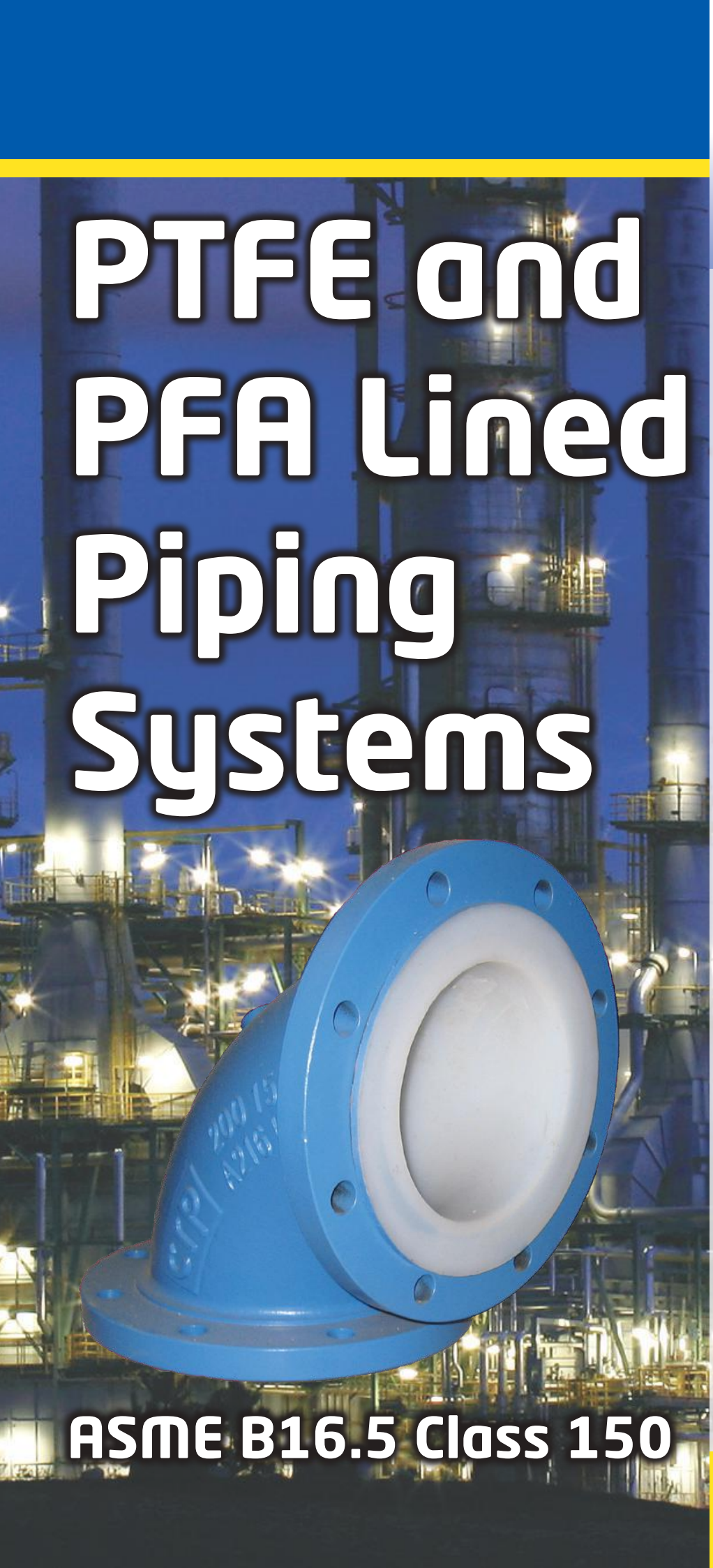
# PTFE and PFA Lined Piping Systems



## ASME B16.5 Class 150

crp

the corrosion expert

CRP is a world leader in the manufacture of PTFE and PFA lined equipment including pipe, fittings, valves, bellows, sight glasses and other ancillary equipment. CRP supplies to the chemical, agro-chemical, pharmaceutical, petrochemical, biotechnology, pulp & paper, metals refining, food and beverage manufacturing sectors.

The core of CRP's product offering is PTFE and PFA lined piping. CRP manufacture the most comprehensive range of equipment to provide a cost effective and versatile piping system.

This manual covers the ASME Class 150 product range. The range is also manufactured to DIN dimensional standards and to other international piping standards.

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# Why choose CRP?

**Materials**
- Focus on Fine Powder PTFE and PFA the best materials for corrosion, permeation and high purity management
- The lowest total cost of ownership

**Materials Management**
- Technical reassurance and control over all manufacturing processes in-house
- Traceability of materials and testing through the complete supply chain
- Logistical control in manufacturing making the business flexible and responsive to customer needs
- Control of complete supply chain from raw material to finished product

**Develop**
- Continuing investment in product and process innovation
- Both a manufacturer and distributor of complementary lined equipment with the capability of complete package supply
- A business with the flexibility and nimbleness of a small company, but with the financial underpinning of a large enterprise

**Expert**
- A problem solving business whose catalogue is only the start
- Real technical expertise in an area where experience is critical
- A technically qualified field sales team whose role is to provide product support, training and expertise to solve unique site problems
- A global player supplying world-wide with a local presence

**Standards**
- Designed, manufactured and tested according to the European Pressure Equipment Directive
- Manufacturing and test in accordance with **ASTM F1545**
- Extensive in-house testing of raw and processed materials and finished products

**Performance Measures**
- Driven by what is important to our customers:
  - Quality - **ISO 9001:2015** certified
  - Delivery lead times
  - Delivery reliability - tracking and managing delivery performance for on time in full delivery
- As a true manufacturer capable of being flexible to manage emergencies

**Track Record**
- 35 years of product development
- 35 years of process technology development
- Long term supply contracts to global businesses
- Long term supply contracts to small local businesses - globally
- More than 2,500 satisfied customers

# Our Plan

**"To be a World Class supplier of fluoropolymer lined equipment through delivering technically superior products and by creating close relationships with customers that require high levels of service, quality, innovation and technical support to provide the lowest cost of ownership."**



# Index

# Key Product Families

CRP complement the lined piping with associated products that follow the PTFE or PFA lined theme. These include:

- **PFA lined Ball, Plug and Butterfly Valves for the UK market**
- **PFA lined Swing Check and Poppet Check Valves**
- **PFA lined Control Valves**
- **PFA lined Strainers**
- **PFA lined and unlined Tubular Sight Glasses and Level Gauges**
- **PTFE Bellows or Expansion Joints**

The business also produces a comprehensive range of standard and customised sampling systems for those that require safe and representative sampling, typically for sampling hazardous or expensive materials. These can be In-line, mounted directly to pipe work or reactor vessels or mounted to the top of reactors. CRP distribute a range of Graphite and Silicon Carbide Heat Exchangers plus many pipeline complementary items including special earthing washers "Spikies" for lined systems, PTFE gaskets designed specifically for lined systems and a comprehensive range of safety shields.

Most importantly CRP positions itself as a problem solving business and although we produce catalogues we spend much time developing specific products or product combinations to solve customer processing problems. Again, this is facilitated by having our own design and manufacturing capability.

# Materials Introduction

## Lining Materials

CRP manufactures product in both virgin and static-dissipating (also known as anti-static) fluoropolymer resins; principally in PTFE and PFA. These are supplied under the HiPerFlon label representing a combination of raw materials and processing choices. In addition we manufacture products in a modified PTFE that provides enhanced performance against permeation. This is termed Ultra HiPerFlon or abbreviated to UHP.

More background to lining materials is provided in the following section on Design Philosophy, but here is a very simple guide to our key fluoropolymer resins and where they are used.

### Virgin PTFE HiPerFlon

CRP's Virgin PTFE is called HiPerFlon in order to recognise the unique combination of material - a fine powder PTFE and process - paste extrusion. It is used principally on pipe spools in straight lengths and some simple fittings without branches.

### PTFE UHP (Ultra HiPerFlon)

This material is used for high performance requirements specifically for the management of permeation.

### Static-Dissipating PTFE (Anti-static)

Here a small percentage of carbon black is used within the virgin PTFE which reduces the electrical resistance of the material to a level at which any electrical charge generated by static charging within a pipeline can flow through the PTFE to the adjoining

Lining Material Range

| Nominal Bore | | Pipe Spools | | | | Fittings | |
|---|---|---|---|---|---|---|---|
| | | Virgin PTFE HiPerFlon | Static-Dissipating PTFE | UHP PTFE | | Virgin PFA/PTFE | Static-Dissipating PFA/PTFE |
| Inches | mm | Heavy Duty | Heavy Duty | Heavy Duty | Superweight | Heavy Duty | Heavy Duty |
| ½ | 15 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| ¾ | 20 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 1 | 25 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 1½ | 40 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 2 | 50 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 3 | 80 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 4 | 100 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 6 | 150 | ✓ | ✓ | | ✓ | ✓ | ✓ |
| 8 | 200 | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 10 | 250 | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 12 | 300 | ✓ | ✓ | ✓ | | ✓ | ✓ |
| 14 | 350 | ✓ | ✓ | ✓ | | ✓ | ✓ |





| Key Lining Choices | |
|---|---|
| Application | Product Choice |
| Most applications requiring lined pipe and fittings | HiPerFlon Virgin PTFE and PFA |
| Applications with known permeant chemicals | UltraHiPerFlon PTFE and PFA |
| Applications for high purity | HiPerFlon Virgin PTFE and PFA |
| Applications requiring management of static discharge; typically non-conducting solvents | HiPerFlon Static-Dissipating PTFE and PFA |

## Outer Housings

### Pipe Spools and Fabricated Fittings

Pipe spools are manufactured using carbon steel rated for pressure containing purposes. These are either provided with integral stub ends behind which we mount a flange – referred to as Van Stone spools, or a welded flange or stub end combined with a loose or rotating flange. Fabricated steelwork and to earth.

### Virgin PFA

PFA as a melt processable material with all of the performance characteristics of PTFE and some more is used as the material of choice for lined fittings, being capable of dealing with more complex geometries and having superior performance in the most challenging applications.

### Static-Dissipating (Anti-static) PFA

This fulfills the same requirement for fittings as static-dissipating PTFE does for pipe spools.

fittings are made from a combination of carbon steel pipe, forgings, flanges and stub ends. All welding activities are undertaken using "coded" welders.

### Cast Fittings

Where CRP differs significantly from the competition is that the majority of pipe fittings are manufactured as steel lost wax investment castings. A number of product quality reasons have driven this choice, notably:

1. No fabrication welds, therefore no concerns about weld integrity
2. Greater strength
3. Precise close tolerance parts for installation fit
4. Dimensional accuracy for lining geometry
5. No flash or parting lines
6. Clear written casting detail for identification and traceability

Cast steel fittings are significantly – almost 50% - stronger than fabrications of a similar nominal bore and importantly do not contain construction welds. The grade of steel used by CRP is ASTM A216 WCB with a minimum cast wall of 5.5mm at 25NB which is some 2.12 mm thicker that schedule 40 steel tube of the equivalent nominal bore

The dimensional accuracy gives improved lining control with lined faces which are square to the line axis of the fittings bores and bores that are concentric to the flange periphery and the body outside diameter. The extensive machining of the steel casting provides flat rear faces to flanges allows accurate torqueing of bolts and assists in flanges being pulled up square. The fine ceramic powder used in creating the steel casting mould allows much greater detail to be cast and moreover be much more readable than that provided by sand cast ductile iron and such markings are not even possible with fabricated fittings – generally leaving them anonymous and untraceable.

# Design Philosophy

## Manufacturing

It is important to understand that CRP manufacture their own products in their manufacturing facility based just north of Manchester in the UK. CRP is unusual in the UK as the only direct manufacturer of the product from raw fluoropolymer through to the finished product. This gives the business great advantages of logistical control of delivery lead-times and due date adherence. It also means that we are fully in control of our own manufacturing processes and quality and can provide complete product traceability.

## Process Expertise

CRP has been around for much of the time that PTFE and all of the time that PFA have existed on the planet. The company has had the benefit of growing up with these materials and has played a key role in their development for processing through working with the raw material manufacturers and developing their own processing equipment. All of the key machines and associated equipment at CRP for both PTFE and PFA production have been developed - and continue to be developed in-house. This enables us to continue to expand the product range, but as importantly gives us the certain knowledge of how products have been manufactured. This is critical when not all attributes of such products can be tested through routine production tests. CRP is the only manufacturer producing PFA moulded elbows and tees in sizes up to 14in diameter.

