

WAVISTRONG™

Hubless Flange

ASSEMBLY INSTRUCTIONS
TAPERED BELL AND SPIGOT (TB/TS)
ADHESIVE BONDED JOINT



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Assembly Instructions - Hubless Flange
Tapered Bell And Spigot (TB/TS)
Adhesive Bonded Joint

TERMS OF USE

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OVERVIEW

Future Pipe Industries, member of Future Pipe Group, is a leading manufacturer of high performance, anti-corrosive pipe systems for Oil & Gas, Petrochemical, Power Generation, Desalination and Civil Industries, in addition to the municipal applications. The group was founded in 1973, and since then, has evolved into the leading provider of composite thermosetting pipe systems and technologies in Europe, Africa and the Middle East.

TABLE OF CONTENTS

1	General	3
2	References	3
3	Quality	3
4	Health and safety	4
5.	Inspection	4
6.	Requirements for the Bonding Surface and Ambient Conditions	5
	6.1 Cleaning of the Hubless flange bell end.....	5
	6.2 Unprepared and prepared surface.....	5
	6.3 Ambient conditions and conditioning of bonding surfaces.....	5
	6.4 Cleaning of a machined spigot end or a sanded bell end.....	6
	6.5 Sanding of spigot and Hubless flange bell end.....	7
7.	Dimensioning of a taper spigot end	8
	7.1 Cutting of pipe.....	8
	7.2 Shaving of a pipe end.....	9
8.	Preparing for Bonding	10
	8.1 Sanding and conditioning of both bonding surfaces.....	10
	8.2 Dry fit and marking.....	10
	8.3 Installation of pulling equipment.....	11
9.	Bonding	12
	9.1 Preparation of adhesive.....	12
	9.2 Application of adhesive.....	12
	9.3 Assembly of the spigot in the hubless flange bell.....	13
	9.4 Curing of adhesive.....	13
10.	Materials, Tools and Consumables	15
	10.1 Materials.....	15
	10.2 Tools.....	15
	10.3 Consumables.....	15
Annex A	16
	Dimensions – Hubless flange Tapered Spigot (TS)	
Annex B	18
	Dimensions – Hubless flange Tapered Bell (TB/FL)	

1. GENERAL

This document describes the method to assemble the Tapered Bell and Tapered Spigot (TB-TS) adhesive bonded joints specifically meant only for the Hubless flange joint.

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 is familiar with and fully understands the techniques described in this document.

The instructions in this document are 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 methods.

Besides, our supervisors may be consulted for clarification of statements made in this document and for advice about specific problems encountered in the field.

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:

- WS TCD 009 Wavistrong Easy-Fit Adhesive Instructions

3. QUALITY

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

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

4. HEALTH AND SAFETY

When working with GRE products, the 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)



Fig. A

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

5. INSPECTION

Pipes and hubless flanges used in the pipeline system shall be inspected for damages 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.

Ensure all necessary tools and materials are available.

Take notice of the safety precautions stated in this document and those in the referenced instructions.

6. REQUIREMENTS FOR THE BONDING SURFACE AND AMBIENT CONDITIONS

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

6.1. Cleaning of the Hubless flange bell end

The outer face of a hubless flange bell and the inner surface must be clean and dry before starting any operation.

If these unprepared surfaces of product ends have been in contact with oil or grease, they must be cleaned using a clean cloth, which is soaked in clean acetone, M.E.K. (Methyl Ethyl Ketone) or M.I.B.K. (Methyl Iso Butyl Ketone). Dry the cleaned surface with a clean, dry and non-fluffy cloth.



Fig.1

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. 1).

6.2. 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 was after completion of the manufacturing process.

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 wall structure may come in direct contact with the environment and therefore this surface is sensitive to contamination.

6.3. Ambient conditions and conditioning of bonding surfaces

If the bonding surfaces are visibly wet, these surfaces must be dried and heated.

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 forming 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 surfaces.

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.

To dry the bonding surface, raise the temperature of the bonding surfaces using hot air gun 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 end during the bonding procedure should be kept between 15 °C and 40 °C, but also at least 3 °C above dew point.

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

6.4. 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 6.5).

In case of doubt about the nature of the contamination cut the concerned spigot- or bell end.

If there are no traces of contamination on the pipe ends, clean these bonding surfaces using a clean, dry and non-fluffy cloth.

Do not touch the cleaned bonding surface, nor allow it to be contaminated.

