	3.25	*83*	4.25	*108*	2.81	*71*	3.61	*27*	260	117.9

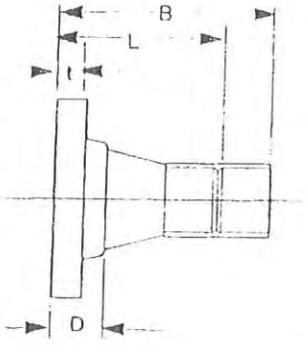
45° laterals



Nom Pipe Size		Laying Length (L_1)		Laying Length (L_2)		Socket Depth (D_5)		Approx Wt	
in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		lb • *kg*	
2	*50*	2.50	*64*	8.00	*203*	1.82	*46*	4	*1.8*
3	*80*	3.00	*76*	10.00	*254*	1.82	*46*	7	*3.2*
4	*100*	3.00	*76*	12.00	*305*	1.82	*46*	9	*4.1*
6	*150*	3.50	*89*	14.50	*368*	2.25	*57*	15	*6.8*
8	*200*	4.50	*114*	17.50	*445*	2.50	*64*	27	*12.2*
10	*250*	5.00	*127*	20.50	*521*	2.75	*70*	47	*21.3*
12	*300*	5.50	*140*	24.50	*622*	3.00	*76*	67	*30.4*
14	*350*	5.50	*140*	24.50	*622*	3.50	*89*	87	*39.5*
16	*400*	5.50	*140*	24.50	*622*	4.00	*102*	110	*49.9*

Combination reducers (flanged large end)

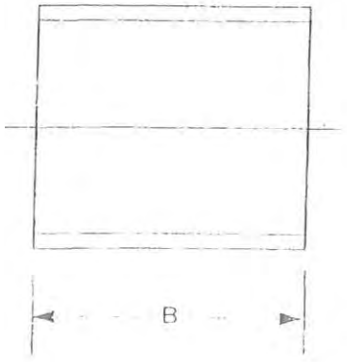
Standard flanges are filament wound. Molded flanges available in 2- through 12-inch sizes.



Nom Pipe Size		Laying Length* (L)		Overall Length (B)		Flange Thickness At Face (t)		Flange Thickness At Hub (D)		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
3x2	*80x50*	6.25	*159*	8.06	*205*	1.00	*25*	2.00	*51*	7	*3.2*
4x2	*100x50*	7.25	*184*	9.06	*230*	1.00	*25*	2.00	*51*	8	*3.6*
4x3	*100x80*	7.25	*184*	9.06	*230*	1.13	*29*	2.00	*51*	9	*4.1*
6x3	*150x80*	9.25	*235*	11.25	*286*	1.13	*29*	2.00	*51*	11	*5.0*
6x4	*150x100*	9.25	*235*	11.25	*286*	1.25	*32*	2.00	*51*	13	*5.9*
8x4	*200x100*	11.25	*286*	13.75	*349*	1.25	*32*	2.00	*51*	15	*6.8*
8x6	*200x150*	11.25	*286*	13.75	*349*	1.75	*44*	2.38	*60*	17	*7.7*
10x6	*250x150*	12.25	*311*	15.00	*381*	1.75	*44*	2.38	*60*	19	*8.6*
10x8	*250x200*	12.25	*311*	15.00	*381*	2.00	*51*	2.63	*67*	26	*11.8*
12x8	*300x200*	14.25	*362*	17.25	*438*	2.00	*51*	2.63	*67*	29	*13.2*
12x10	*300x250*	14.25	*362*	17.25	*438*	2.00	*51*	2.88	*73*	34	*15.4*
14x10	*350x250*	16.13	*410*	19.88	*505*	2.00	*51*	2.88	*73*	39	*17.7*
14x12	*350x300*	16.13	*410*	19.88	*505*	2.13	*54*	3.81	*97*	47	*21.3*
16x12	*400x300*	18.13	*461*	22.38	*568*	2.13	*54*	4.25	*108*	54	*24.5*
16x14	*400x350*	18.38	*467*	22.38	*568*	2.81	*71*	4.25	*108*	66	*29.9*

* Laying length is measured from contact surface to pipe stop in Quick Lock bell.

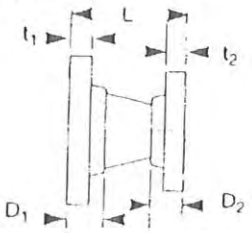
Pipe nipples



Nom Pipe Size		Overall Length (B)		Approx Wt	
in.•	*mm*	in.•	*mm*	lb.•	*kg*
1	*25*	2.25	*57*	0.1	*0.0*
1½	*40*	2.62	*67*	0.2	*0.1*
2	*50*	3.75	*95*	0.2	*0.1*
3	*80*	3.75	*95*	0.3	*0.1*
4	*100*	3.75	*95*	0.5	*0.2*
6	*150*	4.62	*117*	0.9	*0.4*
8	*200*	5.12	*130*	1.4	*0.6*
10	*250*	5.62	*143*	1.9	*0.9*
12	*300*	6.12	*155*	2.4	*1.1*
14	*350*	7.25	*184*	6.7	*3.0*
16	*400*	8.25	*210*	9.7	*4.4*

Flanged tapered body reducers

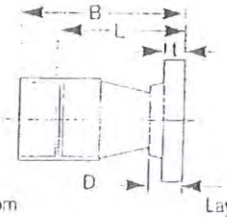
Flanges are filament wound. Flanges in 2-, 3- and 4-inch sizes are available only in heavy-duty (hubless) configuration. Molded flanges available in 2- through 12-inch sizes. Fittings with asterisk (*) meet ANSI laying lengths.



Nom Pipe Size		Laying Length (L)		Flange Thickness At Face (t_1)		Flange Thickness At Hub (D_1)		Flange Thickness At Face (t_2)		Flange Thickness At Hub (D_2)		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
1½x1	*40x25*	6.50	*165*	1.38	*35*	1.38	35	1.13	29	1.13	29	4	1.8
2x1	*50x25*	8.75	*222*	1.00	*25*	2.00	51	1.13	29	1.13	29	5	2.3
2x1½	*20x40*	8.00	*203*	1.00	*25*	2.00	51	1.38	35	1.38	35	6	2.7
3x2*	*80x50*	6.00	*152*	1.13	*29*	2.00	51	1.00	25	2.00	51	9	4.1
4x2*	*100x50*	7.00	*178*	1.25	*32*	2.00	51	1.00	25	2.00	51	10	4.5
4x3*	*100x80*	7.00	*178*	1.25	*32*	2.00	51	1.13	29	2.00	51	11	5.0
6x3*	*150x80*	9.00	*229*	1.75	*44*	2.38	60	1.13	29	2.00	51	15	6.8
6x4*	*150x100*	9.00	*229*	1.75	*44*	2.38	60	1.25	32	2.00	51	17	7.7
8x4*	*200x100*	11.00	*279*	2.00	*51*	2.63	67	1.25	32	2.00	51	21	9.5
8x6*	*200x150*	11.00	*279*	2.00	*51*	2.63	67	1.75	44	2.38	60	23	10.4
10x6*	*250x150*	12.00	*305*	2.00	*51*	2.88	73	1.75	44	2.38	60	28	12.7
10x8*	*250x200*	12.00	*305*	2.00	*51*	2.88	73	2.00	51	2.63	67	35	15.9
12x8*	*300x200*	14.00	*356*	2.13	*54*	3.13	80	2.00	51	2.63	67	45	20.4
12x10*	*300x250*	14.00	*356*	2.13	*54*	3.13	80	2.00	51	2.88	73	50	22.7
14x10*	*350x250*	16.00	*406*	2.81	*71*	3.81	97	2.00	51	2.88	73	73	33.1
14x12*	*350x300*	16.00	*406*	2.81	*71*	3.81	97	2.13	54	3.13	80	84	38.1
16x12*	*400x300*	18.00	*457*	3.25	*83*	4.25	108	2.13	54	3.13	80	100	45.4
16x14*	*400x350*	18.00	*457*	3.25	*83*	4.25	108	2.81	71	3.81	97	115	52.2

Combination reducers (flanged small end)

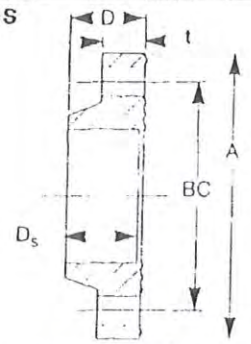
Flanges are filament wound with tapered body. Molded flanges available in 2- through 12-inch sizes.



Nom Pipe Size		Laying Length* (L)		Overall Length (B)		Flange Thickness At Face (t)		Flange Thickness At Hub (D)		Approx Wt	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	lb.•	*kg*
3x2	80x50	6.25	159	8.06	205	1.13	29	2.00	51	8	3.6
4x2	100x50	7.25	184	9.06	230	1.25	32	2.00	51	9	4.1
4x3	100x80	7.25	184	11.06	281	1.25	32	2.00	51	10	4.5
6x3	150x80	9.25	235	11.06	281	1.75	44	2.38	60	13	5.9
6x4	150x100	9.25	235	11.06	281	1.75	44	2.38	60	14	6.4
8x4	200x100	11.25	286	13.06	332	2.00	51	2.63	67	18	8.2
8x6	200x150	11.25	286	13.50	343	2.00	51	2.63	67	19	8.6
10x6	250x150	12.25	311	14.50	368	2.00	51	2.88	73	24	10.9
10x8	250x200	12.25	311	14.75	375	2.00	51	2.88	73	29	13.2
12x8	300x200	14.25	362	16.75	425	2.13	54	3.13	80	39	17.7
12x10	300x250	14.25	362	17.00	432	2.13	54	3.13	80	41	18.6
14x10	350x250	16.13	410	19.88	505	2.82	72	3.81	97	59	26.8
14x12	350x300	16.13	410	19.13	486	2.82	72	3.81	97	56	25.4
16x12	400x300	18.13	461	21.13	537	3.25	83	4.25	108	78	35.4
16x14	400x350	18.38	467	21.38	556	3.25	83	4.25	108	82	37.2

*Laying lengths measured from face surface to pipe stop in 2-inch socket.

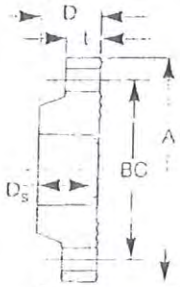
Flanges



Filament-wound and molded flanges correspond to ANSI B16.5 Cl. 150 classification. Sealing ring thicknesses for 1- and 1½-inch flanges are 0.035; for 2- through 8-inch flanges, 0.047; and for 10- through 16-inch flanges, 0.060, respectively. Molded flanges are indicated with an asterisk (*). See **Assembly Instructions for Bondstrand fiberglass flanges, FP196**, for recommendations on gasket selection, nut and washer dimensions, bolt lengths and torques, and tightening sequences.

Nom Pipe Size	Flange Dia (A)	Bolt Circle (BC)	Laying Length (L)	Flange Thickness At Hub (D)	Flange Thickness At Face (t)	Socket Depth (D_S)	Hole Count	Hole Dia	Bolt Dia	Approx Wt
in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*		in.• *mm*	in.• *mm*	lb.• *kg*
1 *25*	4.25 *108*	3.13 *80*	0.063 *2*	– –	– –	1.06 *27*	4	0.63 *16*	0.50 *13*	1 *0.5*
1½ *40*	5.00 *127*	3.88 *99*	0.125 *3*	– –	– –	1.25 *32*	4	0.63 *16*	0.50 *13*	2 *0.9*
2 *50*	6.00 *152*	4.75 *121*	0.188 *5*	2.00 *51*	1.00 *25*	1.82 *46*	4	0.75 *19*	0.63 *16*	2 *0.9*
	6.00* *152*	4.75 *121*	0.188 *5*	2.00 *51*	1.00 *25*	1.82 *46*	4	0.75 *19*	0.63 *16*	2 *0.9*
3 *80*	7.50 *191*	6.00 *152*	0.188 *5*	2.00 *51*	1.13 *29*	1.82 *46*	4	0.75 *19*	0.63 *16*	3 *1.4*
	7.50* *191*	6.00 *152*	0.188 *5*	2.00 *51*	1.13 *29*	1.82 *46*	4	0.75 *19*	0.63 *16*	3 *1.4*
4 *100*	9.00 *229*	7.50 *191*	0.188 *5*	2.00 *51*	1.25 *32*	1.82 *46*	8	0.75 *19*	0.63 *16*	4 *1.8*
	9.00* *229*	7.50 *191*	0.188 *5*	2.00 *51*	1.56 *40*	1.82 *46*	8	0.75 *19*	0.63 *16*	4 *1.8*
6 *150*	11.00 *279*	9.50 *241*	0.125 *3*	2.38 *60*	1.75 *44*	2.25 *57*	8	0.88 *22*	0.75 *19*	7 *3.2*
	11.00* *279*	9.50 *241*	0.125 *3*	2.38 *60*	1.75 *44*	2.25 *57*	8	0.88 *22*	0.75 *19*	7 *3.2*
8 *200*	13.50 *343*	11.75 *298*	0.125 *3*	2.63 *67*	2.00 *51*	2.50 *64*	8	0.88 *22*	0.75 *19*	10 *4.5*
	13.50* *343*	11.75 *298*	0.125 *3*	2.63 *67*	2.00 *51*	2.50 *64*	8	0.88 *22*	0.75 *19*	12 *5.4*
10 *250*	16.00 *406*	14.25 *362*	0.125 *3*	2.88 *73*	2.00 *51*	2.75 *70*	12	1.00 *25*	0.86 *22*	14 *6.4*
	16.00* *406*	14.25 *362*	0.125 *3*	2.88 *73*	2.00 *51*	2.75 *70*	12	1.00 *25*	0.88 *22*	16 *7.3*
12 *300*	19.00 *483*	17.00 *432*	0.125 *3*	3.13 *80*	2.13 *54*	3.00 *76*	12	1.00 *25*	0.88 *22*	22 *10.0*
	19.00* *483*	17.00 *432*	0.125 *3*	3.13 *80*	2.13 *54*	3.00 *76*	12	1.00 *25*	0.88 *22*	27 *12.2*
14 *350*	21.00 *533*	18.75 *476*	0.312 *8*	3.81 *97*	2.81 *71*	3.50 *89*	12	1.12 *28*	1.00 *25*	37 *16.8*
16 *400*	23.50 *597*	21.25 *540*	0.250 *6*	4.25 *108*	3.25 *83*	4.00 *102*	16	1.12 *28*	1.00 *25*	53 *24.0*

Reducing flanges

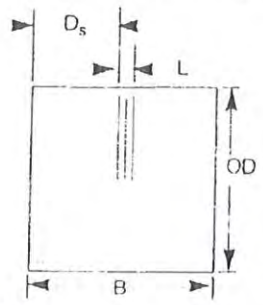


Reducing flanges are of molded construction. See assembly instructions for bolting and gasket recommendations. Use ½-inch drive to avoid wrench socket to flange hub interference while torquing bolts.

