

Assembly instructions for Quick-Lock™ (Conical-Cylindrical) Adhesive-Bonded Joints

1. Introduction

This document describes the method to assemble Quick-Lock (Conical-Cylindrical) adhesive bonded joints. To ensure that the performance of the installed joint complies with the requirements used for the design, it is essential that all personnel involved in the bonding procedure are familiar with and fully understands the techniques described in this document.

The instructions in this document are as complete as possible and are written to be consistent with industry guidelines; however, it is not possible to describe all circumstances that might be encountered in the field. Therefore, our experienced supervisors may deviate from the described method in order to achieve an optimum solution using the latest bonding techniques and processing methods. Our supervisors may be consulted for clarification of statements made in this document and for advice about specific problems encountered in the field.

Annex A shows flow charts of the complete assembly process; Annex A1 shows the spigot dimensioning process and Annex A2 shows the adhesive bonding process.

Definition of words used in these instructions:

- The word “shall” indicates a requirement
- The word “should” indicates a recommendation.

2. References

These instructions are completed with the following referenced documents:

Documentation	Reference number
Operating instructions M74 Pipe Shaver	TLS2001
Operating instructions for Bondstrand Heating Blankets	TLS2009
PSX-60 epoxy adhesive for bonding GRE pipe & fittings	ADH4720
Operating instructions for B-1 Tool pipe shaver	TLS2013

3. Quality

It is advised that the bonder possesses a valid Joints/Bonder Qualification Certificate, issued by the pipe manufacturer or a Qualified Certifier.

After preparation of spigot- and bell end, the actual bonding and finishing of the adhesive joint shall be performed continuously and without any interruption or delay.

4. Inspection

All pipe, fittings or components used in the pipeline/piping system shall be inspected for damage, prior to the actual bonding activity. Rejected items shall be separated and quarantined from undamaged materials to avoid unintentional use.

Adhesive kits shall be inspected prior to use. Do not use adhesive kits or containers showing evidence of damage or leakage. The adhesive shall be used before the expiry date, which is shown on the adhesive kit. Make sure that storage of adhesive kits complies with the storage requirements. If the resin side of the adhesive is solid or granular in appearance, consult FGS before proceeding to use the material.

Ensure all necessary tools and materials are available. Take notice of the safety precautions stated in this document and those in the referenced instructions.

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5. Materials, Tools and Consumable 6. Health and safety

5.1 Materials

- Adhesive (Purchase from the pipe manufacturer)

5.2 Tools

- Shaver (Purchase from the pipe manufacturer)
- Heating blanket (plus temperature controller, if applicable) (Purchase from the pipe manufacturer)
- Measuring tape and/or folding rule
- Vernier calliper
- Pi-tape®*
- Pipe fitters' wrap-around
- Level and marker
- Pipe vice or stable supports (brackets) with rubber coated clamping device
- Hacksaw, disc grinder or power jigsaw
- Protractor
- Small electrical or air driven grinding machine
- Pairs of winches or come-alongs (if applicable)
- Pairs of band clamps with puller rings (if applicable)
- Insulation material or blankets
- Digital temperature gauge for surface temperature measurement
- Dew point meter
- Thermometer
- Relative humidity meter
- Infra-red thermometer
- Hot air blower (if applicable)
- Tenting (subject to weather conditions)

5.3 Consumable Items

- Cutting disks
- Emery disks, emery cups, emery cloth, flapper wheels (all grade P40 to P60)
- Spatula (rubber scraper plate, filling knife), marker pen, dust (paint) brush
- Cleaning plug
- Cleaning rags, non-detergent cleaning fluid

When working with GRE products, following safety precautions shall be taken:

- Wear at all time suitable protective clothing.
- Use Personnel Protective Equipment (PPE), such as:
 - Long sleeves
 - Hard hat (if required by site conditions)
 - Safety shoes
 - Glasses
 - Gloves (for mechanical and chemical protection)
 - Dust mask (during machining and sanding)
 - Ear protection (during mechanical operations)

For health and safety data reference is made to the applicable instructions (See Section 2).



*Registered trademark of Pi Tape Corp.

7. Requirements for Bonding Surface and Ambient Conditions

This section gives descriptions of specific conditions of the pipe surfaces meant for adhesive bonding, as well as methods to obtain the required condition of the bonding surfaces.