## Our Materials and Processes

CRP are proud of their association with key materials manufacturers and have selected the top international suppliers of fluoropolymers for their materials providing both quality and technical support. Concerning PTFE there are two key material forms used in our industry, granular powders and fine powders (technically known as coagulated dispersions.)

## Paste Extrusion

CRP chooses to use fine powders combined with a pipe liner production process called paste extrusion. The powder has a base particle size of 0.18 - 0.25µm making them one hundred times smaller than the granular powders. Moreover, the particle size distribution is extremely narrow versus that of the granular powders. A combination of the two characteristics provides a packing density for the material of 55%, which is close to the theoretical maximum for spheres of equal size. However, the fine powder material has another attribute that really moves its processing on and this is the agglomeration of these base or primary particles into larger secondary particles of 400-600 µm in size.

These features come into their own in the paste extrusion process. In this process the PTFE is extruded through a die with a pin inside providing the internal diameter and wall thickness of the soon to become pipe liner. The die has a smaller cross-sectional area than the PTFE billet being extruded and its form is gradual causing the flow velocity to increase as the material enters the die. This generates a shear gradient in the direction of the flow and forces the paste material into irreversible plastic deformation. The extruded material gains strength from the deformation, a process called fibrillation and the void content is further reduced. This is because the secondary particles are deformed into fibrils - a string like alignment of the primary particles, and have irreversibly deformed, but the primary particles are preserved intact although kneaded, bouncing back into their round form after extrusion. Once through the extrusion process the primary particles relax and return to their original spherical shape, leaving a more compact structure.

In terms of what this means for the user is that paste extruded fine powders, combined with the homogeneous nature of the liner and it's unifrom wall thickness provide the highest levels of permeation resistance and the smoothest material finish - aiding both service life and the cleanability of the product.

## PFA Transfer Moulding

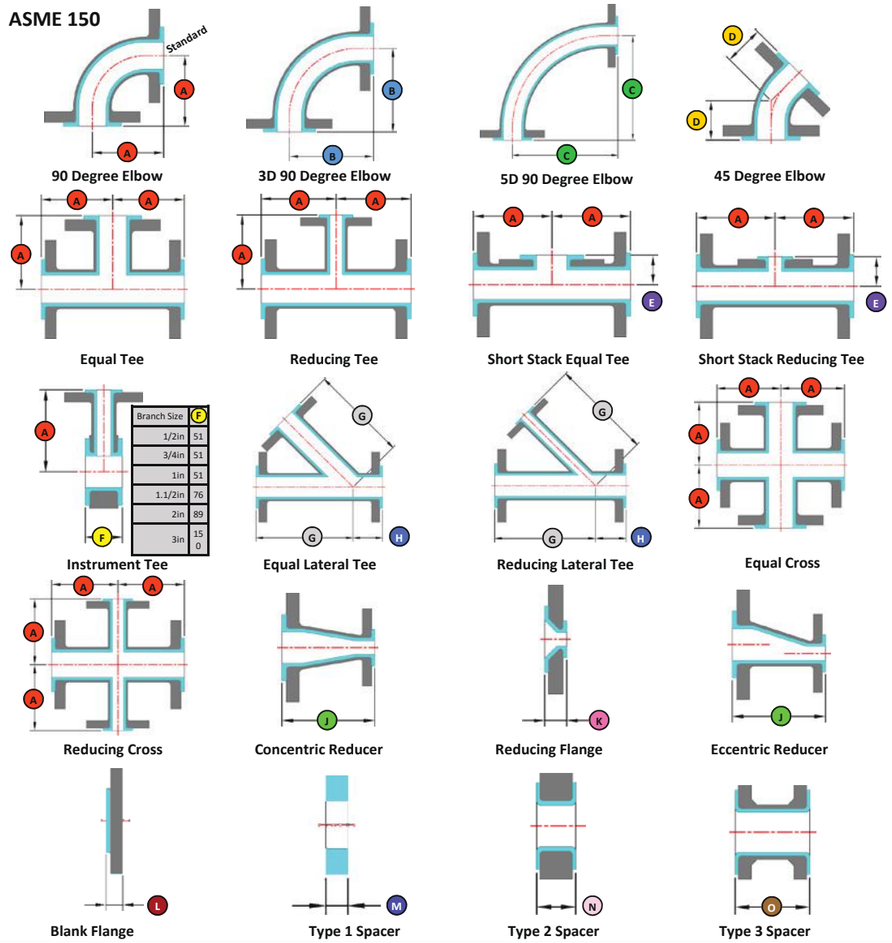
PFA was the outcome of years of research into creating a fluoropolymer that is a true thermoplastic and therefore melt processable. In production PTFE has the challenge of requiring very specialist techniques to create the shapes required for products. PFA does not have this disadvantage as it is capable of being melted and moulded into shape. Again CRP chooses PFA's that have the highest performance in corrosive applications - manifest by a low melt flow rate (MFR). Also high purity PFA's are also available for specific applications. The process for lining components in PFA is challenging, as the PFA has to be injected at high pressure and temperature into a void created inside the component in a stress free manner. The process is isothermal in that the component, it's tooling and the PFA all have to be at the melt temperature of the PFA through the moulding process - called transfer moulding. A further challenge is that the PFA reduces in volume as it cools and this reduction has to be catered for through the introduction of futher raw material.

The equipment for transfer moulding has been developed in-house and significant equipment development has been initiated recently with the use of the expertise of the Polymer Science department at a local university.



# Summary Dimensional Table

Dimensions are generally to ASME B16.5 and expressed in millimetres.




| Nominal Bore | DN | A | B | C | D | E | G | H | J | K | L | M Max. | N Max. | O Max. | Van Stone Spool Min. | Fixed/ Rotating Spool Min. | Spool Max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 in | DN 15 | 65* | | | | | | | | | 14 | 25 | 60 | 100 | 250 | 90 | 6000 |
| 3/4 in | DN 20 | 75 | | | | | | | | 30 | 15 | 25 | 60 | 100 | 250 | 90 | 6000 |
| 1 in | DN 25 | 89 | n/a | 127 | 44 | 30 | 146 | 44 | | 30 | 16 | 25 | 60 | 100 | 250 | 90 | 6000 |
| 1 1/2 in | DN 40 | 102 | 114 | 191 | 57 | 37 | 178 | 51 | 114 | 30 | 19 | 25 | 60 | 100 | 250 | 95 | 6000 |
| 2 in | DN 50 | 114 | 152 | 254 | 63 | 43 | 203 | 64 | 127 | 30 | 21 | 25 | 70 | 150 | 250 | 110 | 6000 |
| 3 in | DN 80 | 140 | 229 | 381 | 76 | 56 | 254 | 76 | 152 | 35 | 26 | 25 | 70 | 150 | 250 | 120 | 6000 |
| 4 in | DN 100 | 165 | 305 | 508 | 102 | 67 | 305 | 76 | 178 | 35 | 26 | 25 | 70 | 150 | 250 | 125 | 6000 |
| 6 in | DN 150 | 203 | 457 | 762 | 127 | 105 | 368 | 89 | 229 | 40 | 27 | 25 | 80 | 150 | 500 | 140 | 6000 |
| 8 in | DN 200 | 229 | 610 | 1016 | 140 | 125 | 444 | 114 | 279 | 40 | 31 | 25 | 80 | 200 | 500 | 150 | 3000 |
| 10 in | DN 250 | 279 | 762 | 1270 | 165 | 165 | 521 | 127 | 305 | 35 | 32 | 25 | 80 | 200 | n/a | 165 | 3000 |
| 12 in | DN 300 | 305 | 914 | 1524 | 190 | 190 | 622 | 140 | 356 | 40 | 34 | 25 | 80 | 200 | n/a | 170 | 3000 |
| 14 in | DN 350 | 356 | 1067 | 1778 | 190 | 210 | | | 406 | 40 | 37 | 25 | 80 | 200 | n/a | 190 | 3000 |

*Please note that 1/2in 90 Degree Elbow is 100mm. The Face to face Dimension of reducing fittings is normally defined by the nominal bore of the larger size. Special dimensions are available on request. For further information go to our website at www.crp.co.uk or call us on +44(0)1706 756400. Please note, no warranties are given on the accuracy of the data, which may be subject to revision, for confirmation please refer to the appropriate standards documents. CRP's dimensions may vary from those of other manufacturers and not all components

# Joint Data

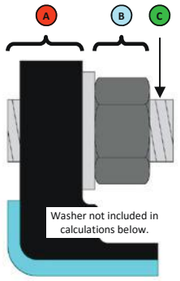
## Half Joint Calculator for ASME B16.5 Class 150 Joints for CRP Lined Equipment

Dimensions in millimetres

### Bolting and Torque Details

| Nominal Bore | DN | Flange Ø | Pitch Circle Ø | No. of Bolt Holes | Hole Ø | Bolts/ Studs | Bolts/Studs Metric | Torque Nm |
|---|---|---|---|---|---|---|---|---|
| 1/2 in | DN 15 | 90 | 60.3 | 4 | 15.9 | 1/2" | M12 | 7 |
| 3/4 in | DN 20 | 98 | 69.9 | 4 | 15.9 | 1/2" | M12 | 15 |
| 1 in | DN 25 | 108 | 79.4 | 4 | 15.9 | 1/2" | M12 | 19 |
| 1 1/2 in | DN 40 | 127 | 98.4 | 4 | 15.9 | 1/2" | M12 | 27 |
| 2 in | DN 50 | 152 | 120.7 | 4 | 19.0 | 5/8" | M16 | 47 |
| 3 in | DN 80 | 190 | 152.4 | 4 | 19.0 | 5/8" | M16 | 73 |
| 4 in | DN 100 | 229 | 190.5 | 8 | 19.0 | 5/8" | M16 | 54 |
| 6 in | DN 150 | 279 | 241.3 | 8 | 22.2 | 3/4" | M20 | 108 |
| 8 in | DN 200 | 343 | 298.5 | 8 | 22.2 | 3/4" | M20 | 136 |
| 10 in | DN 250 | 406 | 362.0 | 12 | 25.4 | 7/8" | M24 | 127 |
| 12 in | DN 300 | 483 | 431.8 | 12 | 25.4 | 7/8" | M24 | 145 |
| 14 in | DN 350 | 533 | 476.3 | 12 | 28.6 | 1" | M27 | 182 |

Please refer to CRP User Guide for more information relating to making joints in PTFE/PFA lined equipment. Remember re-torqueing is required after 24 hours or one process cycle.




| Nominal Bore | DN | Component | Half Joint Total Thickness (A) |
|---|---|---|---|
| 1 in | DN 25 | Heavy Duty Van Stone Spool | 20.5 |
| 1 1/2 in | DN 40 | Heavy Duty Van Stone Spool | 23.5 |
| 2 in | DN 50 | Heavy Duty Van Stone Spool | 25.5 |
| 3 in | DN 80 | Heavy Duty Van Stone Spool | 29.5 |
| 4 in | DN 100 | Heavy Duty Van Stone Spool | 33.0 |
| 6 in | DN 150 | Heavy Duty Van Stone Spool | 36.5 |
| 8 in | DN 200 | Heavy Duty Van Stone Spool | 42.0 |
| 1/2 in | DN 15 | Heavy Duty Spool Fixed Flange | 13.5 |
| 3/4 in | DN 20 | Heavy Duty Spool Fixed Flange | 14.5 |
| 1 in | DN 25 | Heavy Duty Spool Fixed Flange | 17.5 |
| 1 1/2 in | DN 40 | Heavy Duty Spool Fixed Flange | 20.5 |
| 2 in | DN 50 | Heavy Duty Spool Fixed Flange | 21.5 |
| 3 in | DN 80 | Heavy Duty Spool Fixed Flange | 26.5 |
| 4 in | DN 100 | Heavy Duty Spool Fixed Flange | 28.0 |
| 6 in | DN 150 | Heavy Duty Spool Fixed Flange | 31.0 |
| 8 in | DN 200 | Heavy Duty Spool Fixed Flange | 35.0 |
| 10 in | DN 250 | Heavy Duty Spool Fixed Flange | 38.0 |
| 12 in | DN 300 | Heavy Duty Spool Fixed Flange | 40.0 |
| 1/2 in | DN 15 | Heavy Duty Spool Rotating Flange | 23.5 |
| 3/4 in | DN 20 | Heavy Duty Spool Rotating Flange | 26.5 |
| 1 in | DN 25 | Heavy Duty Spool Rotating Flange | 29.5 |
| 1 1/2 in | DN 40 | Heavy Duty Spool Rotating Flange | 32.5 |
| 2 in | DN 50 | Heavy Duty Spool Rotating Flange | 35.5 |
| 3 in | DN 80 | Heavy Duty Spool Rotating Flange | 42.5 |
| 4 in | DN 100 | Heavy Duty Spool Rotating Flange | 44.0 |
| 6 in | DN 150 | Heavy Duty Spool Rotating Flange | 49.0 |
| 8 in | DN 200 | Heavy Duty Spool Rotating Flange | 55.0 |
| 10 in | DN 250 | Heavy Duty Spool Rotating Flange | 60.0 |
| 12 in | DN 300 | Heavy Duty Spool Rotating Flange | 62.0 |
| 14 in | DN 350 | Heavy Duty Spool Rotating Flange | 65.5 |

