



**FUTURE PIPE INDUSTRIES**  
Complete Pipe System Solutions

**Wavistrong™ Supplemental installation instructions  
For Taper- Taper Adhesive Bonded Joints (TB/TS)  
with standard 20 mil (0.5 mm liner)**

*(Not applicable for anti-abrasion piping with thicker liners)*

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## 1. General

These supplemental instructions describe the assembly method for taper- taper adhesive bonded joints for standard Wavistrong™ TB/TS pipe systems. To ensure that the pipe system will meet the required performance after installation, it is essential that all personnel involved with the bonding procedure is familiar with and fully understands the joining techniques described in this document. **THESE INSTRUCTIONS ARE SUPPLEMENTARY TO THE WAVISTRONG INSTALLATION MANUAL.**

The method described in this instruction is as complete as possible. 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 method.

## 2. References

- Wavistrong Easy- Fit adhesive instructions
- Wavistrong Shaver Instruction Taper- Taper Adhesive Bonded Joint

## 3. Inspection

All pipes, fittings, or any component used in the pipe system shall be inspected on damages prior to bonding of the components. Defective items should not be used in any installation.

Adhesive kits shall be inspected prior to use. Do not use adhesive kits or containers showing evidence of damage or leakage. The adhesive shall not be used beyond the expiry date shown on the adhesive kit. Storage conditions for the adhesive kits shall be strictly adhered to (see section 8).

Ensure all necessary tools and materials are available (see section 12). All safety precautions need to be checked (see section 11).

## 4. Calibration

4.1 Various Wavistrong shaver tools are available for making the spigot in the field. The manufacturer's instructions shall be followed to operate the shaver.

4.2 Ensure the pipe is adequately supported or clamped on a pipe vise, protected with a rubber sheet (minimum 2 mm thickness) around the pipe to avoid any damage on the pipe.

4.3 Scribe the pipe at the desired pipe length using a pipe fitters wrap- a- round, taking notice of the minimum cutting length (see Annex B).

4.4 Cut the pipe square with a hacksaw or an abrasive cutting disc (diamond or carbide grid).

4.5 Measure the socket length BA (see Annex B, figure 2) and mark the outer surface of the pipe to be shaved on a distance [BA + extra length X] from the head of the pipe. (X is a value to be chosen, e.g. 2" (50 mm)).

4.6 The surface of the pipe to be machined must be dry and clean. If the surface has been in contact with oil or grease, it should be removed using a clean cloth soaked in acetone, M.E.K. (Methyl Ethyl Ketone) or M.I.B.K. (Methyl Iso Butyl Ketone). Do not use paint thinners, gasoline (petrol) or alcohol for cleaning. Dry the cleaned surface with a clean dry cloth.

- 4.7 Operate the shaver in accordance with the manufacturer's instructions.
- 4.8 Ensure the machined ends meet the dimensions within tolerances according to Annex A.
- 4.9 Dismantle the shaver tool. Clean the calibrated spigot preferably with a clean dust bristle/ brush (or a clean, dry cloth).  
It is advised to check the calibrated spigot dimensions by sliding a non- abraded bell end over the spigot. The distance between the head of the socket and the earlier made marking (see section 4.5) on the spigot end of the pipe shall be  $[X + C [ + 0.20-0.25"] (+5-10) \text{ mm}]$ , where the over- measure (C) depends on the diameter (ID) as shown in table 1.

Table 1. Over- measure (C)

ID inch (mm)	$\alpha$ (degrees)	C inch (mm)
1-6" (25-150 )	1.75	1.0" (25)
8-24" (200-600)	2.5	0.6" (15)

