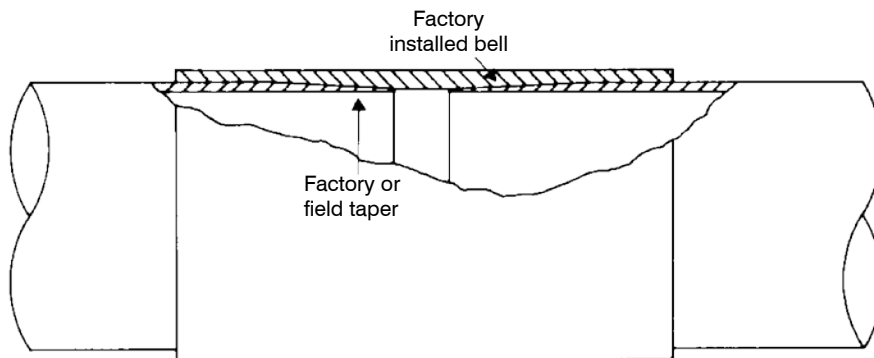


Adhesive-Bonded Bell x Spigot Joints

For Bondstrand™ Series 3000/3000A, 3200/3200A

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, 1-3/4° (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



- String the pipe along the right-of-way.
- After ensuring that the tapered bell & spigot end are clean and dry, the end caps should be replaced until the joint is ready to be made.
- Make a thorough inspection of the pipe wall and tapered spigot end for any signs of cracking or impact damage.

Adhesive Mixing & Application



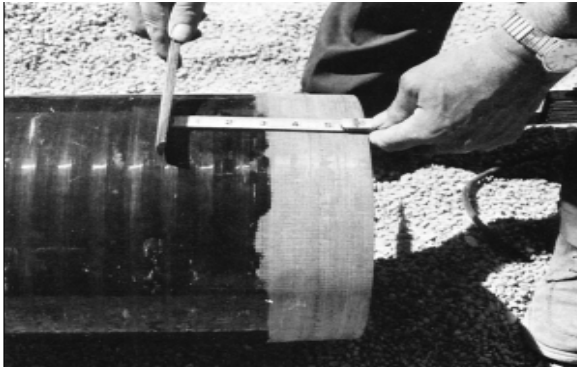
- Ensure that the taper and bonding surfaces are clean. If the surfaces are oily or greasy, they should be cleaned by sanding or with cleaner (not supplied). It is imperative that the bonding surfaces be clean and dry before adhesive application. A light sanding to “freshen” the surfaces should be done.
- Mix adhesive according to directions taking careful notice of the working life. Please review adhesive kit instructions prior to mixing.
- 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 loose joint component should be slightly rotated while applying force to the joint. A small reverse twist will “lock” the joint. This rotation of the joint end will redistribute the adhesive evenly and work any air out of the bond line.

8"-16" Pipe



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



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



- 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.



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

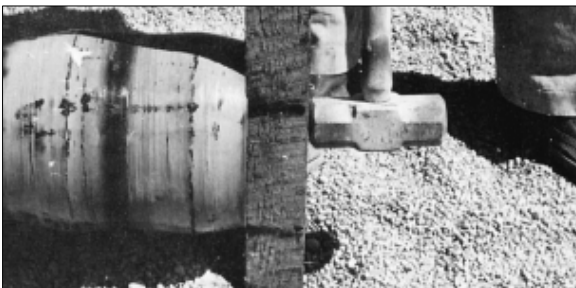
8"-16" Pipe



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



- 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 Nylon straps 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

1. Do not use excessive force. Over insertion should be avoided because it can crack the spigot end and result in a faulty joint.
2. After proper insertion has been accomplished, check for possible backout at the joint, by momentarily reducing tightness of come-along.
3. 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.
4. 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.
5. Do not pressurize the line until adhesive has fully cured. Curing time at various temperatures are shown in the adhesive kit instructions.