Please note that for certain sizes of product - particularly small 45 degree elbows, threaded holes and stud bolts are used, changing these calculations. For more information please see our website

*Assuming nuts are faced one side

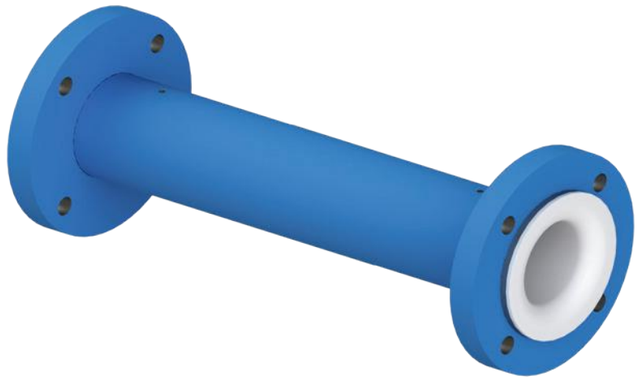
| Nominal Bore | DN | Component | Half Joint Total Thickness (A) |
|---|---|---|---|
| 1/2 in | DN 15 | Fitting Fixed Flange | 12.5 |
| 3/4 in | DN 20 | Fitting Fixed Flange | 15.0 |
| 1 in | DN 25 | Fitting Fixed Flange | 17.0 |
| 1 1/2 in | DN 40 | Fitting Fixed Flange | 21.0 |
| 2 in | DN 50 | Fitting Fixed Flange | 23.0 |
| 3 in | DN 80 | Fitting Fixed Flange | 28.5 |
| 4 in | DN 100 | Fitting Fixed Flange | 29.5 |
| 6 in | DN 150 | Fitting Fixed Flange | 31.5 |
| 8 in | DN 200 | Fitting Fixed Flange | 36.5 |
| 10 in | DN 250 | Fitting Fixed Flange | 39.5 |
| 12 in | DN 300 | Fitting Fixed Flange | 41.0 |
| 14 in | DN 350 | Fitting Fixed Flange | 43.5 |
| 1/2 in | DN 15 | Fitting Rotating Flange | 22.5 |
| 3/4 in | DN 20 | Fitting Rotating Flange | 27.0 |
| 1 in | DN 25 | Fitting Rotating Flange | 29.0 |
| 1 1/2 in | DN 40 | Fitting Rotating Flange | 33.0 |
| 2 in | DN 50 | Fitting Rotating Flange | 37.0 |
| 3 in | DN 80 | Fitting Rotating Flange | 44.5 |
| 4 in | DN 100 | Fitting Rotating Flange | 45.5 |
| 6 in | DN 150 | Fitting Rotating Flange | 49.5 |
| 8 in | DN 200 | Fitting Rotating Flange | 56.5 |
| 10 in | DN 250 | Fitting Rotating Flange | 61.5 |
| 12 in | DN 300 | Fitting Rotating Flange | 63.0 |
| 14 in | DN 350 | Fitting Rotating Flange | 67.5 |

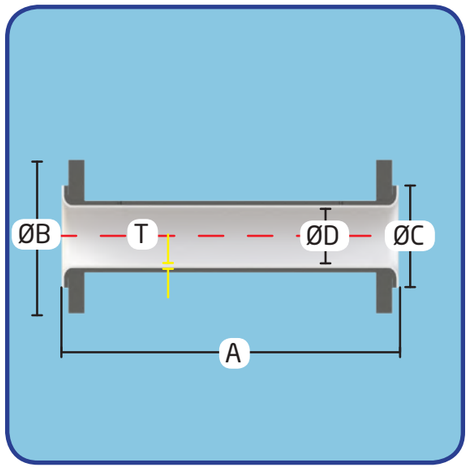
| UNC Thread | Thread Pitch (C) | Nut Thickness * [mm] Ordinary | Nut Thickness * [mm] Heavy (B) |
|---|---|---|---|
| 1/2" | 2.0 | 11 | 12 |
| 5/8" | 2.3 | 14 | 16 |
| 3/4" | 2.5 | 17 | 19 |
| 7/8" | 2.8 | 19 | 22 |
| 1" | 3.0 | 22 | 25 |

| Metric Thread | Thread Pitch (C) | Nut Thickness [mm] (B) |
|---|---|---|
| M12 | 1.75 | 10 |
| M16 | 2.0 | 13 |
| M20 | 2.5 | 16 |
| M24 | 3.0 | 19 |
| M27 | 3.0 | 22 |



# Van Stone Pipe Spool
## Rotating Flanges






The process of manufacturing a pipe spool with both flanges rotating without the use of conventionally welded or screw threaded stub ends is known as the "Van Stone" system. The process essentially forms a lap collar by spinning over the parent tube at right angles to the original tube axis.

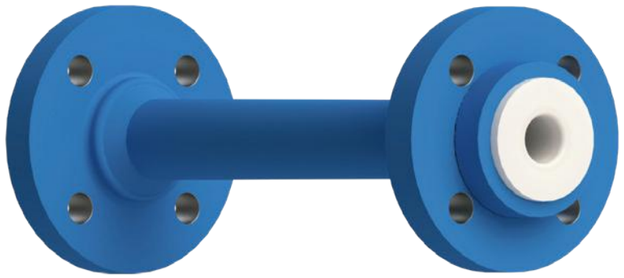
The technical advantages are that flanges are absolutely square, flange to flange bolting is short so giving less shank to gather dirt or become corroded and it provides a cost effective means of providing two rotating flanges for ease of installation. Van Stone pipe spools are available in sizes up to 8 inch nominal bore.

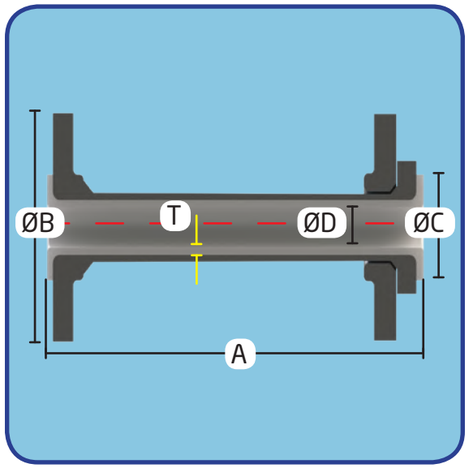
| Van Stone Pipe Spool Rotating Flanges — UltraHiPerFlon® | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Length | | | | | | | Weight | |
| | | Minimum | Maximum | Flange Outside Diameter | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | Superweight/ Heavy Duty UHP PTFE Liner Thickness Nominal[1] | Lined Bore Nominal[2] | Flange Pack | Per metre |
| Nominal Bore | | A | | Ø B | Ø C | T | T | Ø D | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | mm | kg | kg |
| ½ | 15 | 250 | 6000 | 90 | 35 | 2.3 | 2.3 | 16 | 1.0 | 2.0 |
| ¾ | 20 | 250 | 6000 | 100 | 43 | 2.3 | 2.3 | 16 | 1.3 | 2.0 |
| 1 | 25 | 250 | 6000 | 110 | 51 | 3.2 | 4.5 | 20 | 3.0 | 2.8 |
| 1½ | 40 | 250 | 6000 | 125 | 73 | 3.2 | 4.5 | 34 | 4.0 | 5.0 |
| 2 | 50 | 250 | 6000 | 150 | 92 | 3.2 | 4.5 | 46 | 6.0 | 6.5 |
| 3 | 80 | 250 | 6000 | 190 | 127 | 3.2 | 4.8 | 70 | 10 | 12.3 |
| 4 | 100 | 250 | 6000 | 230 | 157 | 4.5 | 5.0 | 93 | 12 | 16.0 |
| 6 | 150 | 500 | 6000 | 280 | 216 | 5.5 | 6.0 | 143 | 22 | 32.0 |
| 8 | 200 | 500 | 3000 | 345 | 270 | 8.5 | 8.5 | 188 | 27 | 54.0 |

1 - Liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.

2 - Based on HiPerFlon and because of the method of manufacture and tolerances on steel materials these are a guide. Please consult if you require a precise dimension for instrument, mixer or other insertion or a calibrated volume.

# Welded Pipe Spool
## Fixed-Rotating Flanges






This spool construction has a welded slip on flange at one end and a welded stub end and loose backing flange at the other to provide a rotating flange. This is the most common pipe spool standard world-wide.

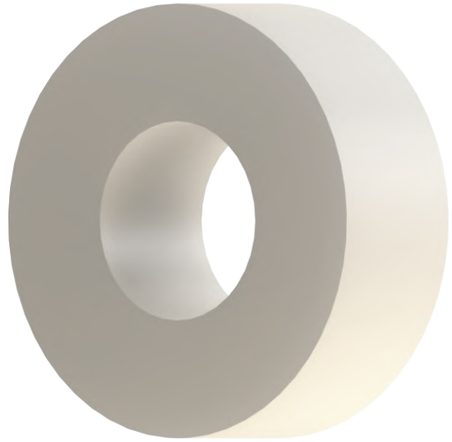
| Welded Pipe Spool F/R | | | | | | | UltraHiPerFlon® | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Length | | | | | | | Weight | |
| | | Minimum | Maximum | Flange Outside Diameter | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | Superweight/ Heavy Duty UHP PTFE Liner Thickness Nominal[1] | Lined Bore Nominal[2] | Flange Pack | Per metre |
| Nominal Bore | | A | | Ø B | Ø C | T | T | Ø D | | |
| Inches | mm | mm | mm | mm | mm | mm | | mm | kg | kg |
| ½ | 15 | 90 | 6000 | 90 | 35 | 2.3 | 2.3 | 16 | 2 | 2.0 |
| ¾ | 20 | 90 | 6000 | 100 | 43 | 2.3 | 2.3 | 16 | 2 | 2.0 |
| 1 | 25 | 90 | 6000 | 110 | 51 | 3.2 | 4.5 | 20 | 3 | 2.8 |
| 1½ | 40 | 95 | 6000 | 125 | 73 | 3.2 | 4.5 | 34 | 4 | 5.0 |
| 2 | 50 | 110 | 6000 | 150 | 92 | 3.2 | 4.5 | 46 | 6 | 6.5 |
| 3 | 80 | 120 | 6000 | 190 | 127 | 3.2 | 4.8 | 70 | 10 | 12.3 |
| 4 | 100 | 125 | 6000 | 230 | 157 | 4.5 | 5.0 | 93 | 12 | 16.0 |
| 6 | 150 | 140 | 6000 | 280 | 216 | 5.5 | 6.0 | 143 | 22 | 32.0 |
| 8 | 200 | 150 | 3000 | 345 | 270 | 8.5 | 8.5 | 188 | 27 | 54.0 |
| 10 | 250 | 165 | 3000 | 405 | 324 | 9.1 | 9.1 | 247 | 38 | 70.0 |
| 12 | 300 | 170 | 3000 | 485 | 381 | 10.4 | 10.4 | 286 | 59 | 86.0 |
| 14 | 350 | 190 | 3000 | 535 | 413 | 8.3 | 8.3 | 319 | 80 | 109.0 |

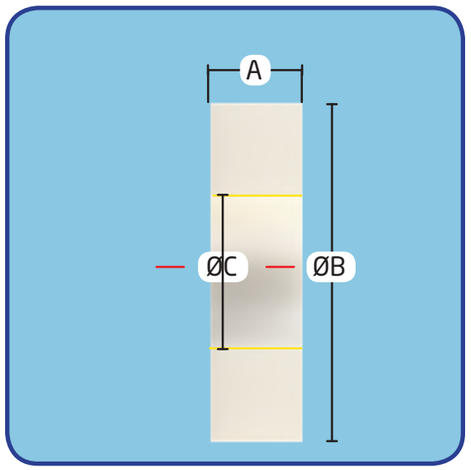
1 - Liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.