7.1 Cleaning of a plain pipe end or an unprepared bell end

Both, the outer surface of a plain cut (not machined) pipe end and the inner surface of an unprepared (See Section 7.2) bell must be clean and dry before starting any operation. If these unprepared surfaces have been in contact with oil or grease, they must be cleaned using a clean cloth, which is soaked cleaning fluid. Dry the cleaned surface with a clean, dry and non-fluffy cloth. If there are no traces of oil or grease contamination on these pipe ends, clean the surfaces using a clean, dry and non-fluffy cloth (See Fig. 7.1.a).



Fig. 7.1.a

7.2 Unprepared and prepared surface

An unprepared surface is a surface on the inside of a bell or on the outside of a pipe end, where the original resin rich coating is still intact as it were after completion of the manufacturing process. Any manual or mechanical abrasion process, such as sanding or sand blasting, has never reduced the original thickness of these resin rich layers. A prepared surface is a surface on the inside of a bell or on the outside of a pipe end that has been abraded manually or mechanically. By the abrasion process, the reinforcement of the composite may come in direct contact with the environment and is therefore sensitive for contamination.

7.3 Ambient conditions and conditioning of bonding surfaces

If the bonding surfaces are visibly wet, these surfaces must be dried. If the temperature of the bonding surfaces is less than dew point plus 3° C, these surfaces must be heated in order to avoid condensate on the bonding surface. If the relative humidity of the environment is >95 %, if it is foggy, or if there is any form of precipitation (e.g., rain, snow, hail), precautionary measures must be taken to create an environment where the bonding process can be performed under conditioned circumstances (e.g. a shelter). Drying of wet surfaces is performed using a clean, dry and non-fluffy cloth and is followed by heating of the bonding areas. Heating of surfaces that are wet or below dew point plus 3° C is performed with a heating source such as a hot air blower or a heating blanket. The humidity of a (sheltered) bonding environment is reduced with e.g. a hot air blower. Raise the temperature of the bonding surfaces during the heating process up to maximum 80° C or set the temperature of the heating blanket at maximum 80° C.

If the environment heats the bonding surface above 40° C, protect it from direct radiation by sunlight. The temperature of the bonding surfaces of spigot and bell, during the bonding procedure, shall be kept between 15° C and 40° C, also at least 3° C above dew point. Precautionary measures

shall be taken to guarantee compliance with the required humidity and temperature conditions during the complete but bonding procedure.

7.4 Cleaning of a machined spigot end or a sanded bell end

A machined, prepared or sanded bonding surface that has been in contact with oil or grease shall not be used and must be cut. Machined, prepared or sanded bonding surfaces that are contaminated by other means than oil or grease can be cleaned by sanding (See Section 7.5). In case of doubt about the nature of the contamination, cut the concerned spigot or bell. If there are no traces of contamination on these pipe ends, clean the surfaces using a clean, dry and non-fluffy cloth. Do not touch the cleaned surface, nor allow it to be contaminated.

7.5 Sanding of spigot and bell end

The sanding operation of the bonding surfaces of both, spigot and bell end, shall be performed within 2 hours from the actual bonding. Bonding surfaces must be clean and dry at the start of the sanding operation (See Sections 7.1, 7.3 and 7.4). Sanding of unprepared bell ends is performed mechanically, using an Emery cup with a grit of grade P40 to P60 (See Fig. 7.5.b).

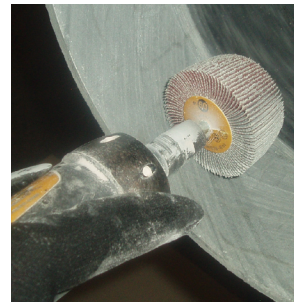


Fig. 7.5.b

Sanding of factory prepared bell ends and machined spigot ends is performed mechanically using an emery cup, a flapper wheel or emery cloth with a grit of grade P40 to P60. A correctly sanded surface does not change in color when continuing sanding (See Fig. 7.5.b). Bonding surfaces must be sanded completely and evenly. The bonding surface must stay smooth by applying an even pressure on the sanding equipment. Break sharp edges of the tip of the machined spigot end.



Fig. 7.5.b

The bonding surface is cleaned using a dry and clean dust brush (See Fig. 7.5.c). Sanded surfaces must have a dull, fresh finish, not a polished look. Do not touch the cleaned surface, nor allow it to be contaminated.