6.5. Sanding of spigot and Hubless flange bell end

The sanding operation of the bonding surfaces of both, spigot- and hubless flange bell end, shall be performed within 2 hours from the actual bonding operation.

Bonding surfaces must be clean and dry at the start of the sanding operation (see sections 6.1, 6.3 and 6.4).

Sanding of unprepared hubless flange bell ends is performed mechanically, using an emery cup with a grid of grade P40 to P60 (see fig. 2). Rotation speed of the emery cup shall be as low as possible.

Sanding of factory and/or field prepared spigot- and hubless flange bell ends is performed mechanically using an emery cup with a grid of grade P40 to P60.

A correctly sanded surface of a hubless flange bell end does not change in colour when continuing sanding (see fig. 2). A factory prepared spigot end has been correctly sanded when the black ink has been removed completely and the surface does not change in colour when continuing sanding (see fig. 3)

Bonding surfaces must be sanded equally in circumferential direction.

The bonding surface must be rough and even by applying an uniform pressure on the sanding equipment. Break any sharp edge of the tip of the machined spigot end.

The bonding surface is cleaned using a dry and clean dust bristle brush (see fig. 4). 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. 2

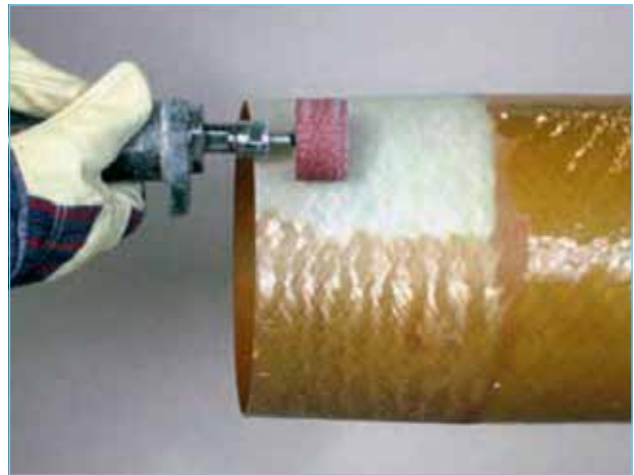


Fig. 3

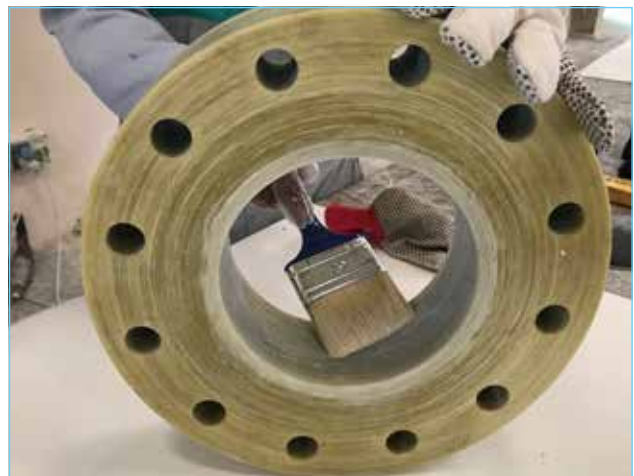


Fig. 4

7. DIMENSIONING OF A TAPER SPIGOT END

In case a pipe with the correct length and (factory) shaved spigot end is available, then continue with section 8 of these instructions.

This section 7 is relevant in case the pipe length has to be adjusted or a spigot end has to be shaved.

Make sure to comply with the relevant requirements stated in section 6 before starting the next step in the activities to complete the bonding procedure.

7.1. Cutting of pipe

a. Contaminated pipe surfaces must be cleaned prior to perform any operation on the pipe (see relevant requirements stated in section 6).

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. 5).

d. Scribe the pipe at the required length, using a pipe fitters' wrap-around (see fig. 6); take notice of the minimum cut length (see Annex B).

e. Cut the pipe square using a diamond coated or carbide hacksaw or an abrasive wheel).