Nom Pipe Size	Flange Dia (A)	Bolt Circle (BC)	Laying Length (L)	Flange Thickness At Hub (D)	Flange Thickness At Face (t)	Socket Depth (D_S)	Hole Count	Hole Dia (F)	Bolt Dia	Approx Wt
in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*	in.• *mm*		in.• *mm*	in.• *mm*	lb.• *kg*
2x1½ *50x40*	5.00 *127*	3.88 *99*	0.50 *13*	2.38 *60*	2.38 *60*	0.63 *16*	4	1.88 *48*	0.50 *13*	2 *0.9*
3x2 *80x50*	7.50 *191*	6.00 *152*	0.12 *3*	1.93 *49*	1.12 *28*	0.75 *19*	4	1.81 *46*	0.63 *16*	3 *1.4*
4x2 *100x50*	9.00 *229*	7.50 *191*	0.12 *3*	1.93 *49*	1.25 *32*	0.75 *19*	8	1.81 *46*	0.63 *16*	6 *2.7*
4x3 *100x80*	9.00 *229*	7.50 *191*	0.12 *3*	1.93 *49*	1.25 *32*	0.75 *19*	8	1.81 *46*	0.63 *16*	5 *2.3*
6x3 *150x80*	11.00 *279*	9.50 *241*	0.69 *18*	2.50 *64*	1.75 *44*	0.88 *22*	8	1.81 *46*	0.75 *19*	12 *5.4*
6x4 *150x100*	11.00 *279*	9.50 *241*	0.69 *18*	2.50 *64*	1.75 *44*	0.88 *22*	8	1.81 *46*	0.75 *19*	11 *5.0*
8x4 *200x100*	13.50 *343*	11.75 *298*	0.94 *24*	2.75 *70*	2.00 *51*	0.88 *22*	8	1.81 *46*	0.75 *19*	21 *9.5*
8x6 *200x150*	13.50 *343*	11.75 *298*	0.50 *13*	2.75 *70*	2.00 *51*	0.88 *22*	8	2.25 *57*	0.75 *19*	17 *7.7*
10x6 *250x150*	16.00 *406*	14.25 *362*	0.75 *19*	3.00 *76*	2.00 *51*	1.00 *25*	12	2.25 *57*	0.88 *22*	29 *13.2*
10x8 *250x200*	16.00 *406*	14.25 *362*	0.50 *13*	3.00 *76*	2.00 *51*	1.00 *25*	12	2.50 *64*	0.88 *22*	24 *10.9*
12x8 *300x200*	19.00 *483*	17.00 *432*	0.75 *19*	3.25 *83*	2.12 *54*	1.00 *25*	12	3.00 *76*	0.88 *22*	43 *19.5*
12x10 *300x250*	19.00 *483*	17.00 *432*	0.50 *13*	3.25 *83*	2.12 *54*	1.00 *25*	12	3.00 *76*	0.88 *22*	36 *16.3*

Couplings and end caps

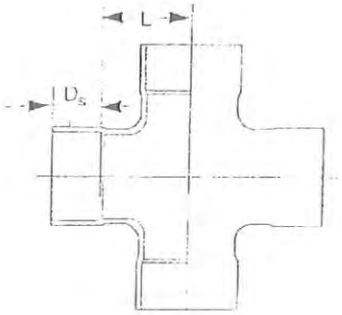
Couplings are filament wound. End caps consist of filament-wound couplings with molded plugs bonded in.



Nom Pipe Size		Overall Length (B)		Socket Depth (D_S)		Outside Dia (OD)		Pipe Stop (L)		Approx Wt Cplg		Approx Wt Cap	
in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		lb. • *kg*		lb. • *kg*	
1	*25*	2.50	*64*	1.06	*27*	1.62	*41*	0.38	*10*	0.2	*0.1*	0.9	*0.4*
1½	*40*	2.88	*73*	1.25	*32*	2.31	*59*	0.38	*10*	0.3	*0.1*	1.0	*0.5*
2	*50*	4.00	*102*	1.81	*46*	2.81	*71*	0.38	*10*	0.6	*0.3*	1.2	*0.5*
3	*80*	4.00	*102*	1.81	*46*	3.94	*100*	0.38	*10*	0.9	*0.4*	2.2	*1.0*
4	*100*	4.00	*102*	1.81	*46*	5.06	*129*	0.38	*10*	1.4	*0.6*	3.4	*1.5*
6	*150*	4.88	*124*	2.25	*57*	7.19	*183*	0.38	*10*	2.4	*1.1*	8.4	*3.8*
8	*200*	5.38	*137*	2.50	*64*	9.25	*235*	0.38	*10*	4.0	*1.8*	14.0	*6.4*
10	*250*	5.88	*149*	2.75	*70*	11.38	*289*	0.38	*10*	5.0	*2.3*	22.0	*10.0*
12	*300*	6.38	*162*	3.00	*76*	13.38	*340*	0.38	*10*	7.0	*3.2*	22.0	*10.0*
14	*350*	7.75	*197*	3.50	*89*	14.69	*373*	0.75	*19*	12.0	*5.4*	–	–
16	*400*	8.75	*222*	4.00	*102*	16.94	*430*	0.75	*19*	14.0	*6.4*	–	–

Crosses

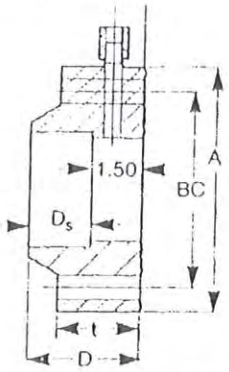
Crosses are filament wound. Mitered crosses are available in 14- and 16-inch sizes. Contact Ameron for dimensions and pressure ratings.



Nom Pipe Size		Laying Length (L)		Socket Depth (D_S)		Approx Wt	
in. • *mm*		in. • *mm*		in. • *mm*		lb. • *kg*	
2	*50*	2.50	*64*	1.81	*46*	3	*1.4*
3	*80*	3.38	*86*	1.81	*46*	6	*2.7*
4	*100*	4.12	*105*	1.81	*46*	7	*3.2*
6	*150*	5.62	*143*	2.25	*57*	13	*5.9*
8	*200*	7.00	*178*	2.50	*64*	23	*10.4*
10	*250*	8.50	*216*	2.75	*70*	37	*16.8*
12	*300*	10.00	*254*	3.00	*76*	61	*27.7*

Orifice flanges

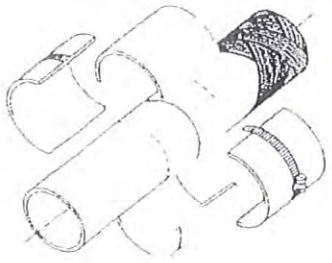
Orifice flanges are filament-wound.



Nom Pipe Size		Flange Dia (A)		Bolt Circle (BC)		Flange Thickness Maximum (D)		Flange Thickness Minimum (t)		Socket Depth (D_S)		Hole Count	Hole Dia		Bolt Dia		Approx Wt	
in.	*mm*	in.	*mm*	in.	*mm*	in.	*mm*	in.	*mm*	in.	*mm*		in.	*mm*	in.	*mm*	lb.	*kg*
2	*50*	6.00	*152*	4.75	*121*	3.38	*86*	2.38	*60*	1.82	*46*	4	0.75	*19*	0.63	*16*	3	*1.4*
3	*80*	7.50	*191*	6.00	*152*	3.38	*86*	2.50	*64*	1.82	*46*	4	0.75	*19*	0.63	*16*	5	*2.3*
4	*100*	9.00	*229*	7.50	*191*	3.38	*86*	2.63	*67*	1.82	*46*	8	0.75	*19*	0.63	*16*	7	*3.2*
6	*150*	11.00	*279*	9.50	*241*	3.75	*95*	2.94	*75*	2.25	*57*	8	0.88	*22*	0.75	*19*	11	*5.0*
8	*200*	13.50	*343*	11.75	*298*	4.00	*102*	3.19	*81*	2.50	*64*	8	0.88	*22*	0.75	*19*	17	*7.7*
10	*250*	16.00	*406*	14.25	*362*	4.25	*108*	3.25	*83*	2.75	*70*	12	1.00	*25*	0.88	*22*	24	*10.9*
12	*300*	19.00	*483*	17.00	*432*	4.50	*114*	3.50	*89*	3.00	*76*	12	1.00	*25*	0.88	*22*	36	*16.3*
14	*350*	21.00	*533*	18.75	*476*	5.00	*127*	4.00	*102*	3.50	*89*	12	1.12	*28*	1.00	*25*	49	*22.2*
16	*400*	23.50	*597*	21.25	*540*	5.50	*140*	4.50	*114*	4.00	*102*	16	1.12	*28*	1.00	*25*	57	*25.9*

Maintenance couplings

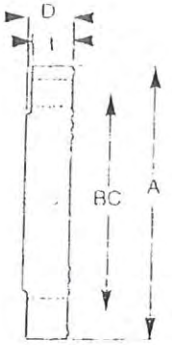
Bondstrand maintenance coupling kits include inner and outer sections, hose clamp(s), and instructions for assembly (**Bondstrand Installation Maintenance Coupling**, FP199). Adhesive must be ordered separately.



Nom Pipe Size		Overall Length		Pressure Rating		Adhesive Kits Required
in.	*mm*	in.	*mm*	psi	N/m^2	6 oz.
1	*25*	2.50	*64*	150	$1.03x10^6$	½
1½	*40*	3.00	*76*	150	$1.03x10^6$	1
2	*50*	4.00	*102*	150	$1.03x10^6$	1
3	*80*	4.00	*102*	150	$1.03x10^6$	1
4	*100*	4.00	*102*	150	$1.03x10^6$	2
6	*150*	4.88	*124*	150	$1.03x10^6$	2
8	*200*	5.38	*137*	150	$1.03x10^6$	3
10	*250*	5.88	*149*	150	$1.03x10^6$	4
12	*300*	6.38	*162*	150	$1.03x10^6$	4
14	*350*	7.38	*187*	150	$1.03x10^6$	6
16	*400*	8.38	*213*	150	$1.03x10^6$	8

Blind flanges

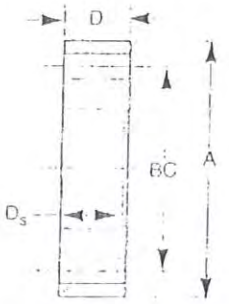
Blind flanges are molded.



Nom Pipe Size		Flange Dia (A)		Bolt Circle (BC)		Flange Thickness At Face (D)		At Holes (t)		Hole Count	Hole Dia (F)		Bolt Dia		Approx Wt	
in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*			in. • *mm*		in. • *mm*		lb. • *kg*	
2	50	6.00	152	4.75	121	1.18	30	1.00	25	4	0.75	19	0.63	16	3	1.4
3	80	7.50	191	6.00	152	1.25	32	1.13	29	4	0.75	19	0.63	16	4	1.8
4	100	9.00	229	7.50	191	1.43	36	1.25	32	8	0.75	19	0.63	16	6	2.7
6	150	11.00	279	9.50	241	2.50	64	1.75	44	8	0.88	22	0.75	19	14	6.4
8	200	13.50	343	11.75	298	2.75	70	2.00	51	8	0.88	22	0.75	19	23	10.4
10	250	16.00	406	14.25	362	3.00	76	2.00	51	12	1.00	25	0.88	22	35	15.9
12	300	19.00	438	17.00	432	3.25	83	2.13	54	12	1.00	25	0.88	22	55	24.9

Heavy-duty flanges

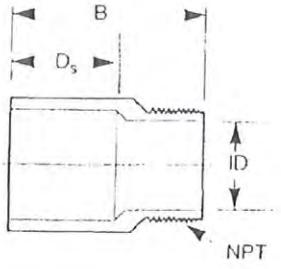
Heavy-duty (hubless) flanges are filament-wound.