Fig. 7.5.c

8. Dimensioning of Quick Lock spigot end

In case a pipe with the correct length and (factory) shaved spigot end is available, then continue with Section 9 of these instructions. This Section 8 is relevant in case the pipe length has to be adjusted or a cylindrical spigot end has to be shaved. Make sure to comply with the relevant requirements stated in Section 7 before starting a next step in the activities to complete the bonding procedure.

8.1 Cutting of pipe

- a Contaminated pipe surfaces must be cleaned prior to performing any operation on the pipe (see relevant requirements stated in Section 8).
- b Ensure that the pipe is adequately supported or clamped on a pipe vice.
Use rubber padding having a minimum thickness of 2 mm or similar to protect the pipe from damage.
- c Determine the required length from the product drawing or by measurement (See Fig. 8.1.c).
- d Scribe the pipe at the required length, using a pipe fitters' wrap-around (See Fig. 8.1.d); take notice of the minimum cut length (See Annex B).
- e Cut the pipe square using a diamond or carbide coated hacksaw or an abrasive wheel.
- f Ensure that the squareness of the cut end remains within required tolerance

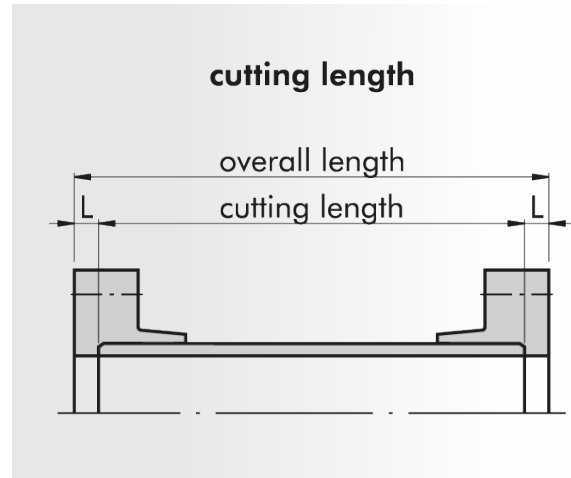
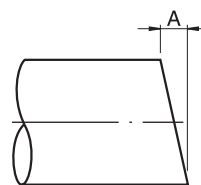


Fig. 8.1.c



Fig. 8.1.d

squareness tolerance



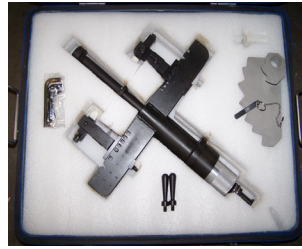
**A = 3 mm (1/8 inch)
maximum**

Fig. 8.1.e

8.2 Shaving of pipe end

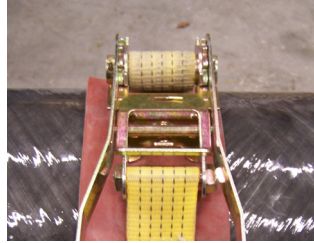
a Various types of shavers are available (See Fig. 8.2.a). To operate the shaver, carefully follow the applicable shaver instructions (See Section 2).

Fig. 8.2.a.



b The pipe end to be shaved shall be clean (see relevant requirements in Section 7) and must be adequately supported (See Section 8.1.b and Fig. 8.2.b).

Fig. 8.2.b



c Start the shaving procedure (See Fig. 8.2.c), using a maximum shaving feed of 2 mm. Be careful shaving the first layer as the pipe wall might have an unequal thickness over the circumference.

Fig. 8.2.c



d Diameter measurement of the spigot is made by use of the Pi-Tape at the mid-point of the spigot length to allow it to be taken while the shaver is still mounted. (See Fig. 8.2.d.1)

The spigot diameter (S1) is determined at about half of the spigot length (SA) (See Fig. 8.2.d1).

Fig. 8.2.d1



The wall thickness of the spigot (T) shall be measured at a number (3 - 6) of positions at the end of the spigot, equally spaced in the circumference (See Fig. 8.2.d2).

Fig. 8.2.d2



The actual spigot dimensions shall be determined after dismantling of the shaver from the pipe end. The spigot dimensions shall comply with the requirements of Annex C, Table C.

- In case of non-compliance of the spigot end dimensions after the shaver has been removed, cut the spigot off the pipe and quarantine the remaining length for possible use in another section of the system. Begin preparation of a new pipe section, starting at 8.1.