2 - Based on HiPerFlon and because of the method of manufacture and tolerances on steel materials these are a guide. Please consult if you require a precise dimension for instrument, mixer or other insertion or a calibrated volume.



# Spacer Type 1

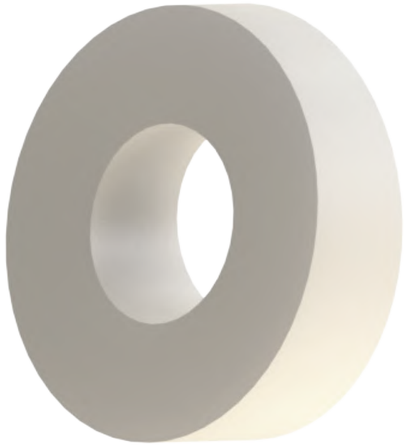


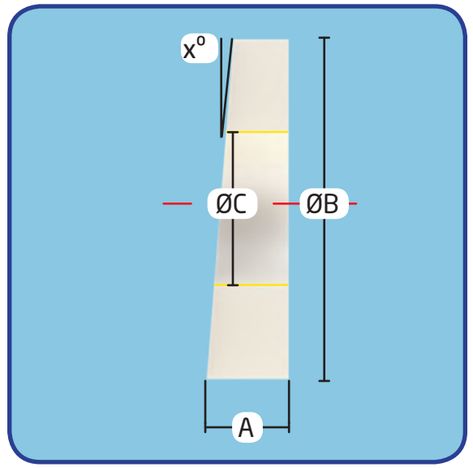



Spacers are used as small gap fillers in a piping system, where the space is too small for a conventional pipe spool or the opportunity does not arise to make a spool to the precise length required. Type 1 spacers have the smallest size range going up to 25mm in length. CRP would not recommend Type 1 spacers above this length as there is no pressure retaining element beyond the PTFE itself. They are a wafer fitting, with an outside diameter sized to fit snugly inside the bolt circle of the adjacent parts.

| Spacer Type 1 | | | | | | |
|---|---|---|---|---|---|---|
| | | Length | | | Bore | |
| | | Minimum | Maximum | Outside | Nominal | |
| Nominal Bore | | A | | Ø B | Ø C | Weight |
| Inches | mm | mm | mm | mm | mm | kg/mm |
| ½ | 15 | 3 | 25 | 44 | 20 | 0.003 |
| ¾ | 20 | 3 | 25 | 54 | 20 | 0.004 |
| 1 | 25 | 3 | 25 | 64 | 25 | 0.006 |
| 1½ | 40 | 3 | 25 | 83 | 38 | 0.009 |
| 2 | 50 | 3 | 25 | 102 | 51 | 0.013 |
| 3 | 80 | 3 | 25 | 133 | 76 | 0.020 |
| 4 | 100 | 3 | 25 | 171 | 102 | 0.032 |
| 6 | 150 | 3 | 25 | 219 | 152 | 0.042 |
| 8 | 200 | 3 | 25 | 275 | 203 | 0.058 |
| 10 | 250 | 3 | 25 | 336 | 254 | 0.082 |
| 12 | 300 | 3 | 25 | 405 | 304 | 0.119 |
| 14 | 350 | 3 | 25 | 446 | 367 | 0.144 |

# Spacer Type 1 Tapered



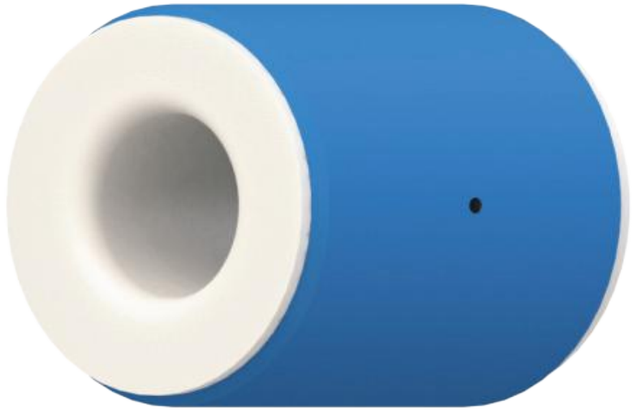


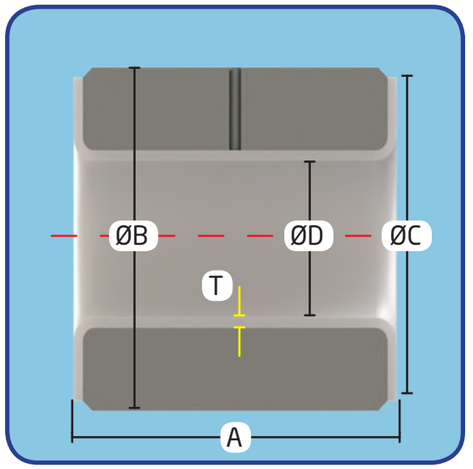

Type 1 spacers can also be provided tapered to a set angle or dimension on opposite sides of a flange face. This can provide a change in the angle of the pipework, useful for starting or ending falls.

| Spacer Type 1 Tapered | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Length | | Outside | Bore Nominal | | Viable Angles | | | | |
| | | Minimum | Maximum | | | | | | | | |
| Nominal Bore | | | A | Ø B | Ø C | Weight | | | | | |
| Inches | mm | mm | mm | mm | mm | kg/mm | 1° | 2° | 3° | 4° | 5° |
| ½ | 15 | 3 | 25 | 44 | 20 | 0.003 | Yes | Yes | Yes | Yes | Yes |
| ¾ | 20 | 3 | 25 | 54 | 20 | 0.004 | Yes | Yes | Yes | Yes | Yes |
| 1 | 25 | 3 | 25 | 64 | 25 | 0.006 | Yes | Yes | Yes | Yes | Yes |
| 1½ | 40 | 3 | 25 | 83 | 38 | 0.009 | Yes | Yes | Yes | Yes | Yes |
| 2 | 50 | 3 | 25 | 102 | 51 | 0.013 | Yes | Yes | Yes | Yes | Yes |
| 3 | 80 | 3 | 25 | 133 | 76 | 0.020 | Yes | Yes | Yes | Yes | Yes |
| 4 | 100 | 3 | 25 | 171 | 102 | 0.032 | Yes | Yes | Yes | Yes | Yes |
| 6 | 150 | 3 | 25 | 219 | 152 | 0.042 | Yes | Yes | Yes | Yes | No |
| 8 | 200 | 3 | 25 | 275 | 203 | 0.058 | Yes | Yes | Yes | Yes | No |
| 10 | 250 | 3 | 25 | 336 | 254 | 0.082 | Yes | Yes | Yes | No | No |
| 12 | 300 | 3 | 25 | 405 | 304 | 0.119 | Yes | Yes | Yes | No | No |
| 14 | 350 | 3 | 25 | 446 | 367 | 0.144 | Yes | Yes | No | No | No |



# Spacer Type 2



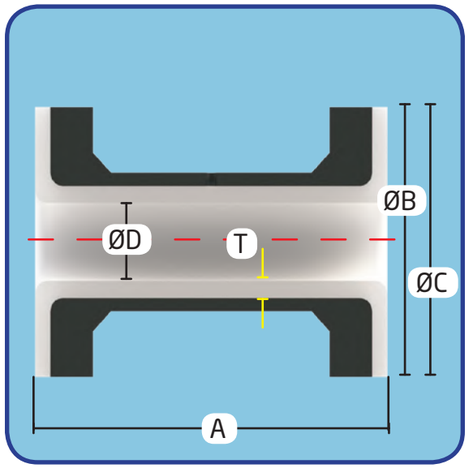



Spacers are used as small gap fillers in a piping system, where the space is too small for a conventional pipe spool or the opportunity does not arise to make a spool to the precise length required. The type 2 spacer is a wafer fitting and should be specified for gap filling from the shortest size available for the relevant nominal bore - being a more robust fitting than the type 1 spacer. It comprises a hollow steel bar with an outside diameter sized to fit snugly inside the bolt circle of the adjacent parts. Tapered type 2 spacers are also available on request.

| Spacer Type 2 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Length | | Steel Housing | Raised Face | PTFE Liner Thickness Nominal[1] | Lined Bore Nominal[2] | Minimum Length Weight | Maximum Length Weight |
| | | Minimum | Maximum | | | | | | |
| Nominal Bore | | | A | Ø B | Ø C | T | Ø D | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | kg | kg |
| ½ | 15 | 26 | 60 | 44 | 35 | 2.3 | 16 | 0.9 | 0.9 |
| ¾ | 20 | 26 | 60 | 54 | 43 | 2.3 | 16 | 1.3 | 1.4 |
| 1 | 25 | 26 | 60 | 64 | 51 | 3.2 | 20 | 1.7 | 1.9 |
| 1½ | 40 | 26 | 60 | 83 | 73 | 3.2 | 34 | 2.2 | 2.4 |
| 2 | 50 | 26 | 70 | 102 | 92 | 3.2 | 46 | 2.9 | 3.5 |
| 3 | 80 | 26 | 70 | 133 | 127 | 3.2 | 70 | 5 | 6 |
| 4 | 100 | 26 | 70 | 171 | 157 | 4.5 | 93 | 9 | 11 |
| 6 | 150 | 26 | 80 | 219 | 216 | 5.5 | 143 | 13 | 16 |
| 8 | 200 | 26 | 80 | 276 | 270 | 8.5 | 188 | 15 | 21 |
| 10 | 250 | 26 | 80 | 336 | 324 | 9.1 | 247 | 19 | 27 |
| 12 | 300 | 26 | 80 | 406 | 381 | 10.4 | 286 | 30 | 40 |
| 14 | 350 | 26 | 80 | 447 | 413 | 8.3 | 319 | 40 | 52 |

1 - Please note liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.
2 - Bore is based on virgin PTFE heavy duty liner, because of method of manufacture and steel tolerances this is a guide only,for other materials and thicknesses please consult the liner tables in the manual.

# Spacer Type 3




Spacers are used as small gap fillers in a piping system, where the space is too small for a conventional pipe spool or the opportunity does not arise to make a spool to the precise length required. Type 3 spacers are manufactured from pipe spool piping, but have stub ends in place of flanges as conventional bolting would not fit in the distance. They should be specified in preference to Type 2 spacers as soon as the gap meets the minimum length. They have an outside diameter sized to fit snugly inside the bolt circle of the adjacent parts.