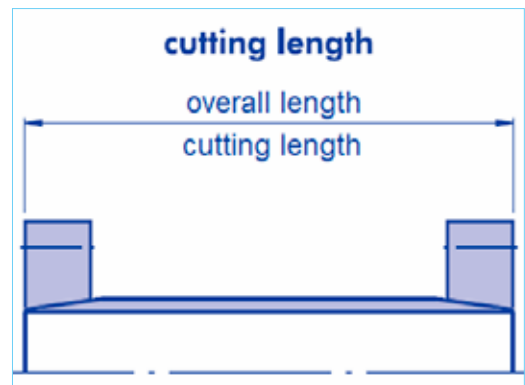


Fig. 5



Fig. 6

Table 1 Tolerance cut end

ID (mm)	A (mm)
25 - 600	± 3

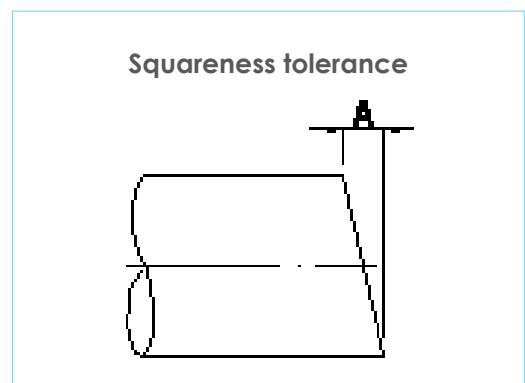


Fig. 7

7.2. Shaving of a pipe end

a Various types of shavers are available (see fig. 8).

To operate the shaver, carefully follow the applicable shaver instructions (see section 2).

Note: TS shaver must be used to shave the hubless flange spigot (TS) configuration.

b The pipe end to be shaved shall be clean (see relevant requirements in section 6) and must be adequately supported (see section 7.1.b and fig. 9).

c Start the shaving procedure (see fig. 10), 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.

d Repeat the shaving action until the required spigot dimensions (see Annex A, table A) are achieved.

Measurement of the nose thickness (T) at a number spots (3 – 6) in the circumference of the head of the spigot (see figure 11) can be used to obtain an indication of having achieved the required spigot diameter (S1).



Fig. 8



Fig. 9



Fig. 10



Fig. 11

8. PREPARING FOR BONDING

Before any actual bonding activity can start, the spigot- and the hubless flange bell end to be jointed shall be prepared as described below.

As more joints can be made with one adhesive kit; in some cases, it may be advantageous to assemble more joints at the same time (see section 2).

8.1. Sanding and conditioning of both bonding surfaces

Make sure to comply with the relevant requirements stated in section 6.

Note 1

The maximum number of sanding operations for each of the bonding surfaces, either the spigot- or the hubless flange 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 A, table A.

Determine the spigot diameter (S1). The wall thickness of the spigot (T) is measured at the end of the spigot at a number (≥ 6) of positions equally spaced in the circumference.

In case the number of sanding operations of the bonding surfaces is more than two, or the spigot dimensions are not in compliance with the requirements, the product shall not be used or the spigot end shall be cut.

8.2. Dry fit and marking

In order to be able to check the required final position of the spigot relative to the hubless flange bell, the joint of a pipe and a fitting is marked with an alignment mark.

Scribe a line on the outer surface of the bell, parallel to the axis of the product and continuing on the outer surface of the pipe containing the shaved spigot end (see fig. 12).

The spigot should be fully inserted and properly align to the face of the flange (see fig. 13).

Note:

If the TS spigot overshoots and coming out of the flange face (see fig. 13.a), the overshoot / excess portion needs to be cut off. The flange face shall be having a flat surface.

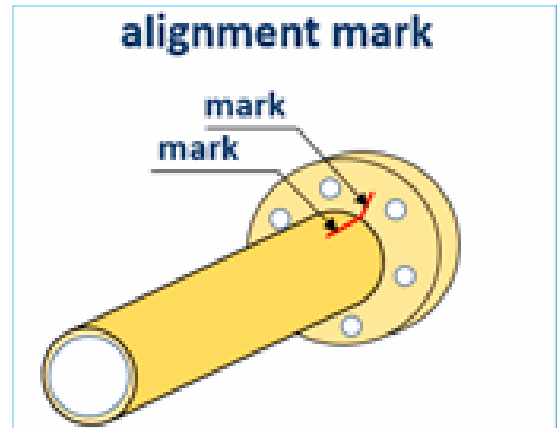


Fig. 12



Fig. 13



Fig. 13.a

8.3. Installation of pulling equipment

If The mechanical equipment can be used to pull the spigot centrally in the bell. Two winches can be used. The position of the winches is equally spaced over the circumference of the parts to be jointed in order to realise centric entrance of the spigot in the bell. Make sure that there will be sufficient space to apply adhesive on the bonding surfaces.

Respect the required alignment of the parts to be jointed as well as the support during the bonding operation (see fig. 14).