9. Preparing for bonding

Prepare a number of joints to be bonded similar to the number that can be made with one adhesive kit (applicable more to small diameter pipe joints) in order to minimize waster. See adhesive instructions (Section 10).

9.1 Sanding and conditioning of both bonding surfaces

a. Make sure to comply with the relevant requirements stated in Section 7.

Note:

The maximum number of sanding operations for each of the bonding surfaces, either the spigot- or the bell end, is two. In case the spigot is re-sanded the relevant spigot dimensions shall be checked by measuring. For dimensional requirements see Annex C, Table C.

In case the number of sanding operations of the bonding surfaces is more than two, or the spigot dimensions are likely no longer in compliance with the requirements, the product shall not be used and the spigot end shall be cut off.

9.2 Dry fit and marking

In order to be able to check the required final position of the spigot relative to the bell and a flange that may be on the spool, the joint of a pipe and a fitting should be marked with an alignment mark.

Scribe a longitudinal line on the outer surface of the bell, continuing on the outer surface of the pipe containing the shaved spigot end (See Fig. 9.2).

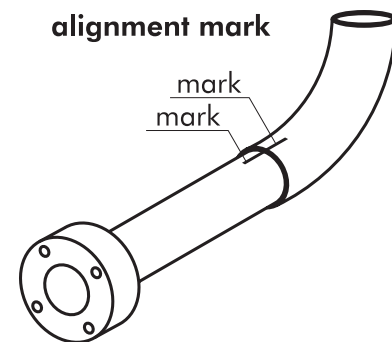


Fig. 9.2

9.3 Installation of pulling equipment

a If possible, the Quick Lock adhesive bonded joint is assembled without the use of mechanical pulling equipment. However, starting from DN200 (8") it is allowed to mount the spigot in the bell using pulling equipment.

b The pulling equipment is installed on both sides of the joint; normally two winches will suffice. The position of the winches is equally spaced over the circumference of the parts to be joined in order to realize centric entrance of the spigot in the bell. Make sure there is enough space to apply adhesive on the bonding surfaces.

c Inspect the required alignment of the parts to be jointed as well as the support during the bonding operation.

10. Bonding

The actual bonding starts with the preparation of the adhesive and finishes when the adhesive between the jointed parts is cooled down to ambient temperature, after completion of curing of the adhesive.

The adhesive shall be supplied by the pipe manufacturer. Be aware that the bonding procedure shall be performed continuously and without any interruption or delay, within the pot life/working life of the adhesive. This means that the period within mixing of the adhesive components until the spigot has been pulled into the bell shall fall within the pot life/working life.

10.1 Preparation of adhesive

- Select the proper type and kit size of adhesive. Determine the number of adhesive kits required for one joint, or the number of joints which can be made with one kit. For detailed information about the adhesive, reference is made to the relevant document (See Section 2).
- The temperature of the adhesive shall comply with the requirements stated in the relevant document (See Section 2).
- Apply the adhesive immediately after finishing the mix procedure.
- Never use adhesive that has started to cure; this is the case when the mixture gets clotted, toughens and the temperature rises significantly.

10.2 Application of adhesive

- Use a fresh spatula or adhesive scraper for the application of adhesive on the freshly prepared bonding surfaces. In case the spatula used for mixing is also used for the application of the adhesive, the spatula must be cleaned first.
- Wet the sanded surfaces of bell- and spigot end with some force with a thin, uniform coating of adhesive (hardly any thickness).

c Apply a thin (0.5 – 0.8 mm) and uniform layer of adhesive on the adhesive coated bonding surface of the bell end. Apply a somewhat thicker (0.8 – 1.0 mm) and uniform layer of adhesive on the adhesive coated bonding surface of the spigot end.

Do not apply more adhesive than strictly necessary to avoid an excessive resin bead on the inside of the joint, resulting in flow restrictions.

Make sure to apply an adhesive layer on the cut end of the spigot and on the pipe stop shoulder in the bell end (See Fig. 10.2.c and Fig. 10.2.d).