## 5. Factory supplied spigot ends

- 5.1 The factory supplied spigots ends (TS) comply with dimensional requirements. See Annex A.
- 5.2 Surfaces to be bonded shall be prepared within one hour of the actual bonding procedure.
- 5.3 Clean the spigot surface to remove oil, grease, mud, fingerprints, etc., using a clean, dry cloth. If the surface has been in contact with oil or grease, it should be removed using a clean cloth soaked in clean acetone, M.E.K. (Methyl Ethyl Ketone) or M.I.B.K. (Methyl Iso Butyl Ketone). Do not use paint thinners, petrol or alcohol for cleaning. Dry the cleaned surface with a clean, dry cloth.  
It is advised to cut machined spigot ends which have been in contact with oil/ grease and not to use them.
- 5.4 Sand the spigot end (TS) using a coarse emery cloth, grade P40 to P60. Clean the bonding surface preferably with a clean dust bristle/ brush (or a clean, dry cloth). The bonding surface should look clean and bright. After cleaning, do not touch the bonding surface nor allow it to be contaminated.

## 6. Bell ends

- 6.1 Surfaces to be bonded shall be prepared within one hour of the actual bonding procedure.
- 6.2 Clean the bell end bonding surface to remove oil, grease, mud, fingerprints, etc., using a clean dry cloth. If the surface has been in contact with oil or grease, it should be removed using a clean cloth soaked in clean acetone, M.E.K. (Methyl Ethyl Ketone) or M.I.B.K. (Methyl Iso Butyl Ketone). Do not use paint thinners, petrol or alcohol for cleaning. Dry the cleaned surface with a clean, dry cloth.
- 6.3 The inner surface of the bell end (TB) shall be sanded using an emery cup grade P40 to P60. The sanding depth shall not exceed 0.012" (0.3 mm). Clean the bonding surface preferably with a clean dust bristle/ brush (or a clean dry cloth). The bonding surface should look clean and bright. After cleaning, do not touch the bonding surface nor allow it to be contaminated.

## 7. Preparation

**Important note:** The spigot, and bell end of a taper- taper (TB/TS) adhesive bonded joint will have to be pulled together (using mechanical tools) and by applying some force to keep the assembled joint 'locked' in place. This force shall be left undisturbed until the adhesive in the joint is cured (1.5 to 5 hrs depending on wall thickness.....see table 3). The force on the jointed parts may only be relieved after curing of the adhesive. Pulling spigot- and socket end together may be realised using puller straps, lever hoist or equivalent.

7.1 Align the sections to be jointed and fix the tools for pulling spigot- and socket end centrally together. Leave sufficient room available to apply an adhesive layer on the bonding surfaces. Use wooden blocks to prevent damage from the pulling devices. Ensure the pipe sections are adequately supported and properly aligned.

7.2 Check the prepared bonding surfaces taking notice of following remarks:

- If the bonding surface has been contaminated, it shall be cleaned and re-sanded as described in sections 5 and 6.
- If bonding has not taken place within one hour after sanding the bonding surfaces, re-sand all surfaces in accordance with sections 5 and 6.
- If the surfaces are wet before bonding, heat these areas with a heating source until they are dry; then the prepared surfaces are cleaned and re-sanded as described in sections 5 and 6.
- At ambient temperatures  $\leq 60$  °F (15 °C) the bonding surfaces must be heated up to 68 – 95°F ( 20 - 30 °C).
- At higher ambient temperatures, shade the bonding surfaces in order to avoid surface temperature in excess of 105 °F (40 °C).

## 8. Adhesive

8.1 Wavistrong Easy- Fit adhesive consists of two components: resin and hardener. Kit sizes of 8.8 oz. (250 g) are available. Wavistrong Easy- Fit adhesive shall be stored at temperatures below 85 °F (30 °C). The temperature of the two components to be mixed shall be between 68 °F (20 °C) and 95 °F (35 °C) during mixing. Below 60 °F (15 °C) the components will not mix well and the adhesive cannot easily be spread on the spigot- and bell end. High ambient temperatures are also to be avoided; above 105 °F (40 °C) the mixture will cure too fast.

8.2 Organise the installation in such way that the adhesive is spread on the bonding surface immediately after mixing. Work within the adhesive setting time (see table 2).

8.3 Add the complete quantity of hardener from the small container to the epoxy resin in the large container and mix both components with the supplied spatula for about 3 minutes until the mixture has a uniform colour. Adhesive components shall not be split into quantities which are less than those of the original set in order to avoid deviations of the required mixing ratio. Never use adhesives that have started to cure and turned tacky, as it will lead to a weak joint.