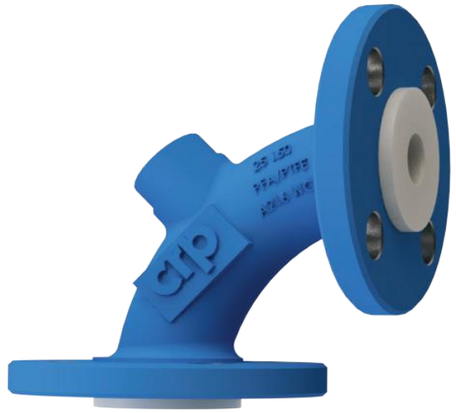
| Spacer Type 3 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Length | | | | | | | |
| | | Minimum | Maximum | Stub End | Raised Face | PTFE Liner Thickness[1] | Lined Bore Nominal2 | Minimum Length Weight | Maximum Length Weight |
| Nominal Bore | | | A | Ø B | Ø C | T | Ø D | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | kg | kg |
| ½ | 15 | 61 | 100 | 44 | 35 | 2.3 | 20 | 0.2 | 0.2 |
| ¾ | 20 | 61 | 100 | 54 | 43 | 2.3 | 20 | 0.4 | 0.4 |
| 1 | 25 | 61 | 100 | 64 | 51 | 3.2 | 23 | 0.5 | 0.6 |
| 1½ | 40 | 61 | 100 | 83 | 73 | 3.2 | 37 | 0.9 | 0.9 |
| 2 | 50 | 61 | 150 | 102 | 92 | 3.2 | 48 | 1.4 | 1.6 |
| 3 | 80 | 71 | 150 | 133 | 127 | 3.2 | 75 | 3 | 3 |
| 4 | 100 | 71 | 150 | 171 | 157 | 4.5 | 98 | 3 | 3 |
| 6 | 150 | 71 | 150 | 216 | 216 | 5.5 | 148 | 4 | 5 |
| 8 | 200 | 81 | 200 | 270 | 270 | 8.5 | 191 | 9 | 10 |
| 10 | 250 | 81 | 200 | 324 | 324 | 9.1 | 241 | 6 | 8 |
| 12 | 300 | 81 | 200 | 381 | 381 | 10.4 | 298 | 9 | 11 |
| 14 | 350 | 81 | 200 | 413 | 413 | 8.3 | 326 | 12 | 14 |

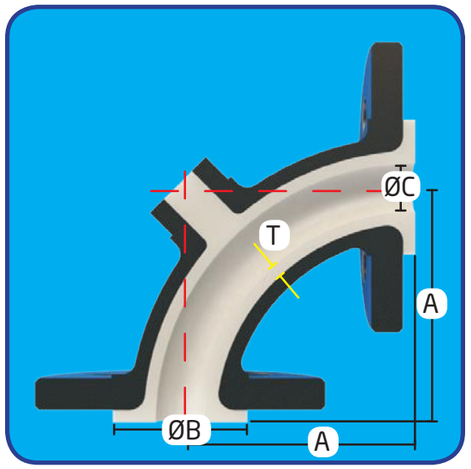
1 - Please note liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.

2 - Bore is based on virgin PTFE heavy duty liner, because of method of manufacture and steel tolerances this is a guide only,for other materials and thicknesses please consult the liner tables in the manual.



# 90° Elbow






The 90° elbow is the most popular of all pipe fittings after the spool, providing a 90° change of direction.

The standard range are dimensioned according to ASME B16.5 and have no specific radius across the size range, from around 3.5 times diameter radius with a 1 inch elbow through to a 1 times diameter radius with a 14 inch elbow. Elbows are wherever possible lined in PFA to provide the permeation and wettability benefits that PFA brings and geometrical accuracy that can be critical in some applications. PFA also brings increased vacuum performance which can be useful in larger line sizes. Non-standard elbows are lined in PTFE as are static-dissipating elbows. Static-dissipating PFA lining is available on request.

By dint of their versatility they are used throughout piping systems although one common application is to use an elbow to create a fall in pipework utilising a rotating flange. (See next page).

For handling more viscous fluids larger radius elbows are available - typically manufactured at 5D (see the appropriate page), but elbows can be manufactured with various radii and angles up to 180° with 45° being the second most common type and 30° and 60° elbows being relatively popular. Also non-standard centreline to face dimensions and dissimilar centreline to face dimensions on each leg can be achieved. When centreline to face dimensions are not provided for special angle elbows, those less than 45° have standard 45° centreline to face dimensions. Those greater than 45° have standard 90° centreline to face dimensions.

The most popular elbow sizes are supplied with a high integrity investment cast steel body and wetted parts are lined with a heavy wall PFA (construction code CP), providing superior permeation resistance and very square flanges. Less popular configurations are lined with paste extruded PTFE, flared over the flange faces in a similar manner to pipe spools.

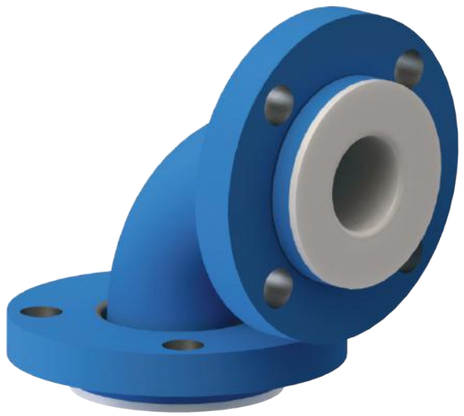
| 90° Elbow | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Wall Thickness | | Bore | | | | |
| | | Centre Line to Face | Raised Face | PFA Heavy Duty Liner Thickness Nominal[1] | HiPerFlon PTFE Liner Thickness Nominal[1] | PFA Liner Bore Nominal[2] | PTFE Liner Bore Nominal[2] | Construction | | Weight |
| Nominal Bore | | A | Ø B | T | T | Ø C | Ø C | | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | Standard | To Order | kg |
| ½ | 15 | 100 | 35 | - | 2.3 | - | 16 | FT | - | 1.5 |
| ¾ | 20 | 75 | 43 | - | 2.3 | - | 20 | FT | - | 1.5 |
| 1 | 25 | 89 | 51 | 4.0 | 3.2 | 20 | 20 | CP | CT/FT | 2.6 |
| 1½ | 40 | 102 | 73 | 4.5 | 3.2 | 33 | 34 | CP | CT/FT | 4.0 |
| 2 | 50 | 114 | 92 | 4.8 | 3.2 | 44 | 46 | CP | CT/FT | 6.5 |
| 3 | 80 | 140 | 127 | 6.5 | 3.2 | 66 | 70 | CP | CT/FT | 12 |
| 4 | 100 | 165 | 157 | 9.0 | 4.5 | 86 | 93 | CP | CT/FT | 17 |
| 6 | 150 | 203 | 216 | 11.0 | 5.5 | 137 | 43 | CP | CT/FT | 27 |
| 8 | 200 | 229 | 270 | 10.0 | 8.5 | 186 | 188 | CP | CT/FT | 56 |
| 10 | 250 | 279 | 324 | 10.0 | 9.1 | 237 | 39 | CP | CT/FT | 65 |
| 12 | 300 | 305 | 381 | 10.0 | 10.4 | 287 | 286 | CP | CT/FT | 115 |
| 14 | 350 | 356 | 413 | 10.5 | 8.3 | 317 | 319 | CP | CT/FT | 140 |

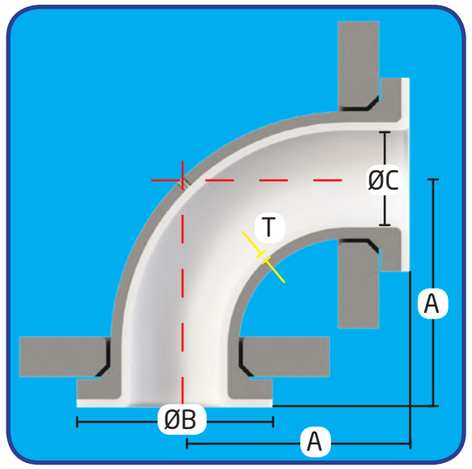
| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PTFE heavy duty liner and PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on Virgin PTFE heavy duty liner and schedule 40 or 30 steel pipe and PFA heavy duty liner in castings. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a calibrated volume in the product please consult us.

# 90° Elbow Rotating Flanges






This design of elbow has two rotating flanges captured behind stub ends. This design makes installation easy and provides versatility. The elbow design is ideal as a stock item for maintenance requirements.

| 90° Elbow Rotating Flanges | | | | | | |
|---|---|---|---|---|---|---|
| Nominal Bore | | Centre Line to Face | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | Construction | Weight |
| | | A | Ø B | Ø C | | |
| Inches | mm | mm | mm | mm | Standard | kg |
| ½ | 15 | 100 | 35 | 16 | FT | 2.5 |
| ¾ | 20 | 75 | 43 | 20 | FT | 2.5 |
| 1 | 25 | 89 | 51 | 20 | FT | 2.6 |
| 1½ | 40 | 102 | 73 | 34 | FT | 4.0 |
| 2 | 50 | 114 | 92 | 46 | FT | 6.5 |
| 3 | 80 | 140 | 127 | 70 | FT | 12 |
| 4 | 100 | 165 | 157 | 93 | FT | 17 |
| 6 | 150 | 203 | 216 | 143 | FT | 27 |
| 8 | 200 | 229 | 270 | 188 | FT | 56 |
| 10 | 250 | 279 | 324 | 239 | FT | 65 |
| 12 | 300 | 305 | 381 | 286 | FT | 115 |
| 14 | 350 | 356 | 413 | 319 | FT | 140 |

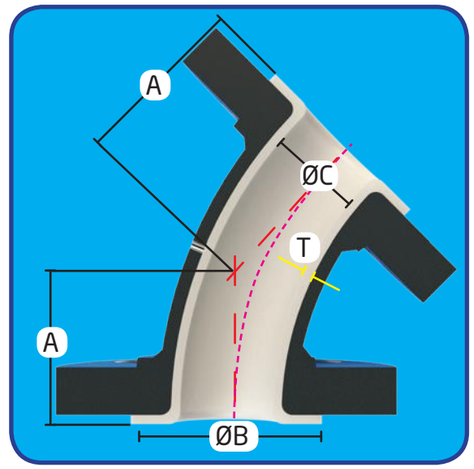
| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PTFE heavy duty liner.

2 - Nominal bores are based on Virgin PTFE heavy duty liner and schedule 40 or 30 steel pipe. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a calibrated volume in the product please consult us.



# 45° Elbow




The 45° elbow of course provides a 45° change of direction. These are generally lined in PTFE. Note that a 1 inch 45° elbow does not have through holes in the flanges, they are tapped ½ inch UNC because of the clash of nuts that would occur otherwise. A metric version is available with M12 or M14 tapped holes. Similar options to those for 90° elbows are available.

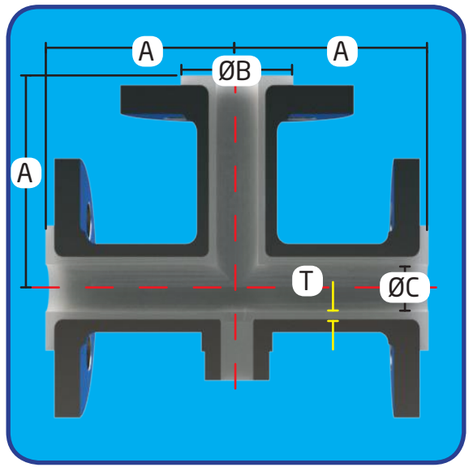
| 45° Elbow | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal Bore | | Centre Line to Face | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | PTFE Liner Bore Nominal[2] | Construction | | Weight |
| | | A | Ø B | T | Ø C | | | |
| Inches | mm | mm | mm | mm | mm | Standard | To Order | kg |
| ½ | 15 | 44 | 35 | 2.3 | 16 | FT | - | 1.2 |
| ¾ | 20 | 44 | 43 | 2.3 | 20 | FT | - | 1.2 |
| 1 | 25 | 44 | 51 | 3.2 | 20 | CT | FT | 2.1 |
| 1½ | 40 | 57 | 73 | 3.2 | 34 | CT | FT | 3.2 |
| 2 | 50 | 64 | 92 | 3.2 | 46 | CT | FT | 5.2 |
| 3 | 80 | 76 | 127 | 3.2 | 70 | CT | FT | 10 |
| 4 | 100 | 102 | 157 | 4.5 | 93 | FT | - | 14 |
| 6 | 150 | 127 | 216 | 5.5 | 143 | FT | - | 22 |
| 8 | 200 | 140 | 270 | 8.5 | 188 | FT | - | 45 |
| 10 | 250 | 165 | 324 | 9.1 | 239 | FT | - | 52 |
| 12 | 300 | 190 | 381 | 10.4 | 286 | FT | - | 92 |
| 14 | 350 | 190 | 413 | 8.3 | 319 | FT | - | 112 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PTFE heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on Virgin PTFE heavy duty liner and schedule 40 or 30 steel pipe. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a calibrated volume in the product please consult us. please consult us.