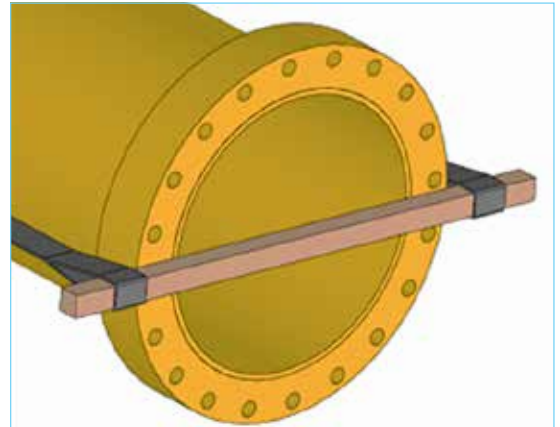


Fig. 14

9. BONDING

The actual bonding starts with the preparation of the adhesive and finishes after completion of the curing, when the adhesive between the jointed parts is cooled down to ambient temperature. 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 time of the adhesive. This means that the period within mixing of the adhesive components until the spigot has been pushed into the bell shall fall within the pot-life/working time.

9.1. Preparation of adhesive

- a. Select the proper type and kit size of adhesive, if applicable. 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).
- b. The temperature of the adhesive shall comply with the requirements stated in the relevant document (see section 2).
- c. Apply the adhesive on the prepared bonding surfaces, immediately after finishing the mix procedure of the adhesive components.
- d. Never use adhesive that has started to cure; this is the case when the mixture gets clotted, toughens and the temperature rises significantly.

9.2. Application of adhesive

- a. 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, this spatula must be cleaned first.
- b. Wet the sanded surfaces of spigot- and bell end with some force with a thin, uniform coating of adhesive (hardly any thickness).
- c. Apply a thin (~0.5mm) 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.
- d. Make sure to apply sufficient adhesive on the cylindrical end of the spigot that will be covered by the bell
- d. Avoid any contact with the adhesive coatings on the bonding surfaces and prevent any contamination.



Fig. 15



Fig. 16

9.3. Assembly of the spigot in the hubless flange bell

- a Parts to be jointed shall be aligned as true as possible. Any visual misalignment is unacceptable.
- b Insert the spigot in the hubless flange bell and push it home while rotating slowly one quarter of a rotation, if possible. Pay attention to the alignment mark on the outer surface with regard to the orientation of the parts to be jointed.
- c Make sure that the spigot is inserted centrally into the bell until the spigot reached the back face of the flange.
- d Remove the excessive adhesive from the outer surface (see fig. 18 and 19) and from the back face of the flange.
- e Provide proper supporting to keep the joint undisturbed.



Fig. 17



Fig. 18



Fig. 19

9.4. Curing of adhesive

- a Until completion of the cure of the adhesive the joint shall not be moved, vibrated or otherwise disturbed.
- b Hubless flanges shall be cured by placing the heating blanket against the inner surface of the flange. Keep the power supply cable free from the blanket.
- c 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).



Fig. 20

Check the functioning of the heating blanket, at least at the start and at the end of the curing process.

- d 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.
For the required curing process reference is made to the relevant adhesive instructions (see section 2).

- e 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.
- f If either the curing time or the curing temperature does not comply with the requirements of the curing cycle, the complete curing cycle shall be repeated.
- g 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.

10. MATERIALS, TOOLS AND CONSUMABLES

10.1. Materials

- Adhesive *

10.2. Tools

- Shaver *
- Heating blanket (plus temperature controller, if applicable) *
- Measuring tape and/or folding rule
- Vernier calliper
- Pi-tape
- Pipe fitters' wrap-around
- Level and marker
- Protractor
- Pipe vice or stable supports (brackets) with rubber coated clamping device
- Hacksaw, disc grinder or power jigsaw
- Small electrical or air driven straight grinder with adjustable rotation speed.
- 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
- Tenting (subject to weather conditions)

* To be supplied by the pipe manufacturer.