Hydrostatic testing is recommended to evaluate the integrity of all new piping installations. For systems operating below the system rating, a test pressure of 1.5 times the system operating pressure is recommended; however, the maximum test pressure must not exceed 1.3 times the lowest pressure rated fiberglass component in the piping system.

The hydro test pressure should be repeated up to ten cycles from 0 psig to the test pressure to provide a high degree of confidence in the piping system. The final pressurization cycle should be allowed to stabilize for 15-30 minutes, then inspected for leaks. Do not attempt to repair leaks while system is pressurized. The hydro test should be repeated after any re-work is performed.

When hydro testing, open high-point vents (if used) to prevent entrapment of air in the lines as the system is slowly filled with water, then close the vents and slowly pressurize to the test pressure. Upon completion of hydro test, relieve the pressure on the system slowly, open vents and any drains to allow for complete drainage of the system.

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

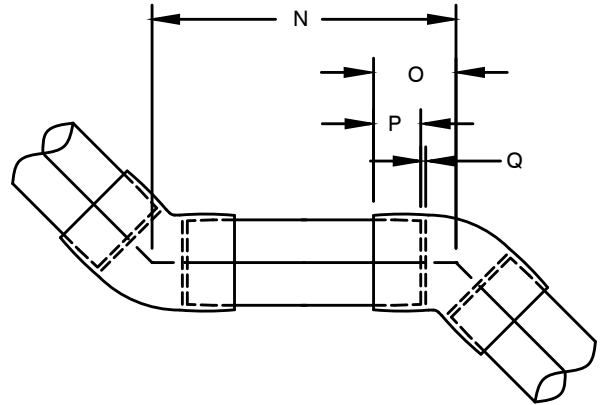
- Wash exposed skin with soap solution (liquid soap preferred) and cool water.
- Use washcloth with "brushing" motion to remove dust or fibers. Do not scrub the skin. This could result in the fibers being imbedded into the skin.
- Rinse thoroughly with clean, cold water.
- Apply lotion or creme to skin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

General Considerations

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.

Bell & Spigot Elbows Centerline to Centerline 2"-6"

Pipe Size	O (90°)	O (45°)	P	Q
in	in	in	in	in
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



Bell & Spigot Elbows Centerline to Centerline 8"-16"

Pipe Size	O (90°)	O (60°)	O (45°)	O (30°)	O (22 1/2°)	O (11 1/4°)	P	Q
in	in	in	in	in	in	in	in	in
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

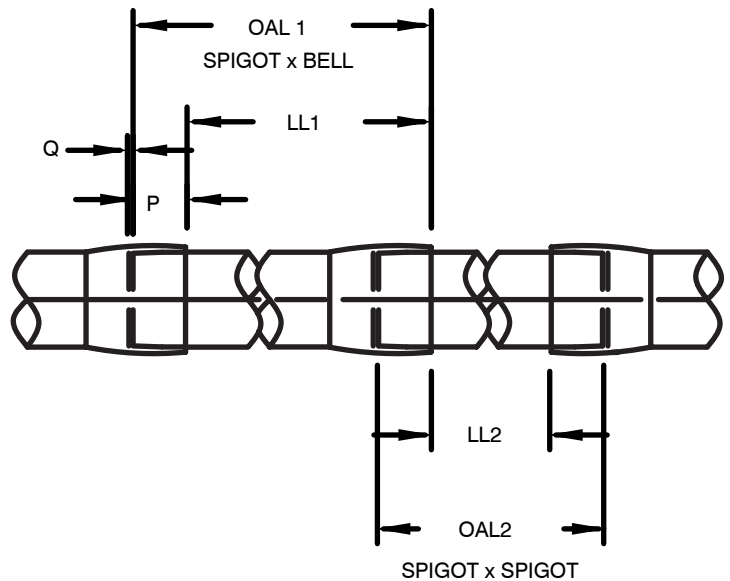
P = Dry Insertion Depth
Q = Lubrication Factor*

Formula:
 $N - (O + O) + (P + P) + (Q + Q) = \text{Length of Pipe to Cut}$

*The Lubrication Factor is the additional amount of insertion that will occur when the joint is coated with adhesive vs. the insertion when the bell and spigot are dry.