# Equal Tee




Equal tees provide a robust pipeline branch of the same nominal bore as the main pipeline itself. They are used for making additions or merging separate flows. Tees are manufactured to ASME B16.5 class 150 dimensions, but variations on standard dimensions are available on request. They can be manufactured with either fixed flanges, rotating flanges or a mix. Fixed flange products are the most economical solution. The most popular tee sizes are supplied with a high integrity investment cast steel body and wetted parts lined with a heavy wall PFA, providing superior permeation resistance.

Committed to PFA as a superior lining material for the highest level of performance, CRP is the only global manufacturer producing PFA moulded fittings in up to 14 inch size.

| Equal Tee | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal Bore | | Centre Line to Face | Raised Face | PFA Heavy Duty Liner Thickness Nominal[1] | PFA Liner Bore Nominal[2] | Construction | | Weight |
| | | A | Ø B | T | Ø C | | | |
| Inches | mm | mm | mm | mm | mm | Standard | To Order | kg |
| ½ | 15 | 65 | 35 | 4.5 | 12 | FP | - | 2.0 |
| ¾ | 20 | 75 | 43 | 4.5 | 12 | FP | - | 3.0 |
| 1 | 25 | 89 | 51 | 4.0 | 19.6 | CP | FP | 4.0 |
| 1½ | 40 | 102 | 73 | 4.5 | 33 | CP | FP | 6.5 |
| 2 | 50 | 114 | 92 | 4.8 | 44 | CP | FP | 10.0 |
| 3 | 80 | 140 | 127 | 6.5 | 66 | CP | FP | 19 |
| 4 | 100 | 165 | 157 | 9.0 | 86 | CP | FP | 27 |
| 6 | 150 | 203 | 216 | 11.0 | 137 | CP | FP | 45 |
| 8 | 200 | 229 | 270 | 10.0 | 186 | FP | - | 68 |
| 10 | 250 | 279 | 324 | 10.0 | 237 | FP | - | 90 |
| 12 | 300 | 305 | 381 | 10.0 | 287 | FP | - | 185 |
| 14 | 350 | 356 | 413 | 10.5 | 317 | FP | - | 200 |

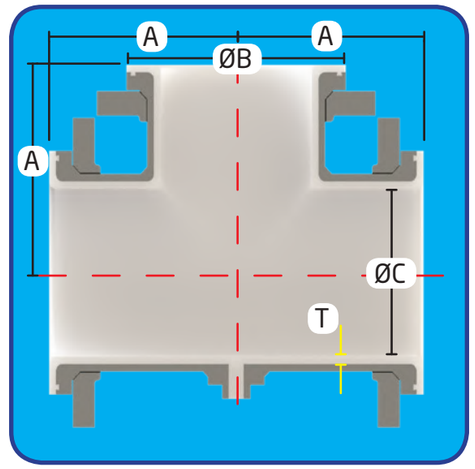
| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

' 2 - Nominal bores are based on schedule 40 or 30 steel pipe and PFA heavy duty liner and PFA heavy duty liner in castings. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.



# Equal Tee Rotating Flanges




This design of tee has three rotating flanges captured behind stub ends. This design makes installation easy and provides versatility. The tee design is ideal as a stock item for maintenance requirements.

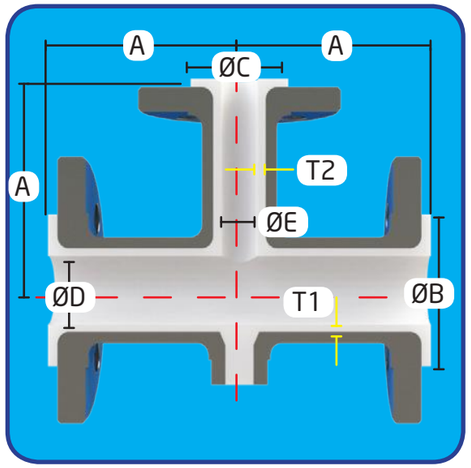
| Equal Tee Rotating Flanges | | | | | | | |
|---|---|---|---|---|---|---|---|
| Nominal Bore | | Centre Line to Face | Raised Face | PFA Heavy Duty Liner Thickness Nominal[1] | PFA Liner Bore Nominal[2] | Construction | Weight |
| | | A | Ø B | T | Ø C | | |
| Inches | mm | mm | mm | mm | mm | Standard | kg |
| ½ | 15 | 65 | 35 | 4.5 | 12 | FP | 2.0 |
| ¾ | 20 | 75 | 43 | 4.5 | 12 | FP | 3.0 |
| 1 | 25 | 89 | 51 | 4.0 | 19.6 | FP | 4.0 |
| 1½ | 40 | 102 | 73 | 4.5 | 33 | FP | 6.5 |
| 2 | 50 | 114 | 92 | 4.8 | 44 | FP | 10 |
| 3 | 80 | 140 | 127 | 6.5 | 66 | FP | 19 |
| 4 | 100 | 165 | 157 | 9.0 | 86 | FP | 27 |
| 6 | 150 | 203 | 216 | 11.0 | 137 | FP | 45 |
| 8 | 200 | 229 | 270 | 10.0 | 186 | FP | 68 |
| 10 | 250 | 279 | 324 | 10.0 | 237 | FP | 90 |
| 12 | 300 | 305 | 381 | 10.0 | 287 | FP | 185 |
| 14 | 350 | 356 | 413 | 10.5 | 317 | FP | 200 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on Virgin PFA heavy duty liner and schedule 40 or 30 steel pipe and PFA heavy duty liner in castings. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.

# Reducing Tee




Reducing tees have a smaller branch diameter than the main pipeline and are generally available in every nominal bore size down from the main branch. They are used for making additions or merging separate flows. Tees are manufactured to ASME B16.5 class 150 dimensions, with the branch centre-line to face dimension the same as that of the main bore irrespective of the nominal bore size of the branch. Variations on standard dimensions are available on request. For sizes at ½ inch and ¾ inch a larger pipe is used to achieve a reasonable bore and the PFA may have a machined bore rather than moulded in situ. They can be manufactured with either fixed flanges, rotating flanges or a mix. Please advise us if you require a specific branch bore for holding or mounting instruments or other devices. Fixed flange products are the most economical solution. The most popular tee sizes are supplied with a high integrity investment cast steel body and wetted parts lined with a heavy wall PFA, providing superior permeation resistance.

## Reducing Tee

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

| Nominal Bore | | Centre Line to Face | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch PFA Heavy Duty Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Bore Nominal[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | Ø C | T1 | T2 | Ø D | Ø E | | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | mm | Standard | To Order | kg |
| ¾ x ½ | 20 x 15 | 75 | 43 | 35 | 4.5 | 4.5 | 12 | 12 | FP | - | 2.0 |
| 1 x ½ | 25 x 15 | 89 | 51 | 35 | 4.0 | 4.5 | 20 | 12 | FP | - | 2.6 |
| 1 x ¾ | 25 x 20 | 89 | 51 | 43 | 4.0 | 4.5 | 20 | 12 | FP | - | 2.9 |
| 1½ x ½ | 40 x 15 | 102 | 73 | 35 | 4.5 | 4.5 | 33 | 12 | FP | - | 4.2 |
| 1½ x ¾ | 40 x 20 | 102 | 73 | 43 | 4.5 | 4.5 | 33 | 12 | FP | - | 4.4 |
| 1½ x 1 | 40 x 25 | 102 | 73 | 51 | 4.5 | 4.0 | 33 | 20 | CP | FP | 4.7 |
| 2 x ½ | 50 x 15 | 114 | 92 | 35 | 4.8 | 4.5 | 44 | 12 | FP | - | 6.3 |
| 2 x ¾ | 50 x 20 | 114 | 92 | 43 | 4.8 | 4.5 | 44 | 12 | FP | - | 6.6 |
| 2 x 1 | 50 x 25 | 114 | 92 | 51 | 4.8 | 4.0 | 44 | 20 | CP | FP | 6.9 |
| 2 x 1½ | 50 x 40 | 114 | 92 | 73 | 4.8 | 4.5 | 44 | 33 | CP | FP | 7.6 |
| 3 x ½ | 80 x 15 | 140 | 127 | 35 | 6.5 | 4.5 | 66 | 12 | FP | - | 12 |
| 3 x ¾ | 80 x 20 | 140 | 127 | 43 | 6.5 | 4.5 | 66 | 12 | FP | - | 13 |
| 3 x 1 | 80 x 25 | 140 | 127 | 51 | 6.5 | 4.0 | 66 | 20 | CP | FP | 13 |
| 3 x 1½ | 80 x 40 | 140 | 127 | 73 | 6.5 | 4.5 | 66 | 33 | FP | - | 14 |
| 3 x 2 | 80 x 50 | 140 | 127 | 92 | 6.5 | 4.8 | 66 | 44 | CP | FP | 15 |
| 4 x ½ | 100 x 15 | 165 | 157 | 35 | 9.0 | 4.5 | 86 | 12 | FP | - | 18 |
| 4 x ¾ | 100 x 20 | 165 | 157 | 43 | 9.0 | 4.5 | 86 | 12 | FP | - | 19 |
| 4 x 1 | 100 x 25 | 165 | 157 | 51 | 9.0 | 4.0 | 86 | 20 | CP | FP | 19 |
| 4 x 1½ | 100 x 40 | 165 | 157 | 73 | 9.0 | 4.5 | 86 | 33 | FP | - | 20 |
| 4 x 2 | 100 x 50 | 165 | 157 | 92 | 9.0 | 4.8 | 86 | 44 | FP | - | 21 |