10.3. Consumables

- Cutting disks
- Emery cups grade P40 to P60
- Spatula (rubber scraper plate, filling knife), marker pen, dust (paint) brush
- Rubber gloves, working gloves, dust masks, safety goggles
- Cleaning plug
- Overalls, safety shoes, safety helmet
- Cleaning rags, cleaning fluid such as acetone, Methyl Ethyl Ketone (MEK) or Methyl Iso Butyl Ketone (MIBK)

ANNEX A
DIMENSIONS – HUBLESS FLANGE TAPERED SPIGOT (TS)

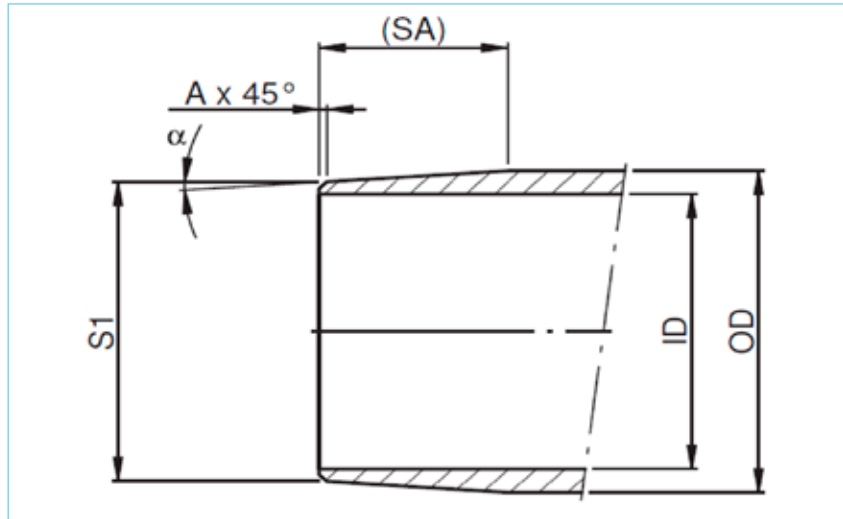


Table A - Dimensions Hubless flange – Tapered Spigot (TS)

PN (bar)	ID (mm)	Pipe OD (mm)	S1 (mm)	SA (± 0.2) (mm)	A (mm)
12.5	350	358.60	353.80	55.0	0.5
	400	409.60	403.92	65.0	0.5
	450	460.60	454.05	75.0	0.5
	500	511.80	504.81	80.0	0.5
	600	613.80	605.50	95.0	0.5
16	250	258.00	253.63	50.0	0.5
	300	309.20	303.96	60.0	0.5
	350	360.40	354.29	70.0	0.5
	400	411.80	404.81	80.0	0.5
	450	463.00	455.14	90.0	0.5
	500	514.20	505.47	100.0	0.5
	600	616.80	606.32	120.0	0.5
20	150	156.40	153.96	40.0	0.5
	200	208.20	203.83	50.0	0.5
	250	259.80	254.12	65.0	0.5
	300	311.40	304.85	75.0	0.5
	350	363.00	355.14	90.0	0.5
	400	414.60	405.87	100.0	0.5
	450	466.20	456.16	115.0	0.5
	500	517.80	506.88	125.0	0.5
	600	621.20	608.10	150.0	0.5

Pipe OD = Pipe Outside Diameter

S1 = Nominal Spigot Diameter

SA = Nominal Spigot Length

$\alpha = 1.75^\circ$ (for DN ≤ 150 mm)

$= 2.50^\circ$ (for DN > 150 mm)

Table A - Dimensions Hubless flange – Tapered Spigot (TS)

PN (bar)	ID (mm)	Pipe OD (mm)	S1 (mm)	SA (±0.2) (mm)	A (mm)
25	100	106.40	104.26	35.0	0.5
	125	131.80	129.36	40.0	0.5
	150	157.80	154.74	50.0	0.5
	200	209.80	204.12	65.0	0.5
	250	261.80	254.81	80.0	0.5
	300	313.80	305.50	95.0	0.5
	350	365.80	356.19	110.0	0.5
	400	418.00	407.08	125.0	0.5
	450	470.00	457.34	145.0	0.5
	500	522.00	508.03	160.0	0.5
32	600	626.00	609.41	190.0	0.5
	80	86.40	84.26	35.0	0.5
	100	106.80	104.36	40.0	0.5
	125	133.00	129.94	50.0	0.5
	150	159.20	155.53	60.0	0.5
	200	211.80	204.81	80.0	0.5
	250	264.40	255.67	100.0	0.5
40	300	317.00	306.52	120.0	0.5
	50	55.20	53.37	30.0	0.5
	65	71.40	69.26	35.0	0.5
	80	86.80	84.36	40.0	0.5
	100	108.20	105.14	50.0	0.5
	125	134.80	130.83	65.0	0.5
	150	161.60	157.02	75.0	0.5
	200	214.80	206.07	100.0	0.5
	250	268.20	257.28	125.0	0.5
50	300	321.40	308.30	150.0	0.5
	25	30.20	28.37	30.0	0.5
	40	45.20	43.37	30.0	0.5
	50	55.80	53.66	35.0	0.5
	65	72.00	69.25	45.0	0.5
	80	88.20	85.14	50.0	0.5
	100	110.00	106.03	65.0	0.5
	125	137.00	132.11	80.0	0.5
	150	164.20	158.39	95.0	0.5
	200	218.20	207.28	125.0	0.5
	250	272.40	258.43	160.0	0.5
	300	326.60	310.01	190.0	0.5