Nom Pipe Size		Flange Dia (A)		Bolt Circle (BC)		Laying Length (L)		Flange Thickness (D)		Socket Depth (D_s)		Hole Count	Hole Dia (F)		Bolt Dia		Approx Wt	
in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*		in. • *mm*			in. • *mm*		in. • *mm*		lb. • *kg*	
1	*25*	4.25	*108*	3.13	*80*	0.06	*2*	1.13	*29*	1.06	*27*	4	0.63	*16*	0.50	*13*	1	*0.5*
1½	*40*	5.00	*127*	3.88	*99*	0.13	*3*	1.38	*35*	1.25	*32*	4	0.63	*16*	0.50	*13*	2	*0.9*
2	*50*	6.00	*152*	4.75	*121*	0.19	*5*	1.94	*49*	1.82	*46*	4	0.75	*19*	0.63	*16*	3	*1.4*
3	*80*	7.50	*191*	6.00	*152*	0.19	*5*	1.94	*49*	1.82	*45*	4	0.75	*19*	0.63	*16*	4	1.8
4	*100*	9.00	*229*	7.50	*191*	0.19	*5*	1.94	*49*	1.82	*46*	8	0.75	*19*	0.63	*16*	6	*2.7*
6	*150*	11.00	*279*	9.50	*241*	0.13	*3*	2.33	*60*	2.25	*57*	8	0.88	*22*	0.75	*19*	10	*4.5*
8	*200*	13.50	*343*	11.75	*298*	0.13	*3*	2.53	*67*	2.50	*64*	8	0.88	*22*	0.75	*19*	14	*6.4*
10	*250*	16.00	*406*	14.25	*362*	0.13	*3*	2.88	*73*	2.75	*70*	12	1.00	*25*	0.88	*22*	21	*9.5*
12	*300*	19.00	*483*	17.00	*432*	0.13	*3*	3.13	*80*	3.00	*75*	12	1.00	*25*	0.88	*22*	32	*14.5*
14	*350*	21.00	*533*	18.75	*476*	0.31	*8*	3.81	*97*	3.50	*89*	12	1.12	*28*	1.00	*25*	45	*20.4*
16	*400*	23.50	*597*	21.25	*540*	0.25	*6*	4.25	*108*	4.00	*102*	16	1.12	*28*	1.00	*25*	59	*26.8*

Adapters (threaded and Victaulic)

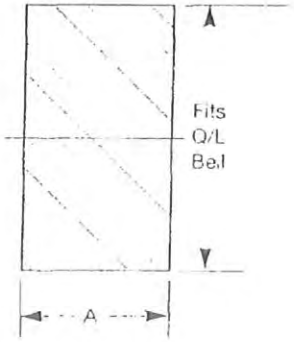
Adapters are available in Quick-Lock bell x NPT threaded male (M), and Quick-Lock bell x Victaulic male end (V) configurations. Sizes 1" (25 mm) and 1½" are filament wound; 2" through 6" are compression molded. Consult manufacturer for dimensions of QL bell x victaulic adapters.



Nom Pipe Size		Overall Length (B)		Socket Depth (D_S)		Inside Dia (ID)		Approx Wt	
in.	*mm*	in.	*mm*	in.	*mm*	in.	*mm*	lb.	*kg*
1	*25*	2.38	*60*	0.87	*22*	0.76	*19*	0.3	*0.1*
1½	*40*	2.81	*71*	1.37	*35*	1.43	*36*	0.4	*0.2*
2	*50*	3.57	*91*	1.81	*46*	1.89	*48*	0.6	*0.3*
3	*80*	4.36	*111*	1.81	*46*	2.80	*71*	1.2	*0.5*
4	*100*	4.63	*118*	1.81	*46*	3.89	*99*	1.6	*0.7*
6	*150*	4.67	*119*	2.25	*57*	5.90	*150*	2.6	*1.2*

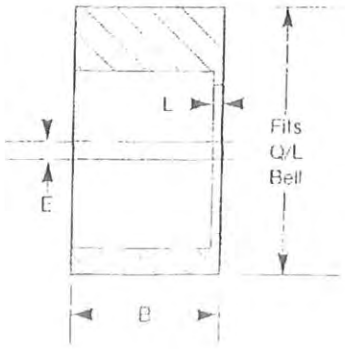
Molded plugs

50 psi maximum



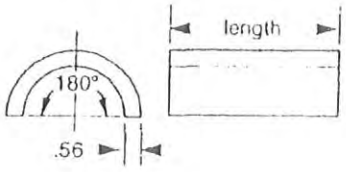
Nom Pipe Size		Total Thickness (T)		Approx Wt	
in.	*mm*	in.	*mm*	lb.	*kg*
2	50	1.94	49	0.6	0.3
3	80	1.94	49	1.3	0.6
4	100	1.94	49	2.0	0.9
6	150	2.38	60	6.0	2.7
8	200	2.63	67	10.0	4.5
10	250	2.88	73	17.0	7.7
12	300	3.13	80	27.0	12.2

Molded reducer bushings



Nom Pipe Size		Overall Length (B)		Pipe Stop (L)		Eccentricity (E)		Approx Wt	
in.	*mm*	in.	*mm*	in.	*mm*	in.	*mm*	lb.	*kg*
3x2	*80X50*	1.94	*49*	0.13	*3*	0.25	*6*	0.7	*0.3*
4x2	*100x50*	1.94	*49*	0.13	*3*	0.75	*19*	1.5	*0.7*
4x3	*100x80*	1.94	*49*	0.13	*3*	0.13	*3*	0.8	*0.4*
6x3	*150x80*	2.38	*60*	0.56	*14*	1.25	*32*	4.1	*1.9*
6x4	*150x100*	2.38	*60*	0.56	*14*	0.63	*16*	3.1	*1.4*
8x4	*200x100*	2.63	*67*	0.81	*21*	1.63	*41*	8.0	*3.6*
8x6	*200x150*	2.63	*67*	0.38	*10*	0.63	*16*	5.0	*2.3*
10x6	*250x150*	2.88	*73*	0.63	*16*	1.63	*41*	12.0	*5.4*
10x8	*250x200*	2.88	*73*	0.38	*10*	0.63	*16*	7.0	*3.2*
12x8	*300x200*	3.13	*80*	0.63	*16*	1.63	*41*	15.0	*6.8*
12x10	*300x250*	3.13	*80*	0.38	*10*	0.63	*16*	8.0	*3.6*

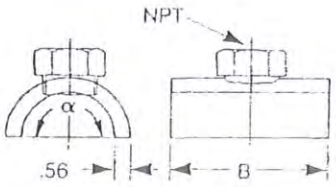
Blank saddles



Blank saddles are filament wound and are used for pipe support and restraint. Thickness for all saddles is 0.56 inches. Available in same lengths as reducing saddles.

Nom Pipe Size		Approx Wt		Adhesive Kits Required	
in.•	*mm*	lb./in.•	*kg/mm*	(3 oz.)	(6 oz.)
1	*25*	0.1	*0.05*	1	
1½	*40*	0.2	*0.09*	1	
2	*50*	0.2	*0.09*	1	
3	*80*	0.3	*0.14*	1	
4	*100*	0.4	*0.18*	1	
6	*150*	0.5	*0.23*	1	
8	*200*	0.6	*0.27*	1	
10	*250*	0.8	*0.36*		1½
12	*300*	1.0	*0.45*		1½
14	*350*	1.1	*0.50*		2
16	*400*	1.2	*0.54*		2

Reducing saddles (bushed outlets)

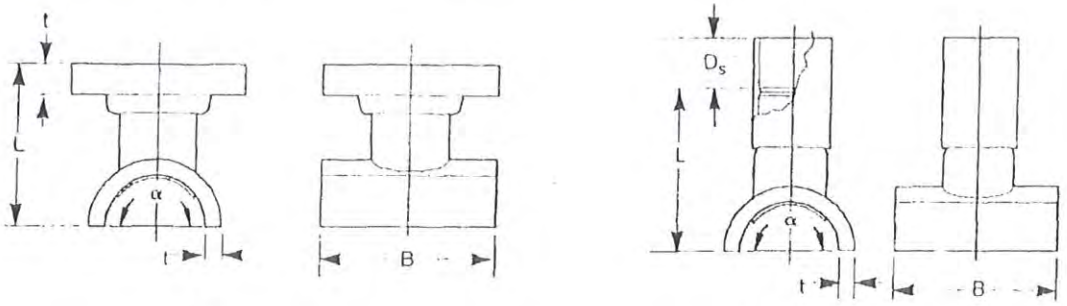


Standard reducing saddles come with 1 1/2-in NPT plastic bushing. All smaller bushings are 316 stainless steel. Other materials available on special order. Saddles are filament wound.

Nom Size		Outlet Nom Size		Length (B)		Saddle Girth (α)	Approx Wt		Adhesive Kits Required	
in.•	*mm*	in.•	*mm*	in.•	*mm*	degrees	lb.•	*kg*	3 oz.	6 oz.
2	*50*	¼, ⅜, ½, ¾	*6, 9, 13, 19*	4.00	*102*	180	1.0	*0.5*	1	
		1	*25*	6.00	*152*	180	2.0	*0.9*	1	
3	*80*	¼	*6*	4.00	*102*	90	1.6	*0.7*	1	
		¼, ⅜, ½, ¾	*6, 9, 13, 19*	4.00	*102*	180	1.6	*0.7*	1	
		1, 1¼, 1½	*25, 30, 40*	6.00	*152*	180	3.9	*1.8*	1	
4	*100*	¼, ⅜	*6, 9*	4.00	*102*	90	2.0	*0.9*	1	
		¼, ⅜, ½, ¾	*6, 9, 13, 19*	4.00	*102*	180	2.0	*0.9*	1	
		1, 1¼, 1½	*25, 30, 40*	6.00	*152*	180	4.0	*1.8*	1	
6	*150*	¼, ⅜, ½	*6, 9, 13*	4.00	*102*	180	2.4	*1.1*	1	
		¼, ⅜, ½, ¾	*6, 9, 13, 19*	4.00	*102*	180	2.4	*1.1*	1	
		1, 1¼, 1½	*25, 30, 40*	6.00	*152*	180	4.6	*2.1*		1
8	*200*	½, ⅜, ½, ¾	*6, 9, 13, 19*	4.00	*102*	90	2.8	*1.3*	1	
		1, 1¼, 1½	*25, 30, 40*	6.00	*152*	180	5.2	*2.4*		1
10	*250*	¼, ½, ½	*6, 9, 13*	4.00	*102*	45	3.8	*1.7*		1
		¾	*19*	4.00	*102*	90	3.8	*1.7*		1
		1, 1¼, 1½	*25, 30, 40*	6.00	*152*	90	6.3	*2.9*		1
12	*300*	¼, ⅜, ½, ¾	*6, 9, 13, 19*	4.00	*102*	45	4.2	*1.9*		1
		1, 1¼, 1½	*25, 30, 40*	6.00	*152*	90	7.4	*3.4*		1
14	*350*	¼, ⅜, ½, ¾	*6, 9, 13, 19*	4.00	*102*	45	4.2	*1.9*		2
		1, 1¼, 1½	*25, 30, 40*	6.00	*152*	90	7.4	*3.4*		2
16	*400*	¼, ⅜, ½, ¾	*6, 9, 13, 19*	4.00	*102*	45	4.2	*1.9*		2
		1, 1¼, 1½	*25, 30, 40*	6.00	*152*	45	7.4	*3.4*		2

Reducing saddles with flanged and Quick-Lock outlets

Both filament-wound and molded flanges are available. Saddles are filament wound. See Quick-Lock coupling table for socket depth, D_S. See Quick-Lock flange table for flange thickness.



Nom Size		Outlet Nom Size		Laying Length (L)		Nominal Thickness (t)		Length (B)		Saddle Girth (α)	Approx Wt (Flg)		(O/L)		Adhesive Kits Required	
in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	in.•	*mm*	degrees	lb.•	*kg*	lb.•	*kg*	3 oz.	6 oz.
03	*80*	1, 1½, 2	*25, 40, 50*	5.25	*133*	0.56	*14*	6.00	*152*	180	4	*1.8*	3	*1.4*	1•	
04	*100*	1, 1½, 2	*25, 40, 50*	6.00	*152*	0.81	*21*	6.00	*152*	180	7	*3.2*	5	*2.3*	1•	
		3	*80*	6.00	*152*	0.81	*21*	9.50	*241*	180	7	*3.2*	5	*2.3*	1•	
06	*150*	1 1½, 2	*25, 40, 50*	7.38	*187*	1.06	*27*	6.00	*152*	180	18	*8.2*	14	*6.4*		1
		3	*80*	7.38	*187*	1.06	*27*	9.50	*241*	180	18	*8.2*	14	*6.4*		1
		4	*100*	7.38	*187*	1.06	*27*	12.00	*305*	180	18	*8.2*	14	*6.4*		1
08	*200*	1, 1½, 2	*25, 40, 50*	8.13	*207*	1.31	*33*	6.00	*152*	90	14	*6.4*	11	*5.0*		1
		3	*80*	8.13	*207*	1.31	*33*	9.50	*241*	180	17	*7.7*	13	*5.9*		1
		4	*100*	8.63	*219*	1.31	*33*	12.00	*305*	180	22	*10.0*	16	*7.3*	1	1
		6	*150*	9.00	*229*	1.31	*33*	17.00	*432*	180	30	*13.6*	21	*9.5*	1	1
10	*250*	1 1½, 2	*25, 40, 50*	9.13	*232*	1.31	*33*	6.00	*152*	90	17	*7.7*	14	*6.4*		2
		3	*80*	9.13	*232*	1.31	*33*	9.50	*241*	90	17	*7.7*	14	*6.4*		2
		4	*100*	9.63	*245*	1.31	*33*	12.00	*305*	180	31	*14.1*	27	*12.2*	1	2
		6	*150*	10.13	*257*	1.31	*33*	17.00	*432*	180	40	*18.1*	35	*15.9*		3
12	*300*	1, 1½, 2	*25, 40, 50*	10.38	*264*	1.31	*33*	6.00	*152*	90	27	*12.2*	23	*10.4*	1	2
		3	*80*	10.38	*264*	1.31	*33*	9.50	*241*	90	27	*12.2*	23	*10.4*	1	2
		4	*100*	10.38	*264*	1.31	*33*	12.00	*305*	90	27	*12.2*	23	*10.4*	1	2
		6	*150*	11.13	*283*	1.31	*33*	17.00	*432*	180	53	*24.0*	46	*20.9*		3
14	*350*	1, 1½, 2	*25, 40, 50*	11.00	*279*	1.31	*33*	6.00	*152*	90	37	*16.8*	35	*15.9*		3
		3	*80*	11.00	*279*	1.31	*33*	9.50	*241*	90	37	*16.8*	35	*15.9*		3
		4	*100*	11.00	*279*	1.31	*33*	12.00	*305*	90	37	*16.8*	35	*15.9*		3
		6	*150*	11.75	*298*	1.31	*33*	17.00	*432*	180	64	*29.0*	49	*22.2*		4
16	*400*	1, 1½, 2	*25, 40, 50*	12.00	*305*	1.31	*33*	6.00	*152*	90	53	*24.0*	41	*18.6*		2
		3	*80*	12.00	*305*	1.31	*33*	9.50	*241*	90	53	*24.0*	41	*18.6*		2
		4	*100*	12.00	*305*	1.31	*33*	12.00	*305*	90	53	*24.0*	41	*18.6*		2
		6	*150*	12.75	*324*	1.31	*33*	17.00	*432*	180	75	*34.0*	61	*30.4*		5

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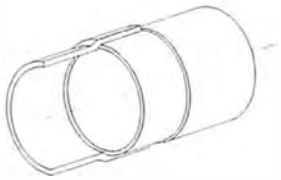
Bondstrand® Installation

FIBERGLASS PIPE GROUP



Installation of Buried Bondstrand Pipe

Introduction

To ensure long life and trouble-free service from a Bondstrand piping system, the principles of excavation, joint make-up, bedding, backfilling and field testing must be properly applied. These principles must be reflected in the phrasing of contract documents and must be enforced through inspection. **Be sure that contractor personnel have been thoroughly trained in Bondstrand assembly procedures by a certified Ameron field representative.**

These recommendations for installing buried Bondstrand pipe are based on two principles:

- Follow Ameron's recommendations for assembling pipe sections and curing the joints carefully.
- Provide evenly distributed support for each section of pipe rather than concentrating the support at points or short stretches of the pipe bottom. Evenly distributed support is achieved through proper bedding.