Table 2. Setting time Wavistrong Easy- Fit adhesive

Temperature adhesive °F (°C)	68 (20)	77 (25)	86 (30)	95 (35)	104 (40)
Setting time (minutes)	30	25	20	15	10

## 9. Bonding

9.1 Wet the freshly prepared bell- and spigot end by applying with some force a thin, uniform layer of adhesive. Once the bonding areas are completely wetted, a thin ( $\approx 20$  mil (0.5 mm)) adhesive layer is applied on the bonding surface of the spigot. Do not apply more adhesive than strictly necessary to avoid an excessive resin bead on the inside of the pipe, which will cause flow disturbance. The machined or sanded surfaces shall be coated completely.

9.2 It is important to avoid that dust, sand or any other foreign particles are mixed with the adhesive.

9.3 Pipe sections shall be aligned as true as possible. Any visual misalignment is unacceptable. Pull the sections to be bonded together using a lever hoist (or similar device) and make sure that the required spigot length (SA, see Annex A, figure 1) shifts into the bell end. Take up slowly and work the joint together, taking care to keep the alignment. Keep pulling until the spigot does not enter any more into the bell, and keep the assembly force on the joint. When properly inserted, the mark on the spigot end (see section 4.5) will be positioned between  $[X + C]$  and  $[X]$  from the head of the bell end (see section 4.5 and 4.9 for X and C).

9.4 Assembly of the parts to be jointed up to full insertion should be performed as one single action to avoid entrapment of air into the adhesive. If the force on the joint is broken and the joint slides out again, the old adhesive shall be wiped off and the bonding procedure according this instruction shall be repeated from section 7.

9.5 Remove the excessive adhesive at the outside and if possible at the inside of the joint. The fillet on the outside of the joint should be smoothly rounded, while the fillet at the inside might be cleaned using a plug.

## 10. Curing

10.1 **The adhesive in the joint shall be cured keeping the assembly force with the mounting tools.** Do not release the lever hoist (see section 9) until the bonding is fully cured. **During curing the joint should not be disturbed under any circumstances;** avoid bending or pulling of the joint during curing.

10.2 Wrap the heating blanket around the joint ensuring the bond area is fully covered. Electrical cables shall remain free. Tie up the heating blanket with a string or steel wire. Insulate the heating blanket with suitable insulating material i.e. glass wool or a fire blanket. Close all open ends of the pipe section to avoid any air flow into the section.

10.3 Pay attention to the overlap of the ends of the heating blanket as follows:

- In case there is no or little overlap a cold sector will be created: the blanket shall be relocated around the joint in order to heat the total bonding surface according the requirements.
- In case the overlap of the blanket is too large there is a chance of overheating of the overlap: insulate the overlapping parts from each other.

10.4 Switch the heating blanket on and adjust the temperature of the blanket such that the surface temperature of the socket of  $255\text{ }^{\circ}\text{F}$  ( $125\text{ }^{\circ}\text{C}$ ) is reached. Check the operation of the blanket throughout the entire curing process (e.g. using a digital temperature gauge). The curing time ( $\geq 1$  hour) starts when the adhesive surface is heated up to the required temperature. The heating-up time depends on the wall thickness of the adhesive socket, but also on the ambient temperature. Note the starting time of the curing next to the joint on the pipe as a check. Table 3 shows the recommended times for a maximum operating temperature of  $203\text{ }^{\circ}\text{F}$  ( $95\text{ }^{\circ}\text{C}$ ) of the pipeline.



Table 3. Recommended heating- up / curing time (hrs) for TB/TB adhesive joint for service temperature  $\leq 203$  °F (95 °C)

Total wall thickness of socket Inch (mm)	Min. heating- up time (hrs)	Min. curing time + heating- up time (hrs)
< 0.4 (10 mm)	0.5	1.5
0.4 – 0.6 (10 – 15 mm)	1	2
0.6 – 0.8 (15 – 20 mm)	2	3
0.8 – 1.0 (20 – 25 mm)	3	4
1.0 – 1.2 (25 – 30 mm)	4	5

10.5 Adhesive bonded flanges may be cured by insertion of a heating blanket in the bore. For a good heat transfer the blanket shall be tightly fixed against the inner side of the flange. Excess adhesive should be wiped from the inner surface prior to inserting the blanket.