Pipe OD = Pipe Outside Diameter

S1 = Nominal Spigot Diameter

SA = Nominal Spigot Length

$\alpha = 1.75^\circ$ (for DN ≤ 150 mm)

$= 2.50^\circ$ (for DN > 150 mm)

ANNEX B
DIMENSIONS – HUBLESS FLANGE TAPERED BELL (TB/FL)

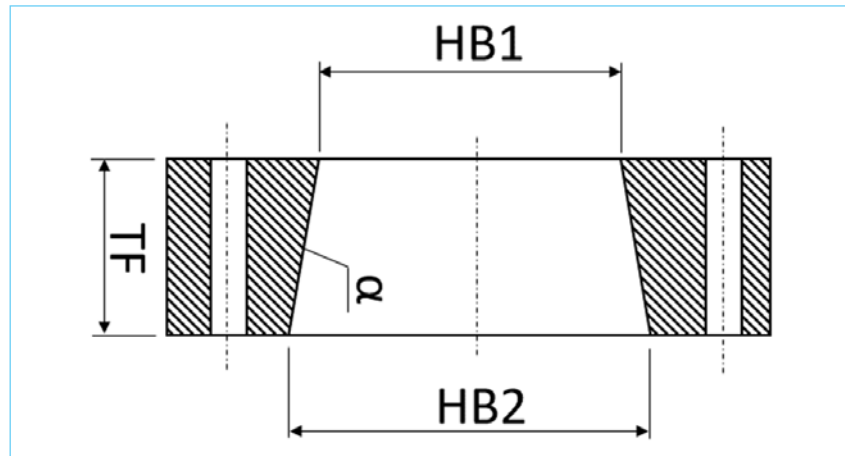


Table B - Dimensions Hubless flange - Tapered Bell (TB)

PN (bar)	ID (mm)	HB1 (mm)	HB2 (mm)	TF (mm)
12.5	350	353.80	358.60	55
	400	403.92	409.60	65
	450	454.05	460.60	75
	500	504.81	511.80	80
	600	605.50	613.80	95
16	250	253.63	258.00	50
	300	303.96	309.20	60
	350	354.29	360.40	70
	400	404.81	411.80	80
	450	455.14	463.00	90
	500	505.47	514.20	100
	600	606.32	616.80	120
20	150	153.96	156.40	40
	200	203.83	208.20	50
	250	254.12	259.80	65
	300	304.85	311.40	75
	350	355.14	363.00	90
	400	405.87	414.60	100
	450	456.16	466.20	115
	500	506.88	517.80	125
	600	608.10	621.20	150

Table B - Dimensions Hubless flange - Tapered Bell (TB)

PN (bar)	ID (mm)	HB1 (mm)	HB2 (mm)	TF (mm)
25	100	104.26	106.40	35
	125	129.36	131.80	40
	150	154.74	157.80	50
	200	204.12	209.80	65
	250	254.81	261.80	80
	300	305.50	313.80	95
	350	356.19	365.80	110
	400	407.08	418.00	125
	450	457.34	470.00	145
	500	508.03	522.00	160
32	600	609.41	626.00	190
	80	84.26	86.40	35
	100	104.36	106.80	40
	125	129.94	133.00	50
	150	155.53	159.20	60
	200	204.81	211.80	80
	250	255.67	264.40	100
40	300	306.52	317.00	120
	50	53.37	55.20	30
	65	69.26	71.40	35
	80	84.36	86.80	40
	100	105.14	108.20	50
	125	130.83	134.80	65
	150	157.02	161.60	75
	200	206.07	214.80	100
	250	257.28	268.20	125
50	300	308.30	321.40	150
	25	28.37	30.20	30
	40	43.37	45.20	30
	50	53.66	55.80	35
	65	69.25	72.00	45
	80	85.14	88.20	50
	100	106.03	110.00	65
	125	132.11	137.00	80
	150	158.39	164.20	95
	200	207.28	218.20	125
	250	258.43	272.40	160
300	310.01	326.60	190	