1 Receiving, storing and handling fiberglass pipe

Bondstrand pipe is manufactured from fiberglass reinforced epoxy or vinyl ester resins. When properly handled and installed, fiberglass pipe and fittings will provide a maintenance-free, high-performance piping system. Fiberglass reinforced pipe and fittings are impact sensitive and **must** be handled with a reasonable amount of care. Refer to the Ameron publication SHIPPING, HANDLING, STORAGE AND INSPECTION OF BONDSTRAND FIBERGLASS PIPE, FP167 for pertinent guidelines and a table of pipe weights.

2 Trench design and excavation

1) The excavation must allow the pipe to be laid to the grades and alignments shown on the plans.

2) Provide the narrowest practical trench width that will allow proper compaction of the pipe zone backfill. The trench must have vertical sidewalls from the foundation to at least the top of the pipe. Maintain a minimum trench width equal to the inside diameter of the pipe plus 12 inches (300 mm). The maximum trench width from the foundation to the top of the pipe must not exceed the inside diameter of the pipe plus 24 inches (600 mm).

3) Beneath vehicular traffic, the height of earth cover over the top of the installed pipe must be no less than 3 feet (.91 m) unless suitable methods are used to protect the pipe. See ROADWAY CROSSINGS below.

4) Provide firm, but not hard foundations consisting of sound earth[1] or granular soil[2], and free from stones or lumps exceeding one inch (25 mm) in greatest dimension that might bear against the pipe. Prepare suitable foundations by overexcavating the trench for not less than 4 inches (100 mm) and backfilling

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2 Trench design and excavation

2 inches (50 mm) to subgrade with loose bank run material, graded uniformly in one plane for the full length of the pipe. Overexcavate at each bell so that the pipe barrel rests on the bottom of the trench. Foundations must provide uniform support under the haunches of the pipe along the full length of each pipe section.

5) When the excavation is in soft or wet, unstable soils that will not provide sufficient support for the pipe, overexcavated the trench at least 6 inches (150 mm) and backfill to 2 inches (50 mm) below subgrade with solid granular soil compacted to at least 85-95% Proctor (40-70% relative density). Then complete the subgrade as described in section 5. The method described in NFPA No. 24 section 8-4.3 under "Exception" is not acceptable for fiberglass pipe.

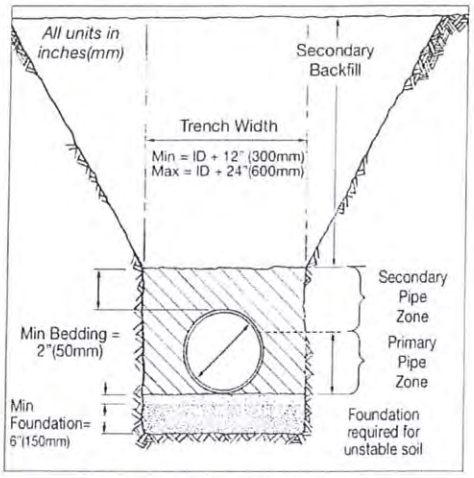


Fig.2. Pipe zone backfill should consist of sound earth or granular material free of stones or lumps exceeding 1 inch (25 mm) in diameter. The material should not contain vegetation or debris that could leave voids upon decomposition. Granular materials such as sand, gravel or crushed rock yield high densities with a minimum of compaction effort and have proven ideal for the pipe zone backfill. Granular materials should pass a ⅜-inch screen and no more than 15% should pass a No. 200 sieve.

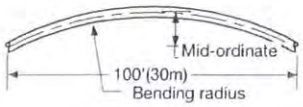
6) When solid rock, hardpan or other hard foundation is encountered during excavation, overexcavate the trench at least 6 inches (150 mm) and backfill to 2 inches (50 mm) below subgrade with solid granular soil compacted to at least 85-95% Proctor (40-70% relative density). Then complete the subgrade as described in section 5.

1) Most native soils, with the exception of highly organic, spongy soils and fat, highly plastic expansive clays.
2) Sand with a maximum particle size of ¼ inch (6 mm) or gravel with a minimum grain size of ¼ inch (6 mm), or pea gravel or crushed rock mixed with sand.

3 Assembling pipe and fittings

1) Prepare and assemble Bondstrand Quick-Lock joints in accordance with the recommendations contained in Ameron publication, FP170. For taper/taper joints to 6 inches (150 mm), consult Ameron publication FP104.

2) Position pipe on 4 x 4 timbers across the trench. Block pipe to hold alignment and prevent lateral movement during cure. For larger diameters, use of come-alongs for joint assembly.



Pipe Diameter		Mid-Ordinate to 100-ft Chord				Bending Radius			
		2000 Series		3000 Series		2000 Series		3000 Series	
(in)	(mm)	(ft)	(m)	(ft)	(m)	(ft)	(m)	(ft)	(m)
2	50	16.5	5.0	19.1	6.0	85	25	75	23
3	80	10.5	3.2	13.4	4.7	125	38	100	30
4	100	8.1	2.5	8.6	2.7	160	48	150	46
6	150	5.3	1.6	6.4	2.0	235	71	200	60
8	200	4.1	1.2	4.0	1.3	305	93	320	98
10	250	3.2	0.9	3.3	1.0	380	116	375	114
12	300	2.7	0.8	2.8	0.9	450	138	450	138
14	350	2.5	0.8	2.2	0.7	495	150	560	170
16	400	2.2	0.7	1.7	0.5	565	172	750	230

1) Curvature may be vertical, horizontal, or a combination. Restraints, if required for alignment control, shall each bear along at least 4 inches (100 mm) of pipe surface.

4 Placing pipe in trench

1) Cure the joints fully before lowering the pipe into the trench. Any vibration or movement of partially cured joints will increase the risk of joint failure.

2) When the joints have cured, raise the pipe slightly to remove the timber supports, using rope or webbed sling to lift the pipe. **Do not use chains.** Lower the pipe into the trench gradually. **Do not drop the pipe.** When working manually, use at least two men for 6-inch (150 mm) pipe and four men for 8 and 10-inch (200 and 250 mm) pipe. Install larger pipe with lifting equipment. Do not lift pipe over 10 inches (250 mm) in diameter or 30 feet (9 m) in length at a single point: use a spreader bar.

4 Placing pipe in trench

3) Should the depth of the trench measured from the top of the supports upon which the pipe is assembled to the trench bottom exceed 5 feet (1.5 m), do not lower the pipe by the method outlined in section 4 as it may overstress the pipe. It is the customer's responsibility to submit specific laying conditions (trench depth, handling equipment, pipe diameter, etc.) to Ameron for recommendations for trench depths in excess of 5 feet (1.5 m).

4) Pipe may be installed in curved trenches provided the curvature is uniform and does not exceed the tabulated values.

5 Bedding and backfill

1) Grade the trench bottom accurately and bed with sand to provide uniform bearing and support along the entire length of each pipe section. Provide a shallow depression for bells and couplings. The grade should not exhibit abrupt changes in direction or slope except at fittings.

2) Do not cover pipe joints until all pressure tests have been performed.

Fill the pipeline with water or use other appropriate means to prevent buried pipe from floating during compaction with water in cohesionless soils.

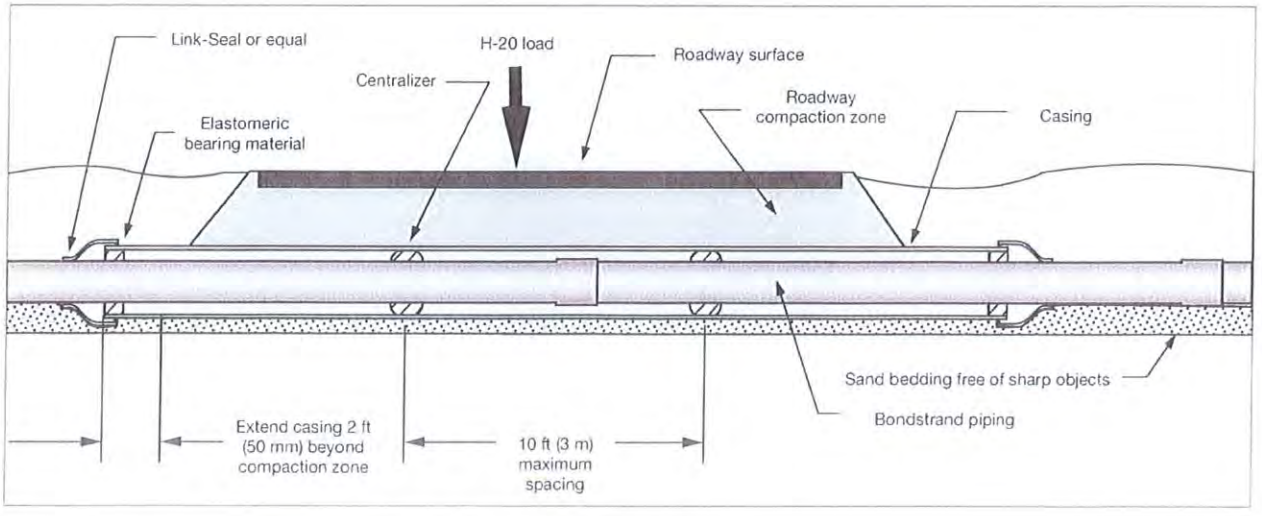
3) Compact the backfill uniformly around the pipe giving particular care to the bedding beneath the haunches of the pipe. Compaction may be done with water if the native soil is free draining. If the native soil is not free draining, bedding with damp sand will facilitate compaction. Extend backfill at least 6 inches (150 mm) above the pipe.

4) Place backfill in 6-inch (150 mm) maximum lifts to a point at least 2 feet (.6 m) above the top of the pipe. Do not use mechanical compactors directly over the pipe until at least 12 inches (300 mm) of fill have been placed over the pipe, or at least 24 inches (600 mm) if heavy compaction equipment is used. Compact each lift to 85% of maximum density as determined in accordance with ASTM D1557 for cohesive soils, or to 70% relative density in accordance with ASTM D2049 for cohesionless soils which fail to produce a well-defined, moisture-density relationship when tested in accordance with ASTM D1557. Avoid damage to pipe wall during compaction. Place the remaining backfill as directed by the engineer. Make in-place tests of soil density in accordance with ASTM D1556 or ASTM D2167. Contact Ameron Applications Engineering for specific information on ASTM specifications.

Mechanical compactors may be used provided harmful shock loads are not transmitted to the pipe. Maintain at least 12 inches (300 mm) between tamping feet and pipe wall to avoid damage to the pipe.

6 Roadway crossings

Where live loads are less than the conventional H20-S16 loading, the burial depth measured from the top of pipe should be at least 3 feet (.91 m) for all diameters. At road crossings where the loading exceeds H20-S16, bury the pipe deeper or use casing pipe and collars or sleeves to protect the pipe. Ameron will make recommendations on increased depth of burial upon request provided complete loading and soil conditions are submitted for an engineering analysis.



7 Hydrostatic thrust

1) It is the responsibility of the engineer to evaluate the need for thrust blocks. A complete evaluation must consider singly and in combination the effects of temperature changes, internal pressure surges and pipeline geometry.

2) Temperature changes produce stress in buried pipe that is restrained by (1) friction of the surrounding bedding, (2) passive soil pressure at fittings, or (3) thrust blocks. Forces developed at fittings in fully restrained pipe are tabulated in Section 8 below.

3) Hydrostatic thrust at fittings is a function of the degree of restraint of the adjacent pipe. *The magnitude of the hydrostatic thrust experienced by a Bondstrand piping system is also a function of the method of construction of the pipe: different values must be used for systems employing reciprocally wound pipe (Series 2000, 2400, 3400, 4000, 5000, 5100 and 7000) and pipe made by the continuous winding process (Series 3000, 3000A, 3200, 3300 and adhesive-bonded oilfield line pipe such as Bondstrand 200, 300, etc). In a fully restrained reciprocally wound Bondstrand fiberglass pipe (i.e., blocked against movement at both ends) with all joints bonded, the Poisson effect produces considerable tension in the pipe wall: as the internal pressure increases, the pipe expands circumferentially and at the same time tries to contract longitudinally. The resulting tensile force in the pipe wall acts to reduce the axial hydrostatic thrust on the fitting by about 50% compared to the thrust experienced in a system using continuously wound Bondstrand pipe.*

The thrust forces acting on a bend are defined as follows:

$T = 2PA \sin \frac{\theta}{2}$ where

T = Thrust at fitting (lb_f)
P = Hydrostatic pressure (psi)
A = Flow area of pipe (in^2)
θ = Angle of bend (deg)

Use this formula for determining thrust in systems employing Series 3000 and related continuously-wound products. To determine hydrostatic thrust in pipe using Series 2000 and related reciprocally-wound piping, use one half the value given by the above formula. Hydrostatic thrusts at fittings in fully restrained systems at 100 psi (7 bar) are tabulated in Appendix A. Thrusts at other pressure may be determined by ratio.

4) Valves should normally be blocked as indicated in section 9.8 (fig. 9.2) to support their own weight, resist thrust and to prevent excessive torque loads on the pipe connections.