10.6 Switch the heating blanket off after completion of the curing time. It is advisable to measure the pipe surface temperature (see table 3) at this stage again in order to control the confirm the proper operation of the heating blanket. Make note the time of the end of the curing time just as with the starting time next to the joint on the pipe. After a successful cure, it is advisable to mark cured joints using a unique colour code with a marker or spray paint.

10.7 Allow the joint to cool down until the surface is warm to the touch and remove all used mounting tools.

10.8 Now the joint may be loaded for use.

## 11. Safety precautions

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

11.1 While cutting and grinding, the below stated personal protection shall be used to avoid skin irritation and inhaling dust.

- Dust mask covering nose and mouth
- Safety glasses
- Pair of suitable hand gloves
- Overalls
- Safety shoes
- Safety helmet

11.2 When working with Wavistrong Easy- Fit adhesive, avoid direct contact with skin. If skin has been in contact with adhesive, wash with clean water and soap before it becomes a solid.

11.3 For Wavistrong Easy- Fit resin and hardener the following R- and S- numbers are applicable:

Table 4. R- and S-numbers Wavistrong Easy- Fit adhesive

Product type	R-number	S-number
Resin (Contains epoxy resin)	R 36/38, 43, 51/53	S 24, 26, 28, 37/39, 61
Hardener (Contains penta-ethylene hexamine)	R 34, 43, 50/53	S 26, 36/37/39, 45, 60, 61



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<u>Resin</u>	Contains epoxy resin
R36/ 38	Irritating to eyes and skin.
R43	May cause sensitisation by skin contact.
R51/ 53	Toxic to aquatic organisms, may cause long- term adverse effects in the aquatic environment.
S24	Avoid contact with skin.
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S28	After contact with skin, wash immediately with plenty of soap and water.
S37/ 39	Wear suitable gloves and eye/ face protection.
S61	Avoid release to the environment. Refer to special instructions/ safety data sheets.
<u>Hardener</u>	Contains penta-ethylene hexamine
R34	Causes burns.
R43	May cause sensitisation by skin contact.
R50/ 53	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
S26	In case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
S36/ 37/ 39	Wear suitable protective clothing, gloves and eye/ face protection.
S45	In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).
S60	This material and its container must be disposed of as hazardous waste.
S61	Avoid release to the environment. Refer to special instructions/ safety data sheets.



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## 12. Materials, tools and consumables

### 12.1 Materials available for purchase from FPI :

- Wavistrong Easy- Fit adhesive kit 8.8 oz. (250g).

### 12.2 Tools

#### 12.2.1 Tools available for purchase from FPI :

- Shaver
- Heating blankets

#### 12.2.2 Tools to be supplied by the contractor:

- Measuring tape/ Pi- tape/ measuring gauge/ pipe fitter's wrap- around
- Pipe vise/ rubber strip (for use in chain clamp)
- Angle grinder/ sanding bobbin/ flexible backing disk
- Hand- drilling machine and rubber mandrel (for use with emery cup)
- Pipe pullers/ puller straps
- Insulating materials for heating blanket
- Digital temperature gauge
- Shelter (depending on environmental conditions)
- Dust exhauster
- Power supply
- Adhesive cleaning devise

### 12.3 Consumables

#### 12.3.1 Consumables to be supplied by the contractor:

- Grinding disks (emery disk grade P40 to P60)
- Cutting disks
- Emery cup grade P40 to P60
- Emery cloth grade P40 to P60
- Spatula (rubber scraper plate, filling knife)/ marker pen/ dust brush (paint brush)
- Rubber gloves/ working gloves/ dust masks / safety glasses
- Overalls/ safety shoes/ safety helmet
- Cleaning rags
- Cleaning fluid (acetone, M.E.K. (Methyl Ethyl Ketone) or M.I.B.K. (Methyl Iso Butyl Ketone))