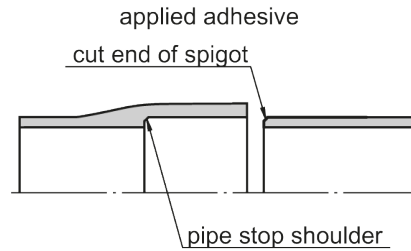


Fig. 10.2.c

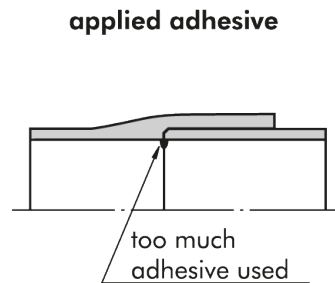


Fig. 10.2.d

d Protect the adhesive coatings on the bonding surfaces and prevent any contamination.

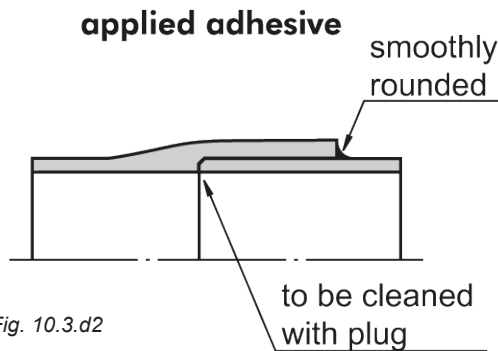
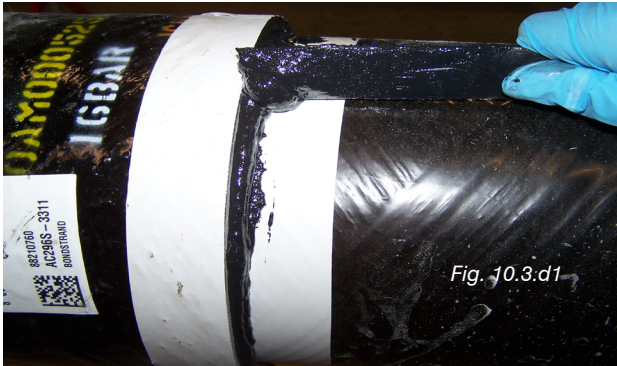
10.3 Assembly of the spigot in the bell

- Parts to be jointed shall be aligned as true as possible. Any visual misalignment is unacceptable.
- Insert the spigot into the bell without rotation until it "bottoms out" against the pipe stop shoulder. Slight rotation to adjust the alignment marks is allowed, but if the marks are more than 45 degrees apart, pull the joint apart, repeat the spreading of the adhesive and reassemble.
- When using pulling equipment for joints DN >200mm (8"), winches should be equally loaded and the sections to be bonded are pulled together with a smooth movement.
- Make sure that the spigot is inserted concentrically into the bell until the entrance of the spigot is stopped by the pipe stop shoulder in the bell.

Note

On-going work must never cause a joint to pull apart or rotate. If this occurs, immediately disassemble the joint and reassemble with original procedure.

- e Remove the excessive adhesive from the outer surface (See Fig. 10.3.d1) and if possible from the inside of the joint. The fillet on the head of the bell should be smoothly rounded; the inside might be cleaned with a plug (See Fig. 10.3.d2).



10.4 Curing of the adhesive

- a Until completion of the cure of the adhesive the joint shall not be moved, vibrated or otherwise disturbed.
- b Wrap the required size and voltage heating blanket around the joint, ensuring full coverage of the bond area and keeping the power supply cable free from the blanket. Tie the heating blanket down using a string or steel wire and assuring an optimal surface contact with the bell (See Fig. 10.4.b). Heating blankets shall be rolled up when not in use.



- c Use of oversized heat blankets should be avoided. Excessive overlap of the blanket can cause overheating, affecting the adhesive cure and useful life of the blanket.

- d Insulate the heating blanket with suitable insulating material. Close at least one open end of the jointed pipe line sections in order to avoid cooling down by draught. Insulating material should overlap the sides of the blanket at least 100 mm and should match the pipe (See Fig. 10.4.d).

- e Apply electric power to the heating blanket. If applicable, adjust the temperature of the blanket such that the surface temperature of the jointed parts complies with the requirements stated in the relevant adhesive instructions (See Section 2). Check the functioning of the heating blanket at least at the start and at the end of the curing process by measuring the surface temperature of the bell using a (digital) thermometer.

- f The curing time starts when the required surface temperature of the jointed components is reached. Write the starting time of the curing on the pipe, next to the heating blanket (See Fig. 10.4.d). For the required curing time, see Annex D.