5) Thrust blocks are required at hydrants and at 6-inch (150 mm) or larger diameter tees and elbows for firewater mains regulated by Factory Mutual Research Corporation.

8 Thrust due to thermal expansion

Thrust forces arising from thermal expansion of the pipe wall in Series 2000 and related products are tabulated below. The effects of thermal expansion will generally be less in systems employing Series 3000 and related piping since the pipe wall thickness of these latter systems is less than for Series 2000 products.

Pipe Dia		Thrust at Fittings for a 140° ΔT in 2000 Series Piping					
		Tees or Ends		90° Elbows		45° Elbows	
(in)	(mm)	(lb_f)	(kN)	(lb_f)	(kN)	(lb_f)	(kN)
2	50	1,880	8.4	2,660	11.9	1,440	6.4
3	80	2,830	12.6	4,000	17.8	2,170	9.7
4	100	4,550	20.3	6,430	28.7	3,480	15.5
6	150	6,760	30.2	9,560	42.6	5,170	23.1
8	200	9,710	43.3	13,700	61.1	7,430	33.1
10	250	12,200	54.4	17,300	77.2	9,340	28.3
12	300	14,500	64.7	20,500	91.4	11,100	49.5
14	350	17,400	77.6	24,200	108.0	13,200	58.9
16	400	22,000	98.1	27,800	123.6	15,100	67.4

1) Initial temperature = 60°F (15°C)
Operating temperature = 200°F(93°C)

9 Thrust block design and construction

1) Once the anticipated thrusts have been determined, thrust block design must consider soil strength, soil stability and location of the water table. Blocks must (a) have adequate bearing area to resist the soil thrust, (b) bear against undisturbed soil and (c) be so designed that the resultant thrust vector passes perpendicularly through the center of the bearing surface (except for valves as in section 9.8). Should the soil be unstable or the installation below the water table, the engineer must make provisions to ensure stability such as driving piles to anchor to deeper layers of soil. Note that any connecting metallic pipe must be anchored at the point of connection to the fiberglass pipe to prevent transfer of excessive stress.

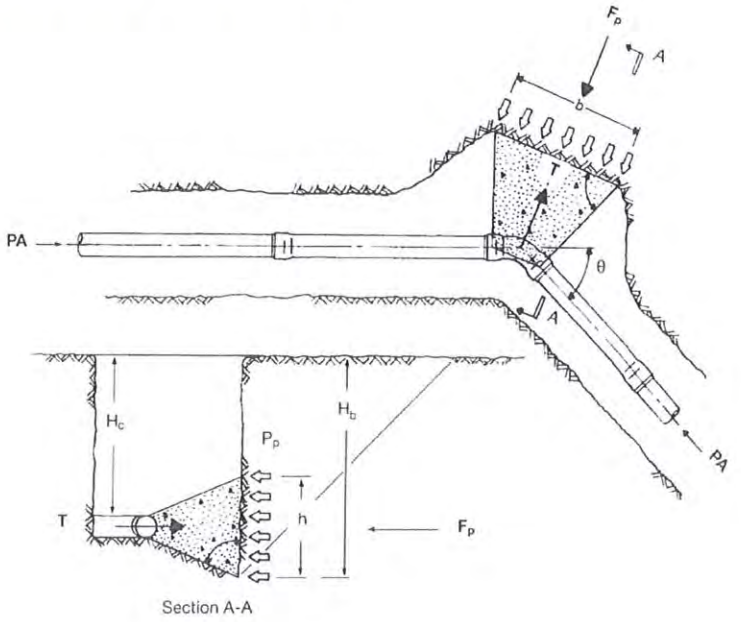


Fig. 9-1 Thrust blocks should be cast with the bearing area against undisturbed native soil.

A	=	Cross sectional area of pipe (in^2)
A_b	=	Block bearing area (ft^2)
b	=	Width of block bearing area (ft)
C_s	=	Soil cohesion factor
D	=	Pipe OD (ft)
f_s	=	Safety factor
F_p	=	Soil thrust (lb_f)
h	=	Height of block bearing area (ft)
H	=	Depth of cover (ft)
H_c	=	Burial depth of pipe (ft)
H_b	=	Depth of block base (ft)
P	=	Operating plus surge pressure (psi)
P_p	=	Passive soil pressure (lb_f/ft^2)
R	=	Soil weight reduction factor
T	=	Thrust force on bend (lb_f)
w	=	Unit soil weight (lb_f/ft^3)
W	=	Soil weight/ft of pipe (lb_f/ft)
θ	=	Pipe bend (deg)
ϕ	=	Soil friction angle (deg)

Formulas:
$T = 2PA \sin\frac{\theta}{2}$ (lb_f)

Existing Condition	Reduction Factor, R
General construction backfill soils compacted to critical void ratio	⅔
Well-compacted backfill and select backfill to critical void ratio	¼

2) Safe bearing pressures for common soil type are tabulated below.

Soil Description	Allowable Soil Bearing Pressure P_p (lb_f/ft^2)	MPa
Rock, hard thick layers	400,000	19.2
Rock, = good masonry	50,000	2.39
Rock, = best brick	30,000	1.44
Rock, = poor brick	10,000	0.48
Clay, always dry	8,000	0.38
Clay, fairly dry	4,000	0.19
Clay, soft	2,000	0.10
Gravel, coarse sand, firm	16,000	0.77
Sand, compact, firm	8,000	0.38
Sand, clean, dry	4,000	0.19
Quicksand, alluvial soil[1]	-	-

1) Piles or tie rods may be required in loose or soft soils, particularly when below the water table.

3) The required bearing area is computed using the formula:

$$A_b = \frac{T}{P_p} \quad \text{where}$$

A_b = Bearing area of thrust block (ft^2)
T = Thrust (lb_f)
P_p = Allowable soil bearing pressure (lb_f/ft^2)

9 Thrust block design and construction

4) ,Thrust blocks for Bondstrand pipe systems should be poured after hydrostatic testing to allow for clear visual inspection of all fitting joints during the test. To retain pipe in proper alignment while testing, placement of sand bedding and backfill per section 5 may be required. Joints should be left exposed for observation during testing.

5) Thrust blocks should be shaped with the "designed bearing area" against native soil of the trench wall. Smaller blocks using a dry mix may be shaped by hand but larger blocks (2 ft^2 or greater) require formwork.

Soil Description	Friction Angle, ϕ (deg)	Cohesion, C_s (lb_f/ft^2)
Well-graded sand		
dry	44.5	0
saturated	39.0	0
Silt (passing 200 sieve)		
dry	40	0
saturated	32	0
Cohesive granular soil		
wet to moist	13-22	385-920
Clay		
wet to moist at max compaction	11.5-16.5	460-1175

6) Unless otherwise specified by the engineer, use a concrete mix consisting of 1 part Portland cement, 2 parts washed sand and 3 parts washed gravel with enough water for a relatively a dry mix. A dry mix is stronger and is easier to shape.

7) Work the concrete thoroughly around the fittings to maximize surface contact. The entire area between the fittings and the freshly cut trench wall must be filled with concrete and be void free. Maintain at least a 2-inch (50 mm) space between concrete vibrators and pipe or fittings as even indirect contact through the concrete aggregate may produce excessive impact loads on the fiberglass pipe.

8) Valve blocks should incorporate the steel necessary to support the weight of the valve and resist any torque loads caused by opening and closing the valve.

9) Thrust blocks should encapsulate crossovers with at least six inches (150 mm) of concrete between fittings and native soil.

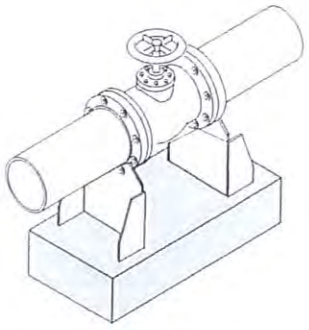


Fig. 9-2. Valves must be independently supported to prevent transfer of torque loads to the fiberglass piping.

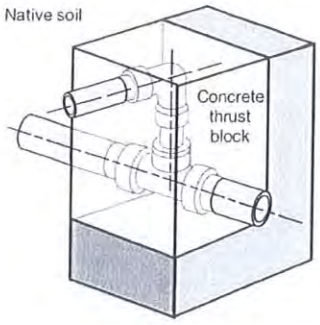


Figure 9-3. Provide encapsulating thrust blocks for crossovers.

10 Manhole penetrations and connections

1) When making penetrations through concrete walls, run Bondstrand pipe through metal pipe sleeves at least two sizes larger in diameter than the pipe. Caulk the space between the sleeve and the pipe with a waterproof compound that dries to a firm but pliable mass.

2) Assemble flanged connections in accordance with the recommendations in ASSEMBLY INSTRUCTIONS FOR BONDSTRAND FIBERGLASS FLANGES, FP196.

3) When connecting fiberglass piping to metallic piping, anchor the metallic line to avoid stress transfer to the fiberglass.

4) Support valves independently of fiberglass piping.

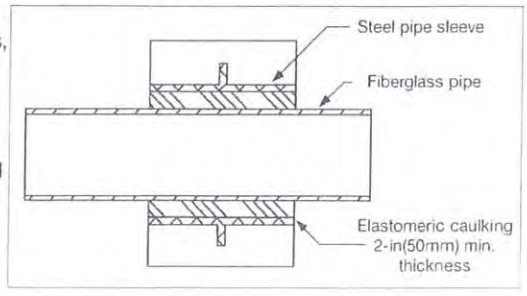


Fig. 10. Typical wall penetration. The fiberglass pipe passes though a metal sleeve two pipe sizes larger than the pipe diameter. The space between pipe and sleeve is sealed with an elastomeric caulking compound.

11 Field testing

1) Pneumatic testing is not recommended for reasons of safety.

2) Use weights on pipe and wood blocking at bends to restrain pipe during test.

3) Displace all free air in the Bondstrand piping system with the test fluid. Provide taps for air and vapor release at all high points in the system.

4) Increase pressure in increments of no more than 50 psi/minute (3 bar/min.).

A Appendix

Hydrostatic Thrust at Reducers at 100 psi[1] in 2000 Series Piping Systems[2]

Reducer Size		Thrust		Reducer Size		Thrust	
(in x in)	(mm x mm)	(lb_f)	(kN)	(in x in)	(mm x mm)	(lb_f)	(kN)
3 x 1½	80 x 40	—	—	10 x 6	250 x 150	2,650	11.8
3 x 2	80 x 50	240	1.0	10 x 8	250 x 200	1,550	6.9
4 x 2	100 x 50	510	2.3	12 x 8	300 x 200	3,350	15.0
4 x 3	100 x 80	270	1.2	12 x 10	300 x 250	1,800	8.0
6 x 3	150 x 80	1,150	5.1	14 x 10	350 x 250	6,000	26.8
6 x 4	150 x 100	880	3.9	14 x 12	350 x 300	2,500	11.2
8 x 4	200 x 100	1,980	8.8	16 x 12	400 x 300	7,000	31.2
8 x 6	200 x 150	1,100	4.9	16 x 14	400 x 350	4,500	20.1

1) In a fully restrained system.
2) Includes Series 2000, 2400, 3400, 4000, 5000, 5100 and 7000.

Hydrostatic Thrust at Reducers at 100 psi[1] in 3000 Series Piping Systems[2]

Reducer Size		Thrust		Reducer Size		Thrust	
(in x in)	(mm x mm)	(lb_f)	(N)	(in x in)	(mm x mm)	(lb_f)	(N)
3 x 1½	80 x 40	—	—	10 x 6	250 x 150	5,300	23.6
3 x 2	80 x 50	470	2.1	10 x 8	250 x 200	3,100	13.8
4 x 2	100 x 50	1,010	4.5	12 x 8	300 x 200	6,700	29.9
4 x 3	100 x 80	540	2.4	12 x 10	300 x 250	3,600	16.1
6 x 3	150 x 80	2,300	10.3	14 x 10	350 x 250	12,000	53.5
6 x 4	150 x 100	1,750	7.8	14 x 12	350 x 300	5,000	22.3
8 x 4	200 x 100	3,950	17.6	16 x 12	400 x 300	14,000	62.4
8 x 6	200 x 150	2,200	9.8	16 x 14	400 x 350	9,000	40.1

1) In a fully restrained system.
2) Includes Series 3000, 3000A, 3200, 3300, Bondstrand 150, 200, 300, 450 and 800.

Thrust at Fittings at 100 psi[1] in 2000 Series Piping Systems[2]

Pipe Dia		Tees or 45° Laterals		90° Elbows		45° Elbows	
(in)	(mm)	(lb_f)	(kN)	(lb_f)	(kN)	(lb_f)	(kN)
2	50	170	.8	245	1.1	130	.6
3	80	405	1.8	575	2.6	310	1.4
4	100	675	3.0	950	4.3	515	2.3
6	150	1,550	6.9	2,200	9.8	1,200	5.4
8	200	2,650	11.8	3,750	16.7	2,050	9.1
10	250	4,200	18.7	5,950	26.5	3,300	37.0
12	300	6,000	26.8	8,450	37.7	4,600	20.5
14	350	7,300	32.6	10,200	45.5	5,500	24.5
16	400	9,500	42.4	13,300	59.3	7,200	32.1

1) In a fully restrained system.
2) Includes Series 2000, 2400, 3400, 4000, 5000, 5100 and 7000.

Thrust at Fittings at 100 psi[1] in 3000 Series Piping Systems[2]

Pipe Dia		Tees or 45° Laterals		90° Elbows		45° Elbows	
(in)	(mm)	(lb_f)	(kN)	(lb_f)	(kN)	(lb_f)	(kN)
2	50	340	1.5	490	2.2	260	1.2
3	80	810	3.6	1,150	5.1	620	2.8
4	100	1,350	6.0	1,900	8.5	1,030	4.6
6	150	3,100	13.8	4,400	19.6	2,400	10.7
8	200	5,300	23.6	7,500	33.5	4,100	18.3
10	250	8,400	37.5	11,900	53.1	6,600	29.4
12	300	12,000	53.5	16,900	75.4	9,200	41.0
14	350	14,600	65.1	20,400	91.0	11,000	49.1
16	400	19,000	84.7	26,600	118.6	14,400	64.2

1) In a fully restrained system.
2) Includes Series 3000, 3000A, 3200, 3300, Bondstrand 150, 200, 300, 450 and 800.