Annex A

Spigot end dimensions (TS)

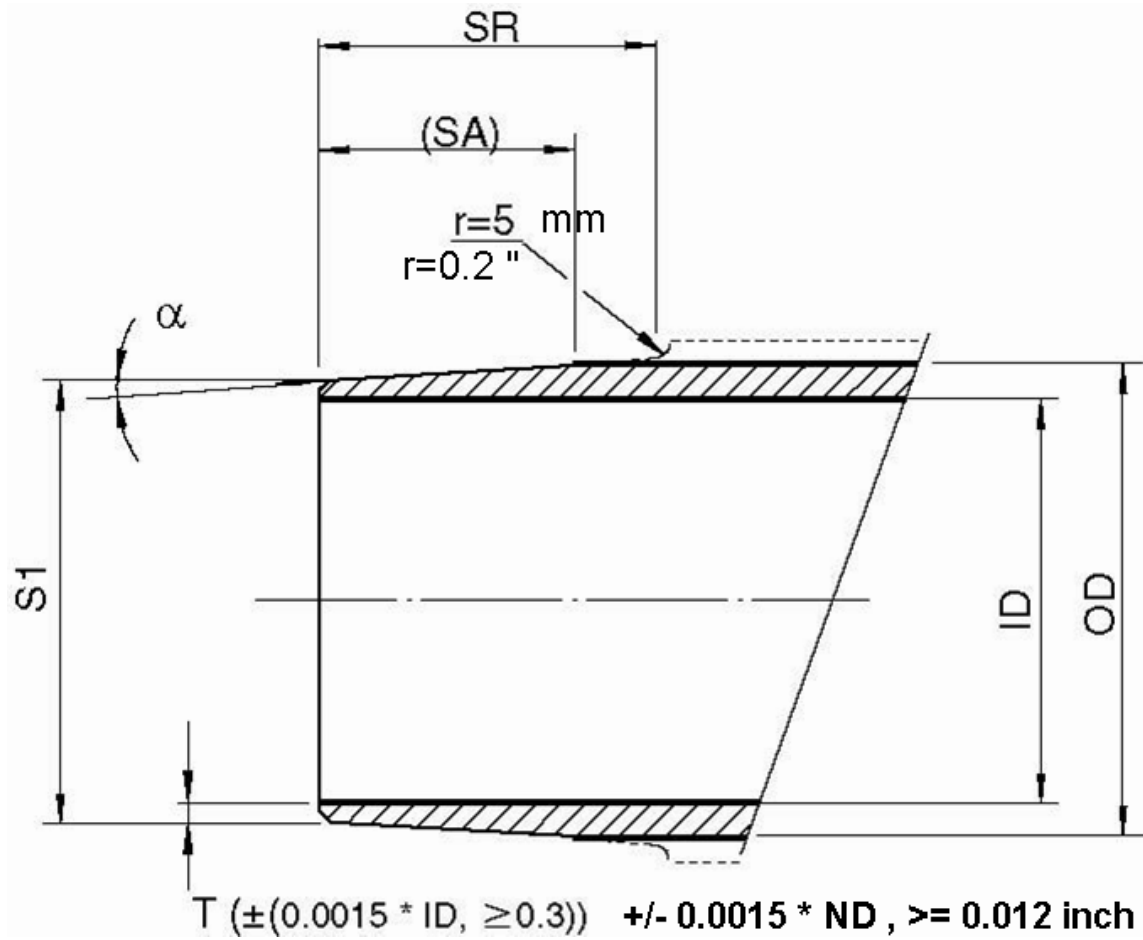


Figure 1. Dimensions of spigot end (TS)



Annex A (continuation)

Dimensions - spigot end (TS)