Fig. 10.4.d

- g Adhesive bonded flanges shall be cured by placing the heating blanket against the inner surface of the flange. For an optimal heat transfer, the blanket shall be pressed against the inner surface of the jointed parts, after the excess adhesive has been removed from the inside of the joint (See Fig. 10.4.g).



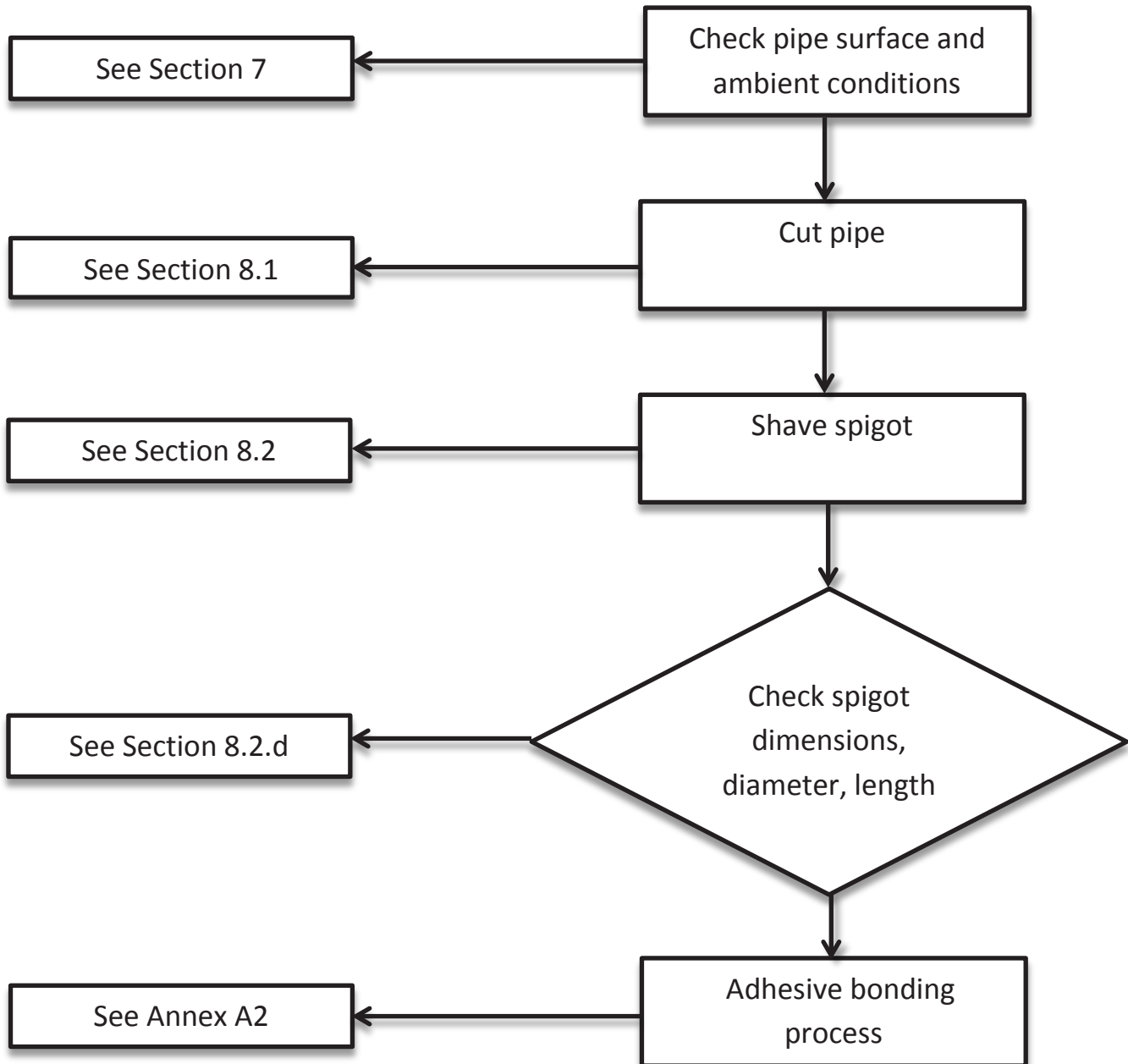
Fig. 10.4.g

- h If the curing process does not comply with the requirements of the curing cycle, the complete curing cycle shall be repeated.
- i The electrical power to the heating blanket shall be switched off after completion of the curing time and after having checked the surface temperature for the last time.