Important notice

This literature and the information and recommendations it contains are based on data reasonably believed to be reliable. However, such factors as variations in environment, application or installation, changes in operating procedures, or extrapolation of data may cause different results. Ameron makes no representation or warranty, expressed or implied, including warranties of merchantability or fitness for purpose, as to the accuracy, adequacy or completeness of the recommendations or information contained herein. Ameron assumes no liability whatsoever in connection with this literature or the information or recommendations it contains.

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Appendix B
Flange Assembly Instructions

These instructions present Ameron's recommendations for the bolted assembly and gasket sealing of epoxy and polyester Bondstrand flanges, filament-wound or molded. Assembly of Bondstrand flanges to steel and other flange materials is also covered. The bonded connection used to mount Bondstrand flanges on pipe is covered by assembly instructions available from Ameron for the particular Bondstrand adhesive being used.

1. Gaskets—Use full-face gaskets of the material thickness and hardness required by the project specifications. If gasket requirements are not specified, choose an elastomer which is suitable for the service pressure, temperatures and chemicals in the system. Ameron recommends the use of a material ⅛ inch thick, with a Shore A durometer hardness of 60 ± 5. Refer to ASTM Specification D 1330 for Sheet Rubber Gaskets, Grade I or II, to establish minimum requirements on physical properties for use with water, except specify a Shore A durometer hardness of 60 ± 5. Refer to Table 5 of ANSI Standard B16.21-1978 for Class 150 full face gasket dimensions other than thickness.

2. Bolts, nuts and washers—The recommended bolts, nuts and washers to be used with Bondstrand flanges conform to ANSI standards as noted in Table 1.

If stud bolts are used, add to the appropriate bolt length given in Table 1 the thickness of a nut plus three threads.

3. Flange assembly—Assemble the joint and finger tighten all nuts. Make sure bolt threads are oiled so that proper torque results are attained. Use washers under both nuts and heads to protect back-facing of Bondstrand flanges.

4. Apply torque increments in sequence—Tighten all nuts in increments following the numerical sequence shown. The idea is to build the pressure uniformly over the entire flange face.

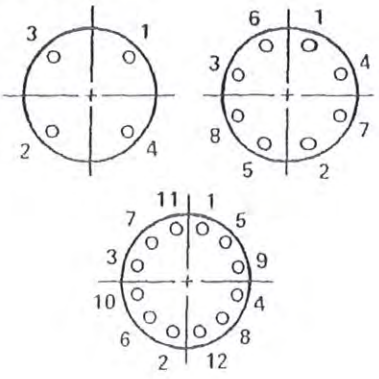

Table 1 Hex Head Bolts[1], Nuts[2] and Plain Washers[3] for Bondstrand Flanges

Flange Size	Bolt Diameter	No. of Bolts	Bolt Length[4] [5] [6] Filament-Wound to Filament-Wound	Filament-Wound to Steel	Molded to Molded	Molded to Steel	Filament-Wound to Molded	Hvy. Duty Filament-Wound to Hvy. Duty Filament-Wound	Hvy. Duty Filament-Wound to Steel	Washer OD[3]	Washer Thickness[3]	Nut Thickness[2]
1½	½	4	—	—	—	4.50	—	—	—	1.06	12	44
2	⅝	4	3.25	3.00	3.25	—	3.25	5.25	4.00	1.31	12	55
3	⅝	4	3.50	3.25	3.75	—	3.75	5.25	4.25	1.31	12	55
4	⅝	8	3.75	3.50	4.25	—	4.00	5.25	4.25	1.31	12	55
6	¾	8	5.00	4.25	5.00	4.25	5.00	—	—	1.47	16	64
8	¾	8	5.50	4.50	5.50	4.50	5.50	—	—	1.47	16	64
10	⅞	12	5.50	4.75	5.50	4.75	5.50	—	—	1.75	16	75
12	⅞	12	5.75	5.00	5.75	5.00	5.75	—	—	1.75	16	75

Notes
1. ANSI B18.2.1, 1972 Regular Hex Head Bolts.
2. ANSI B18.2.2, 1972 Regular Hex Nuts.
3. ANSI B18.22.1-1965 (R1975) Type A, Plain, Narrow Series (same as SAE Standard).
4. Bolt lengths are estimated using Appendix "F" of ANSI B16.5-1977 and include provision for washers under bolt heads and nuts for Bondstrand flanges.
5. Maintain end point clearance of bolts on inside radius of 2-, 3- and 4-inch Bondstrand flanged ANSI 45° elbows by using additional washers or shims under bolt heads as required.
6. Bolt lengths for assemblies including one orifice flange may be estimated by adding 1½ inches to bolt lengths shown in the filament-wound to filament-wound, filament-wound to steel or filament-wound to molded columns depending on whether the mating flange is filament-wound, steel or molded.

Torque should be applied in increments not to exceed those shown in Table 2. (See Paragraph 5 for caution regarding bolting of Bondstrand flanges to other than full-faced flanges.) Proceed through the bolt-tightening sequence as many times as required until the recommended torque is attained.

After each bolt has been tightened to the required torque, recheck the torque on all bolts in the same sequence. Bolts previously tightened may have relaxed as subsequent bolts were tightened. If sealing is not obtained, see Paragraph 6, "Troubleshooting."

5. *Sealing against other flanges*—Ameron offers several flange designs. Without exception they are all suitable for mating with other Bondstrand flanges or with flat-face steel flanges using the bolt torques recommended in Table 2. In addition, all except 4- through 12-inch standard molded flanges can be bolted against valves or raised-face steel flanges to the bolt torques given in Table 2 with a safety factor of at least 1.5 to the minimum failure torque. Always follow these instructions carefully when flanging Bondstrand to raised-face steel flanges, lined pipe and fittings flanges, and wafer valves of all types.

Valves are frequently supplied with sealing devices or details built into the flange facing of the valve. Configuration of these can vary widely. Unless these details are known to seal without a gasket against Bondstrand flanges, the use of the usual full-faced, ⅛-inch thick elastomeric gasket is recommended in addition to such built-in sealing devices or details.

6. *Troubleshooting*—If proper procedures have been followed, no difficulty should be experienced. If troublesome problems occur, try the following suggestions.

a. Loosen and remove all bolts, nuts, washers and gaskets.

b. Check for alignment of assembly. Rebuild to correct alignment if out of alignment.

c. Check flanges for seal ring damage (particularly the rings close to the pipe ID). Flanges with damaged inner seal rings should be replaced.

d. Check the gasket for damage. Replace damaged gasket.

e. Check the surfaces on the raised-face flanges, valve flanges or lined pipe and fittings flanges as the case may be. Clean or repair as needed.

f. Retrace the assembly procedure and sealing should be effected.

Caution: Excess torque can defeat sealing and, if carried high enough, can damage flanges.

Table 2 Bolt Torque for Bondstrand Flanges

Nominal Flange Diameter		Torque Increments		Recommended Torque for Full Pressure Seal	
in.	(mm)	ft-lbs	N-M	ft-lbs	N-M
1½	40	5	7	20	28
2	50	5	7	20	28
3	80	5	7	20	28
4	100	5	7	20	28
6	150	10	14	30	41
8	200	10	14	30	41
10	250	10	14	30	41
12	300	10	14	30	41

Except for 4- through 12-inch standard molded flanges, all Bondstrand flanges have a safety factor to failure torque of 1.5 or greater when bolted in accordance with this procedure against a raised-face steel flange or sleeve-type valve. Standard molded flanges have a safety factor to failure torque of 1.5 or greater when bolted in accordance with this procedure against another Bondstrand flange or against any flat face flange. Standard molded flanges are black or solid gray.

Appendix C
Saddle Mounting Instructions

These instructions describe the proper procedures for mounting Bondstrand filament-wound 180° epoxy saddles on epoxy or vinylester pipe. In addition to mounting simple support saddles, the procedure is also suitable for saddles with metal bushings.

1. Mark the outline of the saddle on the surface of the pipe. Sand the area with an electric belt sander with vacuum dust collector, using belts surfaced with a 40-grit abrasive. Sand until all gloss is removed from pipe surface area to be bonded to saddle.

Danger: Avoid inhaling dust produced by sanding. Provide adequate ventilation or wear OSHA-approved dust respirator.

2. If a hole in the pipe is required, mark and drill the hole opening. Do not use oil or other lubricants for drilling. Make the hole just slightly larger than the outside diameter of the bushing in the prefabricated saddle. A hole saw with a pilot drill and a carbide cutting edge works best for ¾-inch and larger holes, while a standard drill bit for steel will usually suffice for smaller holes. Steel cutting edges of hole saws should have at least 14 teeth per inch to obtain a smooth cut. Use a high-speed heavy duty drill as follows:

Drill Motor Recommendation

Heavy Duty Drill		Hole Saw Size
Size	Min. rpm	
¼-inch	1400	up to 1⅛ inches
⅜-inch	1400	up to 2 inches*
½-inch	1400	up to 2 inches*

*Larger holes are not recommended for general field fabrication.

Examine the inside surface of the pipe around the newly cut hole for cracks in the liner. Chipped or cracked liner material must be sanded off and a thin layer of adhesive added to affected areas in Step 6.

3. Now sand the inside surface of the saddle using a flapper sander. Lightly resand the pipe surface and the edge of the hole, especially if the surface may have been contaminated while drilling the hole. All mating surfaces, plus the edge of the hole, must be clean and dry and must be sanded within two hours of assembly. After sanding, surfaces to be bonded should show a dull, fresh finish —not a polished look.

4. Thoroughly wipe the sanded saddle and pipe surfaces with a clean, dry cloth or use a duster brush to remove dust particles. If surfaces become wet, warm with Bondstrand heating blanket until dry, then resand. Protect the mating surfaces from moisture during wet weather by tenting over the working area. Do not touch the prepared surfaces with bare hands or any article that would leave an oily film.

5. Unless the project specifications or the Bondstrand Chemical Resistance Chart recommend a special adhesive for your particular service, you should use Bondstrand RP-34 Epoxy Adhesive. If a different Bondstrand adhesive is required, simply substitute for the RP-34 an equal quantity of the desired adhesive. Instructions for mixing and using the adhesive are found in the package.

Use the following chart to determine the amount of adhesive required for a saddle 6 inches long.

Adhesive Kits Required to Mount Saddle 6 Inches Long*

	Pipe Diameter						
Kit Size	2	3	4	6	8	10	12
3 fluid oz	1	—	—	1	1	—	—
6 fluid oz	—	1	1	1	1	2	2

*Amount of adhesive required will vary in proportion to length of the saddle.

6. With the wooden stick supplied in the adhesive kit or with a reusable steel spatula, apply enough adhesive to completely cover the mating surfaces of both pipe and saddle and a thin layer to the hole edge in the pipe. Then add a liberal amount of adhesive in the central area of the pipe mating surface so that excess adhesive will be forced to flow from the central area to the saddle edges when the saddle and pipe are banded in Step 7. If saddle is to be mounted over a hole, avoid excess flow toward hole by placing the excess adhesive around the hole and about halfway between the hole and the edge of the saddle.

7. Push the saddle into place. Draw it tightly against the pipe using a ½-inch wide steel strap at each end of the saddle. Remove excess adhesive for craftsmanlike appearance. (Straps may be left in place if desired after the adhesive has cured.)

8. Heat cure the adhesive using Ameron heating blankets. Use two blankets for saddle reductions. Cure time required is 15 minutes more than used for standard Quick-Lock pipe joints. Wrap heating blankets as indicated in Bondstrand assembly instructions found in the adhesive package, making certain that any overlap of the blanket covers the thermostat.

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Bondstrand® Installation

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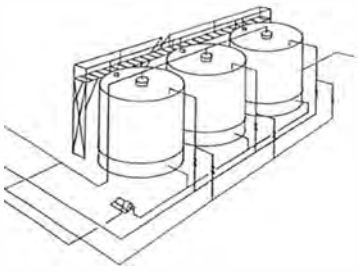
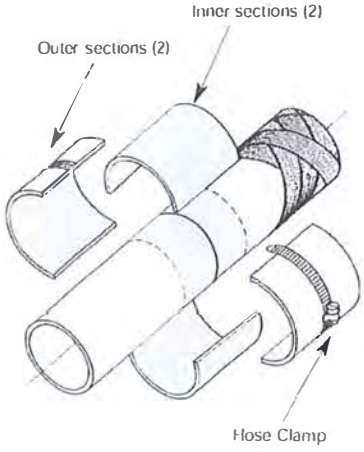


Maintenance Coupling

Assembly instructions for butt-end joints and repair

Instructions



Areas to be sanded and adhesive applied

1. Cutting the pipe — Before cutting the replacement length of pipe, allow the temperature of the existing system to stabilize to avoid length changes through expansion or contraction. Measure the replacement piece carefully so that the space between its ends and the ends of the pipe in the existing system will be no more than ⅛ inch.

2. Positioning the coupling — Center the maintenance coupling over the joint and mark the lap length on the pipe ends. Sand the pipe ends with a belt sander using belts with a 40-grit abrasive. Sand inaccessible areas with a flapper sander or by hand using a "shoeshine" method. Sand until all gloss is removed from surfaces to be bonded. Sand the cut ends of the pipe as well.

3. Checking for snugness of fit — Fit the parts together dry before final sanding. The 180° inner sections placed around the pipe ends should, when held in contact on one side, show from 0 to ⅛ inch separation on the opposite side. If, with zero separation, the inner sections are not snug against the pipe surfaces, file back an edge as required to get a snug fit. If the sections, when fitted snugly, show a separation of more than ⅛ inch, correct any misalignment of pipe ends and sand to fit. The outer sections of the coupling should show ⅛ inch or more of separation.

4. Final sanding — All mating surfaces must be clean and dry and must be sanded within two hours of assembly. Sand using a ¼-inch drill motor at 1700-2000 rpm and a flapper type sander with a 40- 50 grit aluminum oxide abrasive, available from Ameron. After sanding, bonding surfaces should show a dull fresh finish, not a polished look.