Table 5. Dimensions of spigot end (TS) - see figure 1

PN psig	ID inch	S1 inch +0.002 - 0	(SA) inch	SR Inch +0.25 - 0	$\alpha$ (°) +0 -0.25		PN psig	ID inch	S1 inch +0.002 - 0	(SA) inch	SR inch +0.25 - 0	$\alpha$ (°) + 0 -0.25	
<b>115</b> (8 bar)	18	17.8	2.2	3.7	2.50		<b>450</b> (32 bar)	3	3.3	1.9	3.5	1.75	
	20	19.8	2.3	3.7	2.50			4	4.1	2.1	3.7	1.75	
	24	23.8	2.8	4.3	2.50			6	6.0	3.7	5.3	1.75	
								8	8.0	3.7	5.1	2.50	
<b>175</b> (12.5 bar)	14	13.9	2.1	3.3	2.50			10	10.0	4.9	6.1	2.50	
	16	15.9	2.5	3.7	2.50			12	12.0	5.9	7.1	2.50	
	18	17.8	3.0	4.5	2.50			14	13.9	7.0	8.3	2.50	
	20	19.8	3.3	4.7	2.50			16	15.9	8.2	9.4	2.50	
	24	23.8	4.0	5.5	2.50								
							<b>675</b> (40 bar)	2	2.1	1.4	3.1	1.75	
<b>225</b> (16 bar)	10	10.0	2.0	3.3	2.50			3	3.3	2.1	3.7	1.75	
	12	12.0	2.3	3.5	2.50			4	4.1	3.0	4.7	1.75	
	14	13.9	2.9	4.1	2.50			6	6.0	5.2	6.9	1.75	
	16	15.9	3.5	4.7	2.50			8	8.0	5.1	6.3	2.50	
	18	17.8	4.1	5.5	2.50			10	10.0	6.6	7.9	2.50	
	20	19.8	4.4	5.9	2.50			12	12.0	7.8	9.1	2.50	
	24	23.8	5.3	6.9	2.50			14	13.9	9.4	10.6	2.50	
							16	15.9	10.8	12.0	2.50		
<b>300</b> (20 bar)	6	6.0	1.9	3.5	1.75		<b>725</b> (50 bar)	1	1.1	1.4	3.1	1.75	
	8	8.0	2.1	3.3	2.50			2	1.7	1.4	3.1	1.75	
	10	10.0	2.8	4.1	2.50			2	2.1	1.8	3.5	1.75	
	12	12.0	3.3	4.5	2.50			3	3.3	3.0	4.7	1.75	
	14	13.9	4.1	5.3	2.50			4	4.1	4.2	5.9	1.75	
	16	15.9	4.8	6.1	2.50			6	6.0	6.9	8.7	1.75	
	18	17.8	5.5	7.1	2.50			8	8.0	6.6	7.9	2.50	
	20	19.8	6.0	7.5	2.50			10	10.0	8.5	9.8	2.50	
	24	23.8	7.3	8.9	2.50			12	12.0	10.2	11.4	2.50	
								14	13.9	12.1	13.4	2.50	
<b>350</b>	4	4.1	1.9	3.5	1.75			16	15.9	14.0	15.4	2.50	
	6	6.0	2.8	4.5	1.75								
	8	8.0	2.8	4.1	2.50								
	10	10.0	3.7	5.1	2.50								
	12	12.0	4.4	5.7	2.50								
	14	13.9	5.3	6.7	2.50								
	16	15.9	6.3	7.7	2.50								
	18	17.8	7.2	8.7	2.50								
	20	19.8	7.9	9.4	2.50								
	24	23.8	9.5	11.0	2.50								

**Annex B**

**Minimum cutting length**

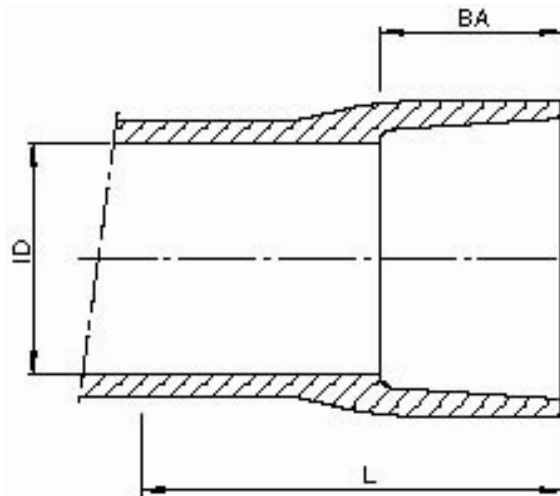


Figure 2. Minimum cutting length (L), socket length (BA) for TB

Table 6. Minimum cutting length (L) (inch)