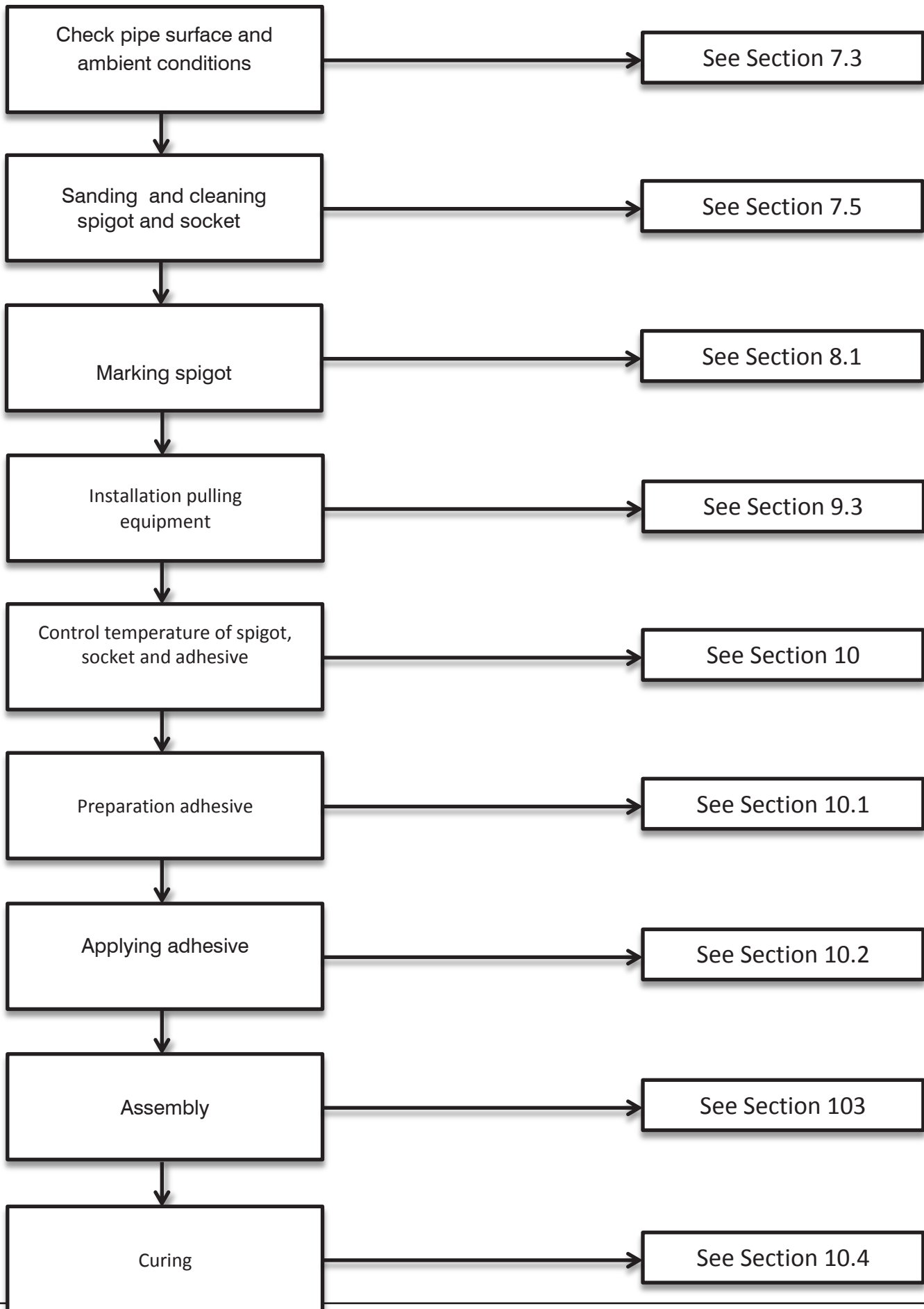
Indicate the end time of the curing cycle on the pipe. It is advised to mark the joint, indicating that the adhesive is cured. Allow the joint to cool down before loading mechanically or hydrostatically.