Use special care in handling parts to avoid contamination. Handle the parts with new gloves which are used only for this purpose or with clean, dry cotton cloths.

If the bonding surfaces are wet, warm them with a Bondstrand heating blanket until dry, then resand. Protect the bonding surfaces from moisture during wet weather with tenting over the work area.

5. Selecting the adhesive — Unless the project specifications or the Bondstrand Corrosion Guide (FP132) recommends a special adhesive for your particular service, use Bondstrand PSX™34 epoxy adhesive. Instructions for mixing and using the adhesive are in the adhesive kit.

Larger couplings are more difficult to handle and assemble; once the adhesive has been mixed, the time available for assembly is limited by the adhesive pot life. A crew of two or three is suggested when assembling 8- through 16-inch couplings.

FP199D (7/99)

Instructions (cont.)

6. Applying the adhesive — With the spatula supplied in the adhesive kit, apply adhesive to completely cover the cut pipe edges, the prepared pipe ends and the inner surfaces of the two inner sections of the coupling. Use enough adhesive so that any excess will be forced to flow to the edges of the sections when assembled around the pipe ends. Assemble these two inner half sections by centering them around the butted ends of the pipe. If the potlife of the adhesive is now more than half expired, it may be necessary to defer further assembly and cure the inner sections. If so, clamp the sections and cure according to the instructions provided in the adhesive kit. After curing, let the parts cool completely, remove the clamps, resand the remaining mating surfaces, mix a new batch of adhesive and proceed as follows.

Apply adhesive to cover completely the outer surfaces of the inner sections. Assemble the two outer sections with the split line about 90° away from the split line in the inner sections. Place the hose clamps around the assembly and draw them tight. Remove excess adhesive for a workmanlike appearance.

7. Curing the adhesive — Heat-cure the adhesive using Ameron heating blankets. Cure time is 1 hour and 15 minutes for all diameters. Apply the heating blankets in accordance with the instructions provided with the blanket, making certain that any overlap of the blanket covers the thermostat. It is always a good idea to insulate around the heating blanket and to close the ends of the piping system to prevent movement of cold air inside the pipe while the adhesive is curing.

Maintenance coupling kit

Kit includes inner and outer sections, hose clamps and assembly instructions. Adhesive must be ordered separately.

Pipe Size	Coupling Code	Coupling Length	Adhesive Usage[1,2]	Pipe Size	Coupling Code	Coupling Length	Adhesive Usage[1,2]
(in)		(in)	(kits)	(in)		(in)	(kits)
—	—	—	—	8	80400801	5.38	3
2	20400801	4.00	1	10	A0400801	5.88	4
3	30400801	4.00	1	12	B0400801	6.38	4
4	40400801	4.00	2	14	C0400801	7.38	6
6	60400801	4.88	2	16	D0400801	8.38	8

1) Approximate number of 5-ounce adhesive kits required per maintenance coupling. Maintenance coupling kits do not include adhesive.

2) Rated hydrostatic pressure for maintenance coupling is 150 psi at 70°F. Pressure rating is reduced by 50% if RP105B adhesive is substituted for PSX™34.

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Bondstrand® Installation Guide

FIBERGLASS - COMPOSITE PIPE GROUP

Guide for Steam Condensate and Hot Water Service

General

This guide provides specific information about the material requirements, design criteria, assembly and testing methods recommended to assure a successful steam condensate return line or a hot water line such as for district heating or geothermal applications using Bondstrand pipe and fittings.

Material

Bondstrand Series 2000 pipe and fittings are suitable for steam condensate return service.[1,2] Joined using Bondstrand RP-34 or PSX™•34, this piping carries hot water safely at temperatures up to 250°F (121°C) when the system is properly designed and installed.

The BONDSTRAND FITTINGS AND ENGINEERING GUIDE[3] provides details on parts certified in accordance with Military Specification MIL-P-28584,[4] an RTRP specification written especially for steam condensate return service. Certificates are available on request.[5] Another military specification offers guidance on design and installation.[6]

In choosing parts for your system, Ameron suggests that you consider also the following:

1. Heavy-duty, filament-wound flanges are recommended in 2-, 3-, and 4-inch (50, 80, and 100 mm) diameter, particularly when systems are blocked or buried. In larger diameters, standard filament-wound flanges provide the necessary strength for this service.
2. As an exception to the use of filament-wound products, molded blind flanges are suitable for steam condensate service and are found on the approved list.[6]
3. For reductions in pipe diameter, Bondstrand filament-wound tapered body reducers are recommended over molded reducer bushings.
4. Tees are recommended for branching. Saddles for branching to either Bondstrand or steel lines are not recommended for steam condensate. Of course, saddles are excellent for supports and for in-line anchor details.[7]
5. Gaskets for both Bondstrand-to-Bondstrand and Bondstrand-to-steel flanged connections should be ⅛-inch (3 mm) thick full-faced gaskets using a suitable elastomer such as ethylene propylene rubber with a Shore A hardness of 60±5.
6. Connections to metal condensate piping are always made using flanges. Metal pipe should be blocked at points of connection to Bondstrand pipe to prevent metal pipe loads from being transferred to the Bondstrand pipe. This applies to drip leg connections as well as condensate lines.
7. Metal piping within manholes may facilitate positive anchoring and provide improved resistance to vibration, torque loads on valves and physical abuse.
8. Bondstrand maintenance couplings are recommended for repair of damaged lines where the ends cannot be separated enough to make a bell and spigot joint. (See **Field Repairs**.)

Systems Protected Against Live Steam

Bondstrand piping performs best in systems designed to carry condensate only in the liquid phase. In these systems, a vented receiver tank or "hot well" collects the condensate from the steam traps. From the tank, Bondstrand piping returns the condensate to the boiler by gravity flow if elevations permit or by a pump arrangement as in Figure 1. These systems are free of steam-induced water hammer and have been shown to perform for up to 20 years without evidence of significant deterioration.

Systems Exposed to Live Steam

Where hot wells are not feasible, other means of dissipating the energy in the drip discharge must be used. Except where possible to design steam transmission lines without steam traps,[8] it will be necessary to remove the condensate from the steam line at drip legs between the boiler and the equipment. Here complete protection against live steam exposure may not be possible, but must be kept to a minimum. Steam flashing within the lines tends to degrade the pipe liner over a period of time, particularly when this flashing also produces water hammer.

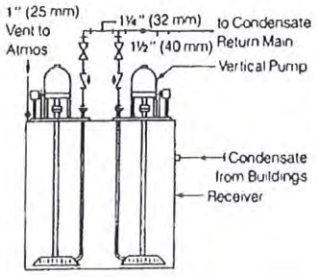


Fig. 1. Typical Hot Well for Pumped Condensate Return

Water hammer occurs in lines filled or partially filled with condensate. When a high temperature (>212°F or 100°C) condensate discharge from a trap is released into these lines, a portion of it flashes to steam. At the instant of release the pressure is nearly that in the steam line. The flash steam immediately formed at the new lower pressure expands greatly, even explosively, and a high-velocity pressure wave moves through the line.

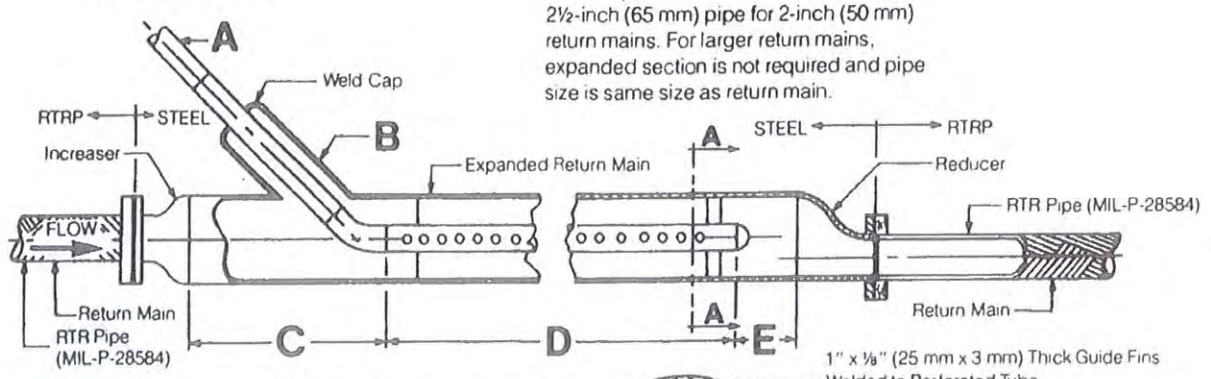
In an empty condensate line, the positive pressure wave would move rapidly through the line, and then, on cooling , collapse back to its original water volume, producing a similar negative pressure wave. With the line full or partially full of condensate, the high-velocity steam pressure wave may become a slug of water which is then slammed through the pipe in a manner destructive to both pipe and equipment. As the steam rapidly cools and recondenses, a reverse wave can develop.

The following steam properties outline the extent of this expansion and contraction. One ounce (28 grams) of steam occupying over 2900 cubic inches at 212°F (47,500 cc at 100°C) and atmospheric pressure will occupy only 1.8 cubic inches (30 cc) after condensing. The flash steam formed on discharge to atmospheric pressure of condensate at 25 psi (1.7 bar) is 5.7 percent by weight, and at 50 psi (3.4 bar) it is 9.0 percent.

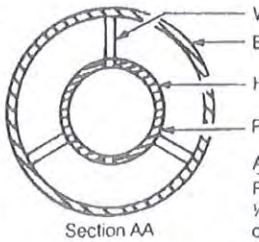
Where some exposure to flash steam is unavoidable, special precautions can be taken to alleviate the problem (see below). Remember, these precautions for systems with some exposure to live steam are not necessary for systems fully protected against live steam-that is, where the condensate temperature is below the boiling point and there are no drip leg connections.

Fig. 2. Detail for Typical In-line Steam Dissipation Chamber at a Trap Discharge Connection

Note: Expanded return main is made from 2½-inch (65 mm) pipe for 2-inch (50 mm) return mains. For larger return mains, expanded section is not required and pipe size is same size as return main.



A	Size, Trap Discharge Line	½" (15 mm)	¾" (20 mm)
B	Size, 45 Weld Nipple	1" (25 mm)	1¼" (32 mm)
C	Length of Expanded Main Ahead of Trap Discharge Pipe	7" (175 mm)	7" (175 mm)
D	Length of Perforated Pipe	16½" (420 mm)	16½" (420 mm)
E	Length of Expanded Main Following Perforated Pipe	2" (50 mm)	2" (50 mm)



All Pipe Shall Be Schedule 80

For ½-inch (15 mm) perforated tube, provide 40, ⅛-inch (3 mm) holes spaced 1½ inches (40 mm) on centers in 4 rows.
For ¾-inch (20 mm) perforated tube, provide 78, ⅛-inch (3 mm) holes spaced 1⅛ inches (28 mm) on centers in 6 rows.

Systems Exposed to Live Steam (cont'd)

1. Take care to assure a uniform grade line in the condensate lines. A gradient of not less than one inch drop in 40 feet (2 mm per m) in the direction of flow is recommended for both buried and suspended systems. Be aware that water-filled low points in the line, particularly those near steam traps, can greatly aggravate water hammer problems.
2. Select suitable traps and develop a program of regular maintenance. Features of trap design to consider should include:
   - minimizing the amount of condensate dumped per trap operation,
   - mode of failure, open or closed, and,
   - selection of the minimum workable size.

   Avoid the temptation to install bypasses; While maintaining traps, valve off the drip line.
3. Provide a dissipator at the steam trap from drip leg connections as shown in Figure-2. Developed by Mr. Bill Stevenson, an engineer with the General Services Administration, these widely used devices serve to absorb the initial shock of the steam flash as well as to quickly dissipate some of the heat energy. They are used in steel as well as RTRP condensate lines.
4. Do not undersize the return piping. Larger sizes dramatically reduce the velocity of the surge wave within the pipe and its potential for damage.

Corrosion Inhibitors

Where a corrosion inhibitor is required to prevent attack on steel components of the piping system, morpholine is recommended. Other amine additives such as cyclo-hexylamine, may cause degradation of the pipe liner if used in concentrations in excess of 1000 parts per million.

Layout of the Buried System

Buried condensate and hot water systems operate at temperatures that normally require anchor blocks at valves, turns and branches. The temperature-induced stress in the blocked Bondstrand pipe will be absorbed in the pipe.[9,10] For lines bedded directly in soil, the designer should not expect that expansion will be absorbed as movement at turns, by expansion loops or by expansion joints.

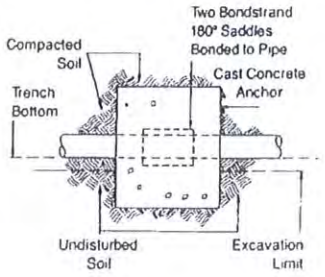


Fig. 3. In-Line Anchor

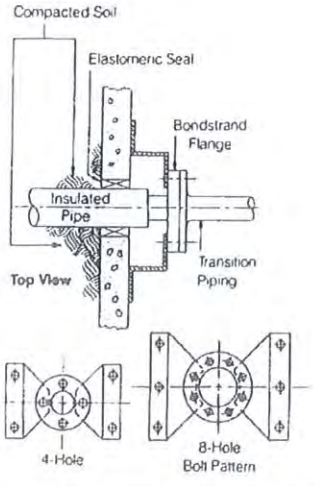


Fig. 4. Anchor Inside Manhole or Wall Penetration

At lower temperatures (<180°F or 82°C) for short runs (<10 ft. or 3 m) from anchor to fitting, and in poor soils (<1000 psf or 48 kN/m^2), anchor blocks may not be required. However, these are special cases and should be carefully analyzed before the decision is made to install the lines without anchor blocks.[11]

In certain locations it may be necessary to place equipment such as pumps, valves or steam dissipation chambers in restrained lines. Equipment replacement or repair, or flange gasket replacement, will then be necessary from time to time. On heat-up, normal thermal expansion produces a compressive longitudinal load in the restrained Bondstrand pipe. Over a period of time this causes a shortening of the pipe such that, unless the flanges are anchored, flanged joints often separate an inch or more when cooled down and disassembled. This makes reassembly potentially difficult.