ND inch	PN psig							
	8	175	225	300	375	450	575	725
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.41
1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.41
2	0.00	0.00	0.00	0.00	0.00	0.00	24.41	25.20
3	0.00	0.00	0.00	0.00	0.00	25.20	25.59	27.56
4	0.00	0.00	0.00	0.00	25.20	25.59	27.56	29.92
6	0.00	0.00	0.00	25.20	27.17	28.74	31.89	35.43
8	0.00	0.00	0.00	25.20	26.77	28.74	31.10	34.25
10	0.00	0.00	25.20	26.77	28.74	30.71	34.25	38.19
12	0.00	0.00	25.59	27.56	29.92	32.68	36.61	41.34
14	0.00	25.20	26.77	29.13	31.89	35.04	39.76	45.28
16	0.00	25.98	27.95	30.71	33.86	37.40	42.52	48.82
18	25.59	27.17	29.13	32.28	35.43	0.00	0.00	0.00
20	25.59	27.56	29.92	33.07	37.01	0.00	0.00	0.00
24	26.77	29.13	31.89	35.83	40.16	0.00	0.00	0.00



**Annex C**

**Number of adhesive kits / Taper joints**

Table 7. Number of 8.8 oz. adhesive kits (250 g) per joint/ number of joints per 8.8 oz. adhesive kit (250 g)

PN psig (bar)	ND inch	Number of kits/ joint (-)	Number of joints/ kit (-)	PN Psig (bar)	ND Inch	Number of kits/ joint (-)	Number of joints/ kit (-)	
<b>(8)</b> <b>115 psi</b>	18	1.0	1.00	<b>(32)</b> <b>450 psi</b>	3	0.2	5.00	
	20	1.0	1.00		4	0.2	5.00	
	24	1.5	0.67		6	0.5	2.00	
<b>(12.5)</b> <b>175 psi</b>	14	1.0	1.00		8	0.6	1.67	
	18	1.0	1.00		10	1.0	1.00	
	20	1.5	0.67		12	1.5	0.67	
	24	1.5	0.67		14	2.0	0.50	
	14	2.0	0.50		16	2.5	0.40	
<b>(16)</b> <b>225 psi</b>	8	0.5	2.00		<b>(40)</b> <b>575 psi</b>	2	0.1	10.00
	10	1.0	1.00			3	0.2	5.00
	12	1.0	1.00	4		0.3	3.33	
	14	1.0	1.00	6		0.6	1.67	
	18	1.5	0.67	8		0.7	1.43	
	20	2.0	0.50	10		1.5	0.67	
	24	2.5	0.40	12		1.5	0.67	
	<b>(20)</b> <b>300 psi</b>	6	0.3	3.33		14	2.5	0.40
8		0.4	2.50	16		3.0	0.33	
10		1.0	1.00	<b>(50)</b> <b>725 psi</b>		1	0.1	10.00
12		1.0	1.00		1.5	0.1	10.00	
14		1.0	1.00		2	0.1	10.00	
16		1.5	0.67		3	0.3	3.33	
18		2.0	0.50		4	0.4	2.50	
20		2.0	0.50		6	0.8	1.25	
24		3.0	0.33		8	0.9	1.11	
<b>(25)</b> <b>350 psi</b>	4	0.2	5.00		10	1.5	0.67	
	6	0.4	2.50		12	2.0	0.50	
	8	0.5	2.00		14	3.0	0.33	
	10	1.0	1.00	16	3.5	0.29		
	12	1.0	1.00					
	14	1.5	0.67					
	16	2.0	0.50					
	18	2.5	0.40					
	20	2.5	0.40					
	24	4.0	0.25					