Annex A Flow Chart Assembly Process Quick Lock Bonded Joint

Annex A1 - Spigot Dimensioning Process



Annex A2 - Adhesive Bonding Process



Annex B Minimum Cut Length

ID (mm)	ID (inch)	L_o	
		in	mm
25	1	6	150
40	1½	6	150
50	2	6	150
80	3	6	150
100	4	6	150
125	5	6.7	170
150	6	6.7	170
200	8	7.2	185
250	10	9.8	250
300	12	9.8	250
350	14	9.8	250
400	16	10.6	270

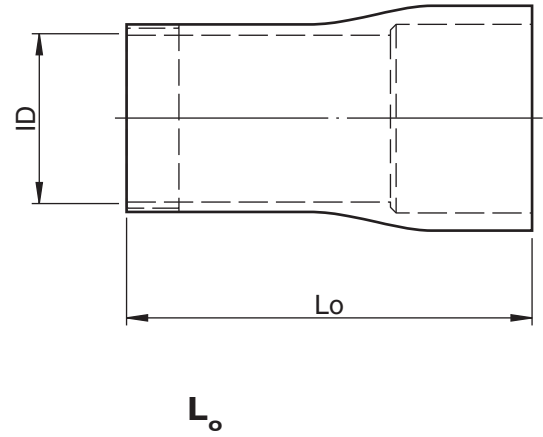


Fig. B1 Minimum cut length (L_o) for pipe Quick Lock bell - spigot

Table B1 Minimum cut length (L_o) (mm)

Annex C Dimensions Quick Lock Spigot

Nom. Dia. (mm)	Nom. Dia. (inch)	T		S1		SA	
		min (mm)	max (mm)	min (mm)	max (mm)	min (mm)	max (mm)
25	1	2.6	3.2	32.6	32.9	25.5	28.5
40	1½	2.6	3.2	47.5	47.8	33.5	36.5
50	2	3	3.6	59.2	59.6	49	52
80	3	2.8	3.4	87.6	88	49	52
100	4	3.5	4.1	112.5	112.9	49	52
125	5	3.7	4.3	139.5	139.9	58.5	61.5
150	6	3.5	4.1	166.2	166.6	59	62
200	8	3.9	4.7	217.1	217.5	65	68
250	10	3.9	4.9	271.3	271.7	71	74
300	12	3.8	5	322.2	322.6	78	81
350	14	4.2	5.6	353.8	354.2	89	92
400	16	4.6	6.2	404.1	404.5	103	106

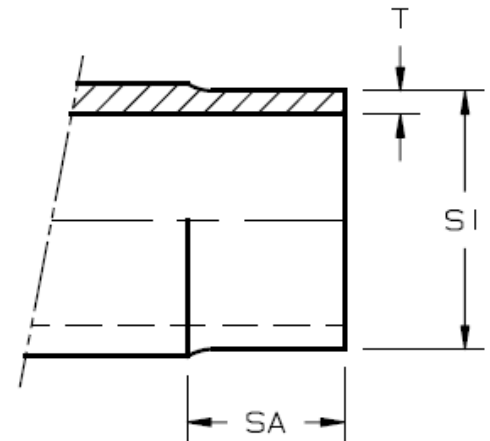


Fig. C Quick Lock Spigot dimensions

Table C Dimensions Quick Lock Spigot

Annex D - Curing Time Quick Lock Joints

	Quick Lock Joints - Standard (BS 2000, 4000 & 7000 series) 1-16 inch (25-400mm)
	Quick Lock Joints - Marine (BS 2000M & 7000M series) ≤6" (≤150mm)
Pipe-to-pipe joints	60
Pipe-to-fitting joints	90
Pipe-to-flange joints	60

Note 1: Curing time starts when the required surface temperature (125°C) of the jointed components is reached.

Note 2: Pipe-to-flange joints are cured from the inside.

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North America

17115 San Pedro Ave. Suite 200
San Antonio, TX 78232 USA
Phone: +1 210 477 7500

South America

Estrada de Acesso à Zona
Industrial Portuária de Suape, s/no.
Recife, PE, Brazil 55.590-000
Phone: +55 81 3501 0023

Europe

P.O. Box 6, 4190 CA
Geldermalsen, The Netherlands
Phone: +31 345 587 587

Asia Pacific

No. 7A, Tuas Avenue 3
Jurong, Singapore 639407
Phone: +65 6861 6118

Middle East

P.O. Box 17324
Dubai, UAE
Phone: +971 4881 3566