Reassembly will be much easier if the Bondstrand inlet and outlet lines are suitably anchored at manhole and building wall penetrations. This can be done using an in-line anchor block outside the wall as shown in Figure 3 or a steel anchor inside the wall as shown in Figure 4. Good soil compaction under the lines around the manholes is necessary so that excessive settlements cannot damage the pipe.

In some locations the stability of the soil under the pipe at penetrations cannot be assured. Soil movements can produce excessive shearing loads on the pipe at the interface to the fixed penetration. Here the anchor should be moved three to five feet from the penetration and the penetration itself sleeved and sealed around the pipe.[12]

As an alternative to sealing between the pipe and sleeve with a "firm but pliable mass, " a Link-Seal® provides an elastomeric seal by means of a preformed modular unit which is bolted into place. These units may also be used to seal pipeline casings at road crossings.

The detail of Figure 3 must not be used to resist the expansion and thrust of restrained steel lines. Connecting steel lines should be both anchored and supported to avoid transferring excessive loads to the Bondstrand pipe.

Refer to Ameron literature[11,12,13] for helpful information on the design and placement of anchor blocks at buried fittings. The properties of Bondstrand pipe at elevated temperatures are such that thrust blocks must be designed to resist both tensile and compressive loads.

Layout of the Suspended System

Suspended systems are generally designed using expansion loops rather than thrust blocks, in part because the required supports are more economical when the pipe is allowed to move freely.[7] Anchors between the loops are required, of course, to control the position of the runs.

Some layouts are simply too restricted to permit the use of loops.Large diameter casings or tunnels are examples. The line may have to be blocked and guided to keep it from "snaking," or expansion joints may be used.

Assembly

Bondstrand pipe, fittings and flanges in condensate and hot water systems should be assembled in accordance with Bondstrand assembly instructions and heat blanket cure times should be 60 minutes for pipe joints and flange mountings, and 75 minutes for joints or fittings.

Field Test

Simple hydrostatic testing of installed Bondstrand pipe and fittings to 150 psi (10 bar) or to 1.5 times working pressure for four hours is usually sufficient to assure proper performance. Testing of a buried system is best accomplished prior to placing backfill and blocking.

In every installation operating at an elevated temperature, maximum reliability is served by heating the system slowly the first time. A temperature rise of not more than 20°F (11°C) per half hour generally will relax fabrication stresses and ensure optimum pipe and joint performance.

Field Repairs

Repairs of leaking pipe, whatever the cause, should be made by removing the faulty section or a short length containing the fault, not by overwrapping the fault with any type of patch or other material. If a joint is damaged during the laying operation, it should be cut off and a coupling bonded to the cut-off end and laid in the line as a normal pipe.

If the damage occurs to an installed pipe which is blocked or otherwise restrained from movement, the section to be repaired is cut out of the existing system and replaced by inserting a length of new pipe or a new fitting or assembly in place of the damaged part. The required buttend joint may be made using a Bondstrand maintenance coupling.

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Section 12: Shrink End Seal Installation

Pipe Size	Cut Length
3 1/2"	1' - 6"
4"	1' - 7"
6"	2' - 1"
8"	2' - 7"
10"	3' - 2"
12"	3' - 8"
14"	4' - 2"
16"	4' - 8"
18"	5' - 3"

Pipe Size	Cut Length
20"	5' - 9"
22"	6' - 3"
24"	6' - 10"
26"	7' - 4"
28"	7' - 10"
30"	8' - 4"
32"	9' - 0"
34"	9' - 5"
36"	10' - 0"

Fig. 12.1

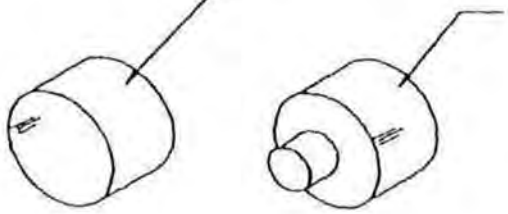
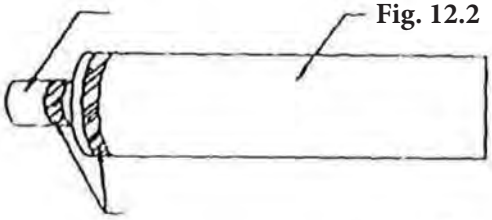
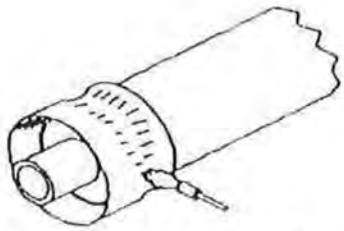


Fig. 12.2





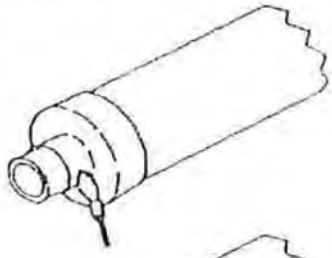
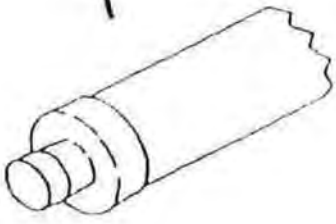


Fig. 12.3



Occasionally projects require each length of Insul-8 pipe to be equipped with factory installed end seals. Where field cuts are required Rovanco will provide field applied shrink end seals. These may also be used on projects where factory applied shrink end seals are not required on each length of pipe, but they may be required for end terminations or anchors.

End seals come in two different types: Tubes and step down caps. The step down caps require a strip of mastic tape to be applied to the casing and the carrier before shrinking begins.

1. Locate the proper size end seal and slide over jacket prior to joining carrier pipe. **See Figure 1**
2. Center the end seal so that 2" minimum of end seal is overlapping the jacket. Using a propane turbo torch, heat the end seal around the circumference of the jacket until it is completely shrink taking care not to burn the jacket. **See Figure 2**

NOTE: Do not concentrate heat in one area. It should be distributed equally around the end seal.

3. Continue heating the shrink down to carrier pipe by aiming flame at an angle where carrier pipe meets insulation. **See Figure 3**
4. Check circumference seams for voids and repeat process where applicable.

Section 13: Operation & Maintenance for Polyurethane Foam Pre-Insulated Pipe Systems

Annual: Remove the drain plugs to check for the presence of water in the air space yearly. When removing the drain plug, be alert for a possible steam flash. If water is found follow the repair procedure outlined below. The drain plugs must be replaced after the inspection to insure water does not inadvertently enter the air space from a flooded manhole or mechanical room.

CAUTION: Extreme caution must be exercised when entering steam manholes and opening vents and drains.

Also do an air test of the conduit yearly. Using an air compressor, pressurize the air space to 15 psig and hold for one (1) hour. If the pressure can not be maintained, see the repair procedure below. Warranty will void if this is not done and logged year to year.

Repair: If a leak in the casing is found, it should be repaired, tested, coated, and backfilled as it was originally installed.

If a leak in the carrier pipe is found, at least a 2' section of pipe should be removed and replaced. The carrier pipe should then be hydrostatically tested at 1½ times it's operating pressure, not to exceed 500 psig. Re-insulate the carrier pipe as specified. Repair the inner conduit casing using a split sleeve, similar to the connector band used in assembling the field joints. Air test the inner conduit casing, then insulate as specified. Cover with a polyethylene sleeve and seal with a wrap around shrink sleeve.

Insulation: If insulation within the conduit becomes wet, then force ventilate the air space in the system at a rate of not less than 3 cubic feet per minute, and apply heat through the internal piping. Introduce the air through the system's high point vent, and force out the low point drain. Caution personnel regarding the possibility of a steam flash out of the low point drain while air is being forced through the system. Place a cool mirror at the exhaust point for a short time at appropriate intervals and position to indicate maximum fogging due to moisture. Continue ventilation until the mirror exhibits no visible fogging.

System Shutdown: If the system is shut down for any length of time, seal the system vents by plugging the goose neck or removing it and installing a plug. Purge with dry nitrogen be fore sealing system. The vents must be opened and the goose neck replaced before the system is turned on again. This will prevent moisture entry during shutdown.

Manholes: Automatic sump pumps, if any, should be thoroughly inspected for proper operation annually. Steam traps, if any, should be routinely inspected and/or replaced, based upon the recommendations of the manufacturer. All flanges should be checked for leakage and tightened if necessary. Any evidence of groundwater leakage should be investigated and repaired. Gland seals, end seals, and the inside wall of prefabricated steel manholes should be routinely inspected for leaks and/or corrosion. Sand and repaint any corrosion to match the existing coating. Check valves routinely for leaks and repack when necessary. Insulation and jacketing of internal piping and equipment should routinely be checked and replaced when necessary. Warranty will void if manholes flood over Rovanco's piping systems.

If you have any questions about anything in this instruction manual, or have any difficulty in completing the work please feel free to contact ROVANCO's Customer Service Department at our main office in Joliet, Illinois (815) 741-6700.

Thank you once again for showing your confidence in ROVANCO by purchasing our Hi-Temp Insul-8 products. We want you to know that we have a full line of pre-insulated and pre-fabricated piping systems for almost any temperature, pressure, or site condition.

If you are not familiar with our complete product line and you would like to know more about our product or would like to have our local Manufacturer's Representative call on you, call ROVANCO at (815) 741-6700, at rovanco.com, or email us at marketing@rovanco.com

Section 14: Parameters For Properly Installing & Operating Systems

Rovanco's pre-insulated and pre-fabricated products are carefully engineered to function as intended. If these products are properly installed, fully-tested, maintained and operated within the parameters for which they were designed, these systems should provide the user with years of trouble-free, efficient operation.

Refer to Rovanco's Installation Instruction(s) and the associated documentation from Rovanco's Engineering Department for important information and instructions that will carefully detail installation, testing, operating, and maintenance procedures. If needed, you are always welcome to contact Rovanco for assistance.

Failure to comply with the procedures as outlined in the Installation Instructions and Engineering support documentation could result in product damage, reduced product service life, costly repairs due to product failure, hazardous conditions which could result in injury to people, property and/or equipment. In addition, it will void Rovanco's warranty.

If any Rovanco product does not perform as it is intended to, please inform Rovanco immediately.

Some problems and their potential causes are listed below. Although this list is not all-inclusive, you may be able to find additional information in Rovanco's Installation Instruction(s) and/or the Engineering Department documentation.

General Piping System Care:

- Wet insulation does not perform as intended and causes the premature failure of the system. Therefore, it is important the system's insulation is kept dry at all times. This includes during storage, installation and when system is operating.
- Our systems have been engineered to operate within a specific temperature & pressure range and under appropriate environmental conditions. Therefore, do not install or put our systems into service if these parameters are not within the product's specifications.
- If you find it is necessary to alter a Rovanco piping system, review the planned alterations with Rovanco or a qualified piping system designer before making any changes.
- Maintenance plays an important role in assuring you get the full service-life out of the system. Rovanco systems are designed to provide years of trouble-free operation, but changing conditions can affect that. So, systems should be inspected regularly to verify they are in good operating condition and functioning as intended. If repairs are required, make them promptly.

Pre-Insulated Foam Systems:

- Piping systems must be kept dry. Moisture of any amount can corrode carrier pipe and prematurely break-down insulation. This will shorten piping system service-life and/or prevent it from operating properly. Keep all piping system dry during storage, installation and when it is operating.
- Assure field joints are completed correctly. This includes the proper field insulating and enclosing the outer jacket in the joint area. Improper completion of filed joints could result in water ingress effecting carrier pipe and/or insulation.
- Damage to jacketing must be repaired immediately. Failure to do so could allow moisture to reach the insulations and/or carrier pipe.
- When installing piping systems designed for underground use that require external expansion pads, you must assure these expansion pads are properly installed according to specifications. Proper installation will allow for associated thermal expansion. Improperly installed expansion pads will put unwanted stress on a piping system that could damage it.

Conduit & Containment Systems:

- Moisture negatively affects a systems functionality and shortens its service-life. Moisture will corrode carrier, conduit & containment piping, leak detection or pull cables and it will degrade insulation. It is important that the air space in these systems is kept dry. If any type of moisture is detected, it must be dried immediately so system is returned to a dry state during installation and operation.
- A combination of moisture in the air space and high operating temperatures will accelerate the destruction of piping, its coating and any insulation. This can result in costly repairs, system damage and possibly system failure. Therefore, do not ever operate these systems under the negative conditions of moisture presence and high temperatures.
- Gland seals provide a seal against a service pipe while still allowing that service pipe to have axial movement. Therefore, it is important all gland seals are adjusted properly to these conditions are met and there is no binding of the service pipe.
- End seal vents and drain piping play an important role in keeping the air space dry. They allow the annular air space to vent and drain as well as prevent moisture ingress. So it is important end seal vents and drain piping is installed properly. This will allow them to function as intended.
- One important detail that will help keep the air space dry and drainable is to assure the piping system is installed with the proper slope so any moisture can drain as intended.

Systems Intended For Underground Installation:

- Plan for adverse weather conditions prior to installation. If trenches gather water, they must be drained prior to the installation of the piping.
- Inspect all steel piping that will be buried prior to backfilling using a Holiday tester. Any holidays or damage to coating must be repaired in accordance with Rovanco's installation instructions prior to backfilling. Failure to repair voids or damage to coating will promote premature corrosion and effect system performance and length of service.
- Prior to backfilling, all carrier pipe, conduit and containment piping must be tested. If piping system integrity is not tested prior to backfilling, it will result in costly excavating and will not be Rovanco's responsibility.
- Cathodic protection system must be installed with thin-coated steel conduit or containment that will be direct buried. The cathodic protection will prevent the premature corrosion of thin-coated steel piping system.
- Line trench accordingly before piping installation. Backfill and compact post-installation in accordance with Rovanco's installation instructions. If these procedures are performed properly, it will help prevent damage to the system when the ground settles.
- Manholes must be kept dry at all times. Installing sump pumps, keeping end seals above water levels and not installing manholes in low points will help prevent water from draining into them.