Bell & Spigot: Face to Face, Center Line to Center Line 2"-16"

Pipe Size	P	Q
in	in	in
2	2.05	1/8
3	2.32	1/8
4	3.15	1/8
6	4.00	1/4
8	5.00	1/4
10	5.00	1/4
12	5.55	1/4
14	6.80	3/8
16	7.00	3/8



$$LL1 = OAL1 - (P + Q)$$

$$LL2 = OAL2 - (2 \times P) - (2 \times Q)$$

Bondstrand Series 3000 Field Hydro Test Procedure

The recommended hydrostatic test pressure is 1.5 times the anticipated system operating pressure. When higher test pressures are desired, the test pressure should not exceed 1.5 times the maximum rated operating pressure of the lowest rated element in the system. It is important to check the pressure rating of all components of the system. Fiberglass fittings, gages, valves, tanks or hoses may carry pressure ratings lower than that of the pipe and may be damaged if over pressurized.

Before filling with water and pressurizing ensure that all pipe supports are installed in accordance with approved construction drawings. If necessary install temporary supports to support piping during hydro test. When filling with water, open high-point vents (if used) to prevent entrapment of air in the lines while the system is slowly filled with water, then close the vents. The hydrostatic pressurization procedure shall follow closer of vents.

When hydrostatic testing, the pressure should be brought up gradually to allow for strain relaxation of the system during pressurization. The initial pressure should be brought up gradually to no more than 150 psi and held for 30 minutes to allow for inspection for leaks. The pressure should then be increased in equal steps, each step held for 10 minutes to the final test pressure over a period of 30 minutes or longer. Once the required test pressure is attained, the pressure shall be held for a period of two hours or such time as required for a full visual inspection of the system to be made.

If the pressure drops during the first half hour at full hydro test pressure, the system must be brought back up to the test pressure and held for at least two hours. A $\pm 4\%$ pressure change during a hydro test is acceptable. If a pressure drop is found during the test due to leakage in the piping, the system shall be depressurized and repaired in accordance with FGS repair procedures. Do not attempt to repair leaks while system is pressurized. No leakage allowance shall be permitted for the fiberglass piping elements. The hydro test should be repeated after any re-work is performed unless waived by the owner representative in writing.

After completion of hydro test, the pressure must be decreased in smooth gradual steps. Before draining the line all vents and drains shall be opened and kept open until the lines are fully drained. Any temporary supports may be removed only after the system is fully drained.

Special Considerations

- Temperature changes have a definite effect on the pressure in the line. In closed systems, where a pipe is directly exposed to the sun an increase in pressure up to 25% may occur. Take necessary precautions to prevent over pressurization. An overnight decrease in pressure from afternoon to early morning is normal due to temperature changes and does not necessarily indicate a leak.
- Water hammer pressure surges should be avoided or minimized during tests. Water hammer surges can produce hydrostatic pressure waves capable of damaging a piping system. The use of slow closing valves and suitable controls on pumps must be used to prevent water hammer.
- The test medium shall be clean industrial water unless otherwise specified by the owner representative. The water should be ambient temperature. Freeze protection must be considered in cold climates where freezing temperatures are expected. Testing with air or gaseous media is particularly dangerous and should be avoided. Gas or air pipelines shall be hydraulically tested then "dewatered". Never test with flammable fluids or gases.
- When testing buried systems, the line should be partially backfilled and temporarily blocked at directional changes to prevent excessive movement during the test.
- Special care should be taken to prevent above ground systems from buckling or moving excessively during test or in the case of sudden depressurization.
- The hydro test pressurization cycle may be repeated up to ten cycles from 0 psig to the test pressure to provide an additional degree of confidence in the piping system. This should be performed after the two hour hold.

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 FGS) 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)

NOTE: 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 FGS's 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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