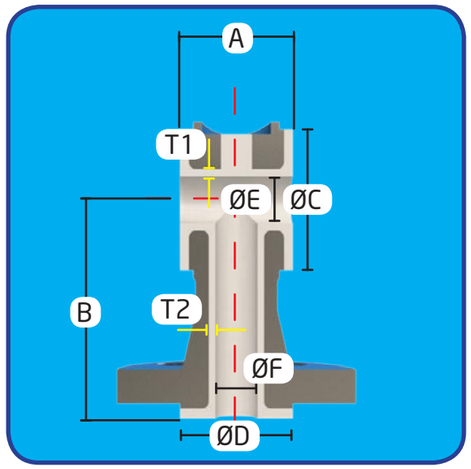


Reducing Tee

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

| Nominal Bore | | Centre Line to Face | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch PFA Heavy Duty Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Bore Nominal[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | B | Ø C | T1 | T2 | Ø D | Ø E | | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | mm | Standard | To Order | kg |
| 4 x 3 | 100 x 80 | 165 | 157 | 127 | 9.0 | 6.5 | 86 | 66 | FP | - | 24 |
| 6 x ½ | 150 x 15 | 203 | 216 | 35 | 11.0 | 4.5 | 137 | 12 | FP | - | 31 |
| 6 x ¾ | 150 x 20 | 203 | 216 | 43 | 11.0 | 4.5 | 137 | 12 | FP | - | 31 |
| 6 x 1 | 150 x 25 | 203 | 216 | 51 | 11.0 | 4.0 | 137 | 20 | FP | - | 32 |
| 6 x 1½ | 150 x 40 | 203 | 216 | 73 | 11.0 | 4.5 | 137 | 33 | FP | - | 33 |
| 6 x 2 | 150 x 50 | 203 | 216 | 92 | 11.0 | 4.8 | 137 | 44 | FP | - | 34 |
| 6 x 3 | 150 x 80 | 203 | 216 | 127 | 11.0 | 6.5 | 137 | 66 | FP | - | 37 |
| 6 x 4 | 150 x 100 | 203 | 216 | 157 | 11.0 | 9.0 | 137 | 86 | FP | - | 40 |
| 8 x 1 | 200 x 25 | 229 | 270 | 51 | 10.0 | 4.0 | 186 | 20 | FP | - | 48 |
| 8 x 1½ | 200 x 40 | 229 | 270 | 73 | 10.0 | 4.5 | 186 | 33 | FP | - | 49 |
| 8 x 2 | 200 x 50 | 229 | 270 | 92 | 10.0 | 4.8 | 186 | 44 | FP | - | 50 |
| 8 x 3 | 200 x 80 | 229 | 270 | 127 | 10.0 | 6.5 | 186 | 66 | FP | - | 54 |
| 8 x 4 | 200 x 100 | 229 | 270 | 157 | 10.0 | 9.0 | 186 | 86 | FP | - | 58 |
| 8 x 6 | 200 x 150 | 229 | 270 | 216 | 10.0 | 11.0 | 186 | 137 | FP | - | 64 |
| 10 x 1 | 250 x 25 | 279 | 324 | 51 | 10.0 | 4.0 | 237 | 20 | FP | - | 72 |
| 10 x 1½ | 250 x 40 | 279 | 324 | 73 | 10.0 | 4.5 | 237 | 33 | FP | - | 73 |
| 10 x 2 | 250 x 50 | 279 | 324 | 92 | 10.0 | 4.8 | 237 | 44 | FP | - | 75 |
| 10 x 3 | 250 x 80 | 279 | 324 | 127 | 10.0 | 6.5 | 237 | 66 | FP | - | 79 |
| 10 x 4 | 250 x 100 | 279 | 324 | 157 | 10.0 | 9.0 | 237 | 86 | FP | - | 83 |
| 10 x 6 | 250 x 150 | 279 | 324 | 216 | 10.0 | 11.0 | 237 | 137 | FP | - | 90 |
| 10 x 8 | 250 x 200 | 279 | 324 | 270 | 10.0 | 10.0 | 237 | 186 | FP | - | 98 |
| 12 x 1 | 300 x 25 | 305 | 381 | 51 | 10.0 | 4.0 | 287 | 20 | FP | - | 105 |
| 12 x 1½ | 300 x 40 | 305 | 381 | 73 | 10.0 | 4.5 | 287 | 33 | FP | - | 107 |
| 12 x 2 | 300 x 50 | 305 | 381 | 92 | 10.0 | 4.8 | 287 | 44 | FP | - | 108 |
| 12 x 3 | 300 x 80 | 305 | 381 | 127 | 10.0 | 6.5 | 287 | 66 | FP | - | 113 |
| 12 x 4 | 300 x 100 | 305 | 381 | 157 | 10.0 | 9.0 | 287 | 86 | FP | - | 117 |
| 12 x 6 | 300 x 150 | 305 | 381 | 216 | 10.0 | 11.0 | 287 | 137 | FP | - | 125 |
| 12 x 8 | 300 x 200 | 305 | 381 | 270 | 10.0 | 10.0 | 287 | 186 | FP | - | 134 |
| 12 x 10 | 300 x 250 | 305 | 381 | 324 | 10.0 | 10.0 | 287 | 237 | FP | - | 145 |
| 14 x 1 | 350 x 25 | 356 | 413 | 51 | 10.5 | 4.0 | 317 | 20 | FP | - | 143 |
| 14 x 1½ | 350 x 40 | 356 | 413 | 73 | 10.5 | 4.5 | 317 | 33 | FP | - | 145 |
| 14 x 2 | 350 x 50 | 356 | 413 | 92 | 10.5 | 4.8 | 317 | 44 | FP | - | 146 |
| 14 x 3 | 350 x 80 | 356 | 413 | 127 | 10.5 | 6.5 | 317 | 66 | FP | - | 151 |
| 14 x 4 | 350 x 100 | 356 | 413 | 157 | 10.5 | 9.0 | 317 | 86 | FP | - | 156 |
| 14 x 6 | 350 x 150 | 356 | 413 | 216 | 10.5 | 11.0 | 317 | 137 | FP | - | 164 |
| 14 x 8 | 350 x 200 | 356 | 413 | 270 | 10.5 | 10.0 | 317 | 186 | FP | - | 173 |
| 14 x 10 | 350 x 250 | 356 | 413 | 324 | 10.5 | 10.0 | 317 | 237 | FP | - | 185 |
| 14 x 12 | 350 x 300 | 356 | 413 | 381 | 10.5 | 10.0 | 317 | 287 | FP | - | 202 |

1 - Liner thicknesses are based on Virgin PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.
2 - Nominal bores are based on Virgin PFA heavy duty liner in castings. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.




Instrument tees are one of the few wafer fittings in a pipeline system, providing the functionality of a flanged equal or reducing tee without the bulk. Their primary use is for the insertion of instrumentation into the flow stream without introducing a dead leg. It is important to know that instrument tees are not included in ASME B16.5, so the dimensions below are specific to CRP. The centreline to face dimension of the branch is as ASME B16.5 for the nominal bore of the body, but the body face to face is sized to suit the diameter of the branch nominal bore. Smaller branch sizes are most popular with instrument tees because of their use with instrumentation. If a specific bore is required for an instrument please discuss this at the time of ordering as sizes are nominal. 3 inch branches are not all possible because of the potential clash with body bolts. Branches of 4 inch and above are not possible because of a clash with the bolts spanning the wafer fitting. The body diameter is sized to fit neatly inside the inner bolt circle of the mating flanges.

## Instrument Tee

| Nominal Bore | | | | | | Body Face to Face | Centre Line to Face Branch | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch Heavy Duty PFA Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal | Branch PFA Liner Bore Nominal | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | | A | B | Ø C | Ø D | T1 | T2 | Ø E | Ø F | Standard | To Order | kg |
| ½ | x | ½[3] | 15 | x | 15 | 51 | 65 | 35 | 35 | 4.5 | 4.5 | 12 | 12 | FP | - | 1.0 |
| ¾ | x | ½[3] | 20 | x | 15 | 51 | 75 | 43 | 35 | 4.5 | 4.5 | 12 | 12 | FP | - | 1.3 |
| ¾ | x | ¾[4] | 20 | x | 20 | 51 | 75 | 43 | 43 | 4.5 | 4.5 | 12 | 12 | FP | - | 1.6 |
| 1 | x | ½[3] | 25 | x | 15 | 51 | 89 | 51 | 35 | 4.0 | 4.5 | 20 | 12 | FP | - | 1.7 |
| 1 | x | ¾[4] | 25 | x | 20 | 51 | 89 | 51 | 43 | 4.0 | 4.5 | 20 | 12 | FP | - | 1.9 |
| 1 | x | 1 | 25 | x | 25 | 51 | 89 | 51 | 51 | 4.0 | 4.0 | 20 | 20 | CP | FP | 2.0 |
| 1½ | x | ½[3] | 40 | x | 15 | 51 | 102 | 73 | 35 | 4.5 | 4.5 | 33 | 12 | FP | - | 2.1 |
| 1½ | x | ¾[4] | 40 | x | 20 | 51 | 102 | 73 | 43 | 4.5 | 4.5 | 33 | 12 | FP | - | 2.4 |
| 1½ | x | 1 | 40 | x | 25 | 51 | 102 | 73 | 51 | 4.5 | 4.0 | 33 | 20 | CP | FP | 2.6 |
| 1½ | x | 1½ | 40 | x | 40 | 76 | 102 | 73 | 73 | 4.5 | 4.5 | 33 | 33 | CP | FP | 4.0 |
| 2 | x | ½[3] | 50 | x | 15 | 51 | 114 | 92 | 35 | 4.8 | 4.5 | 44 | 12 | FP | - | 3.0 |
| 2 | x | ¾[4] | 50 | x | 20 | 51 | 114 | 92 | 43 | 4.8 | 4.5 | 44 | 12 | FP | - | 3.3 |
| 2 | x | 1 | 50 | x | 25 | 51 | 114 | 92 | 51 | 4.8 | 4.0 | 44 | 20 | CP | FP | 3.5 |
| 2 | x | 1½ | 50 | x | 40 | 76 | 114 | 92 | 73 | 4.8 | 4.5 | 44 | 33 | CP | FP | 5.3 |
| 2 | x | 2 | 50 | x | 50 | 89 | 114 | 92 | 92 | 4.8 | 4.8 | 44 | 44 | CP | FP | 6.9 |
| 3 | x | ½[3] | 80 | x | 15 | 51 | 140 | 127 | 35 | 6.5 | 4.5 | 66 | 12 | FP | - | 5 |
| 3 | x | ¾[4] | 80 | x | 20 | 51 | 140 | 127 | 43 | 6.5 | 4.5 | 66 | 12 | FP | - | 5 |
| 3 | x | 1 | 80 | x | 25 | 51 | 140 | 127 | 51 | 6.5 | 4.0 | 66 | 20 | CP | FP | 5 |
| 3 | x | 1½ | 80 | x | 40 | 76 | 140 | 127 | 73 | 6.5 | 4.5 | 66 | 33 | CP | FP | 8 |
| 3 | x | 2 | 80 | x | 50 | 89 | 140 | 127 | 92 | 6.5 | 4.8 | 66 | 44 | CP | FP | 10 |

Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



Instrument Tee

## Instrument Tee

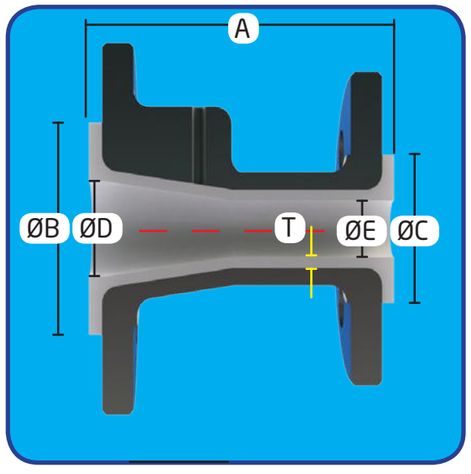
| Nominal Bore | | | | | | Body Face to Face | Centre Line to Face Branch | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch Heavy Duty PFA Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal | Branch PFA Liner Bore Nominal | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | | A | B | Ø C | Ø D | T1 | T2 | Ø E | Ø F | Standard | To Order | kg |
| 4 | x | ¾[4] | 100 | x | 20 | 51 | 165 | 157 | 43 | 9.0 | 4.5 | 86 | 12 | FP | - | 8 |
| 4 | x | 1 | 100 | x | 25 | 51 | 165 | 157 | 51 | 9.0 | 4.0 | 86 | 20 | CP | FP | 8 |
| 4 | x | 1½ | 100 | x | 40 | 76 | 165 | 157 | 73 | 9.0 | 4.5 | 86 | 33 | CP | FP | 12 |
| 4[5] | x | 2 | 100 | x | 50 | 89 | 165 | 157 | 92 | 9.0 | 4.8 | 86 | 44 | CP | FP | 14 |
| 6 | x | ½[3] | 150 | x | 15 | 51 | 203 | 216 | 35 | 11.0 | 4.5 | 137 | 12 | FP | - | 9 |
| 6 | x | ¾[4] | 150 | x | 20 | 51 | 203 | 216 | 43 | 11.0 | 4.5 | 137 | 12 | FP | - | 9 |
| 6 | x | 1 | 150 | x | 25 | 51 | 203 | 216 | 51 | 11.0 | 4.0 | 137 | 20 | CP | FP | 10 |
| 6 | x | 1½ | 150 | x | 40 | 76 | 203 | 216 | 73 | 11.0 | 4.5 | 137 | 33 | CP | FP | 14 |
| 6 | x | 2 | 150 | x | 50 | 89 | 203 | 216 | 92 | 11.0 | 4.8 | 137 | 44 | CP | FP | 18 |
| 6[6] | x | 3 | 150 | x | 80 | 150 | 203 | 216 | 127 | 11.0 | 6.5 | 137 | 66 | FP | - | 30 |
| 8 | x | 1 | 200 | x | 25 | 51 | 229 | 270 | 51 | 10.0 | 4.0 | 186 | 20 | FP | - | 5 |
| 8 | x | 1½ | 200 | x | 40 | 76 | 229 | 270 | 73 | 10.0 | 4.5 | 186 | 33 | FP | - | 8 |
| 8 | x | 2 | 200 | x | 50 | 89 | 229 | 270 | 92 | 10.0 | 4.8 | 186 | 44 | FP | - | 10 |
| 8 | x | 3 | 200 | x | 80 | 150 | 229 | 270 | 127 | 10.0 | 6.5 | 186 | 66 | FP | - | 18 |
| 10 | x | 1 | 250 | x | 25 | 51 | 279 | 324 | 51 | 10.0 | 4.0 | 237 | 20 | FP | - | 18 |
| 10 | x | 1½ | 250 | x | 40 | 76 | 279 | 324 | 73 | 10.0 | 4.5 | 237 | 33 | FP | - | 27 |
| 10 | x | 2 | 250 | x | 50 | 89 | 279 | 324 | 92 | 10.0 | 4.8 | 237 | 44 | FP | - | 33 |
| 12 | x | 1 | 300 | x | 25 | 51 | 305 | 381 | 51 | 10.0 | 4.0 | 287 | 20 | FP | - | 24 |
| 12 | x | 1½ | 300 | x | 40 | 76 | 305 | 381 | 73 | 10.0 | 4.5 | 287 | 33 | FP | - | 36 |
| 12 | x | 2 | 300 | x | 50 | 89 | 305 | 381 | 92 | 10.0 | 4.8 | 287 | 44 | FP | - | 43 |
| 12[7] | x | 3 | 300 | x | 80 | 150 | 305 | 381 | 127 | 10.0 | 6.5 | 287 | 66 | FP | - | 74 |
| 14 | x | 1 | 350 | x | 25 | 51 | 356 | 413 | 51 | 10.5 | 4.0 | 317 | 20 | FP | - | 30 |
| 14 | x | 1½ | 350 | x | 40 | 76 | 356 | 413 | 73 | 10.5 | 4.5 | 317 | 33 | FP | - | 44 |
| 14 | x | 2 | 350 | x | 50 | 89 | 356 | 413 | 92 | 10.5 | 4.8 | 317 | 44 | FP | - | 53 |
| 14 | x | 3 | 350 | x | 80 | 150 | 356 | 413 | 127 | 10.5 | 6.5 | 317 | 66 | FP | - | 89 |

Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Please note liner thicknesses are based on Virgin PFA, for other materials consult the liner tables in the manual.
2 - Bore is based on Virgin PFA, because of method of manufacture and steel tolerances this is a guide only, for other materials and thicknesses please consult the liner tables in the manual.
3 - On 1/2in branch a 3/4in pipe is used.
4 - On 3/4in branch a 1in pipe is used.
5 - Because of the need to pass through the line bolts the branch has a reduced bore in a 1.1/2in pipe.
6 - Because of the need to pass through the line bolts the branch has a reduced bore in a 2in pipe.
7 - Only with UNC bolting.

# Concentric Reducer




These provide for a gradual reduction in bore on the centreline of the pipeline, reducing (or growing) concentrically from one bore size to another through one or several size reductions. They are useful for the movement of slurries, where cavitation is present and on the discharge side of pumps.

## Concentric Reducer

| Nominal Bore | | | | | Face to Face | Large NB Raised Face | Small NB Raised Face | Heavy Duty PFA Liner Thickness Nominal[1] | HiPerFlon PTFE Liner Thickness Nominal[1] | Large Bore Nominal[2] | Small Bore Nominal[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | A | Ø B | Ø C | T | T | Ø D | Ø E | | | |
| Inches | | | mm | | mm | mm | mm | mm | mm | mm | mm | Standard | To Order | kg |
| ¾ | x | ½ | 20 | x 15 | 114 | 43 | 35 | - | 2.3 | 12 | 12 | FT | - | 1.3 |
| 1 | x | ½ | 25 | x 15 | 114 | 51 | 35 | - | 3.2 | 20 | 12 | FT | - | 1.5 |
| 1 | x | ¾ | 25 | x 20 | 114 | 51 | 43 | - | 3.2 | 20 | 12 | FT | - | 1.8 |
| 1½ | x | ¾ | 40 | x 20 | 114 | 73 | 43 | - | 3.2 | 33 | 12 | FT | - | 2.3 |
| 1½ | x | 1 | 40 | x 25 | 114 | 73 | 51 | - | 3.2 | 33 | 20 | CT | FT | 2.7 |
| 2 | x | 1 | 50 | x 25 | 127 | 92 | 51 | 4.8 | - | 44 | 20 | CP | FP | 3.7 |
| 2 | x | 1½ | 50 | x 40 | 127 | 92 | 73 | 4.8 | 3.2 | 44 | 33 | CT | CP/FP/FT | 4.2 |
| 3 | x | 1 | 80 | x 25 | 152 | 127 | 51 | 6.5 | - | 66 | 20 | CP | FP | 6 |
| 3 | x | 1½ | 80 | x 40 | 152 | 127 | 73 | 6.5 | - | 66 | 33 | CP | FP | 7 |
| 3 | x | 2 | 80 | x 50 | 152 | 127 | 92 | 6.5 | 3.2 | 66 | 44 | CT | CP/FP/FT | 8 |
| 4 | x | 1 | 100 | x 25 | 178 | 157 | 51 | 9.0 | - | 86 | 20 | CP | FP | 9 |
| 4 | x | 1½ | 100 | x 40 | 178 | 157 | 73 | 9.0 | - | 86 | 33 | CP | FP | 10 |
| 4 | x | 2 | 100 | x 50 | 178 | 157 | 92 | 9.0 | - | 86 | 44 | CP | FP | 11 |
| 4 | x | 3 | 100 | x 80 | 178 | 157 | 127 | 9.0 | 4.5 | 86 | 66 | CT | CP/FP/FT | 13 |
| 6 | x | 2 | 150 | x 50 | 229 | 216 | 92 | 11.0 | - | 137 | 44 | CP | FP | 17 |
| 6 | x | 3 | 150 | x 80 | 229 | 216 | 127 | 11.0 | - | 137 | 66 | CP | FP | 19 |
| 6 | x | 4 | 150 | x 100 | 229 | 216 | 157 | 11.0 | 5.5 | 137 | 86 | CT | CP/FP/FT | 20 |
| 8 | x | 3 | 200 | x 80 | 279 | 270 | 127 | 10.0 | - | 186 | 66 | FP | - | 28 |
| 8 | x | 4 | 200 | x 100 | 279 | 270 | 157 | 10.0 | - | 186 | 86 | FP | - | 30 |
| 8 | x | 6 | 200 | x 150 | 279 | 270 | 216 | - | 8.5 | 186 | 137 | FT | - | 33 |
| 10 | x | 4 | 250 | x 100 | 305 | 324 | 157 | 10.0 | - | 237 | 66 | FP | - | 40 |
| 10 | x | 6 | 250 | x 150 | 305 | 324 | 216 | - | 9.1 | 237 | 137 | FT | - | 43 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



Concentric Reducer

| Nominal Bore | | | | | Face to Face | Large NB Raised Face | Small NB Raised Face | Heavy Duty PFA Liner Thickness Nominal[1] | HiPerFlon PTFE Liner Thickness Nominal[1] | Large Bore Nominal[2] | Small Bore Nominal[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | A | Ø B | Ø C | T | T | Ø D | Ø E | | | |
| Inches | | | mm | | mm | mm | mm | mm | mm | mm | mm | Standard | To Order | kg |
| 10 | x | 8 | 250 | x 200 | 305 | 324 | 270 | - | 9.1 | 237 | 186 | FT | - | 49 |
| 12 | x | 4 | 300 | x 100 | 356 | 381 | 157 | 10.0 | - | 287 | 66 | FP | - | 58 |
| 12 | x | 6 | 300 | x 150 | 356 | 381 | 216 | 10.0 | - | 287 | 137 | FP | - | 62 |
| 12 | x | 8 | 300 | x 200 | 356 | 381 | 270 | - | 10.4 | 287 | 186 | FT | - | 66 |

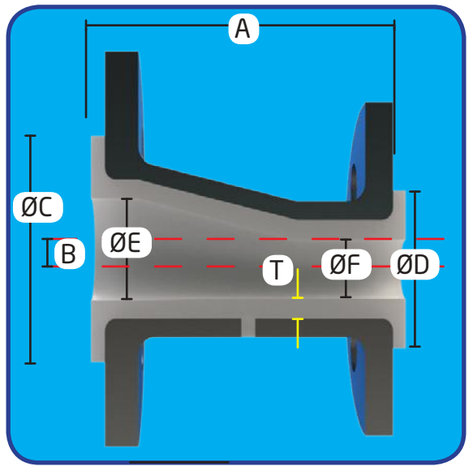
Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on schedule 40 or 30 steel pipe and PFA heavy duty liner. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.

# Eccentric Reducer




Eccentric reducers have a changing centreline for the bore, with one side remaining parallel. Eccentric reducers are used at the suction side of pumps to ensure air does not accumulate in the pipe. The gradual accumulation of air in a concentric reducer could result in a large bubble that could eventually cause the pump to stall or cause cavitation when drawn into the pump, with the flat side up this is avoided. Alternatively eccentric reducers can be useful with the flat side down to allow the complete draining of a pipeline.

## Eccentric Reducer

| Nominal Bore | | | | Face to Face | Centreline Offset | Large NB Raised Face | Small NB Raised Face | Heavy Duty PFA Liner Thickness Nominal[1] | HiPerFlon PTFE Liner Thickness Nominal[1] | Large Bore Nominal[2] | Small Bore Nominal[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | B | Ø C | Ø D | T | T | Ø D | Ø E | | | |
| Inches | | | mm | mm | mm | mm | mm | mm | mm | mm | mm | Standard | To Order | kg |
| ¾ | x | ½ | 20 x 15 | 114 | 3 | 43 | 35 | - | 2.3 | 12 | 12 | FT | - | 1.3 |
| 1 | x | ½ | 25 x 15 | 114 | 6 | 51 | 35 | 4 | 3.2 | 20 | 12 | FP | FT | 1.5 |
| 1 | x | ¾ | 25 x 20 | 114 | 3 | 51 | 43 | - | 3.2 | 20 | 12 | FT | - | 1.8 |
| 1½ | x | ¾ | 40 x 20 | 114 | 11 | 73 | 43 | - | 3.2 | 33 | 12 | FT | - | 2.3 |
| 1½ | x | 1 | 40 x 25 | 114 | 7 | 73 | 51 | 4.5 | 3.2 | 33 | 20 | CP | FP/FT | 2.7 |
| 2 | x | 1 | 50 x 25 | 127 | 13 | 92 | 51 | 4.8 | - | 44 | 20 | CP | | 3.7 |
| 2 | x | 1½ | 50 x 40 | 127 | 6 | 92 | 73 | 4.8 | 3.2 | 44 | 33 | CP | CT/FP/FT | 4.2 |
| 3 | x | 1 | 80 x 25 | 152 | 28 | 127 | 51 | 6.5 | - | 66 | 20 | CP | - | 6 |
| 3 | x | 1½ | 80 x 40 | 152 | 20 | 127 | 73 | 6.5 | - | 66 | 33 | CP | - | 7 |
| 3 | x | 2 | 80 x 50 | 152 | 14 | 127 | 92 | - | 3.2 | 66 | 44 | FT | - | 8 |
| 4 | x | 1 | 100 x 25 | 178 | 40 | 157 | 51 | 9.0 | - | 86 | 20 | FP | - | 9 |
| 4 | x | 1½ | 100 x 40 | 178 | 33 | 157 | 73 | 9.0 | - | 86 | 33 | FP | - | 10 |
| 4 | x | 2 | 100 x 50 | 178 | 27 | 157 | 92 | 9.0 | - | 86 | 44 | CP | - | 11 |
| 4 | x | 3 | 100 x 80 | 178 | 13 | 157 | 127 | 9.0 | - | 86 | 66 | CP | - | 13 |
| 6 | x | 2 | 150 x 50 | 229 | 54 | 216 | 92 | 11.0 | - | 137 | 44 | FP | - | 17 |
| 6 | x | 3 | 150 x 80 | 229 | 40 | 216 | 127 | 11.0 | - | 137 | 66 | FP | - | 19 |
| 6 | x | 4 | 150 x 100 | 229 | 27 | 216 | 157 | - | 5.5 | 137 | 86 | FT | - | 20 |
| 8 | x | 3 | 200 x 80 | 279 | 65 | 270 | 127 | 10.0 | - | 186 | 66 | FP | - | 28 |
| 8 | x | 4 | 200 x 100 | 279 | 52 | 270 | 157 | 10.0 | - | 186 | 86 | FP | - | 30 |
| 8 | x | 6 | 200 x 150 | 279 | 25 | 270 | 216 | - | 8.5 | 186 | 137 | FT | - | 33 |
| 10 | x | 4 | 250 x 100 | 305 | 79 | 324 | 157 | 10.0 | - | 237 | 66 | FP | - | 40 |
| 10 | x | 6 | 250 x 150 | 305 | 52 | 324 | 216 | - | 9.1 | 237 | 137 | FT | - | 43 |

Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



# Eccentric Reducer

## Eccentric Reducer

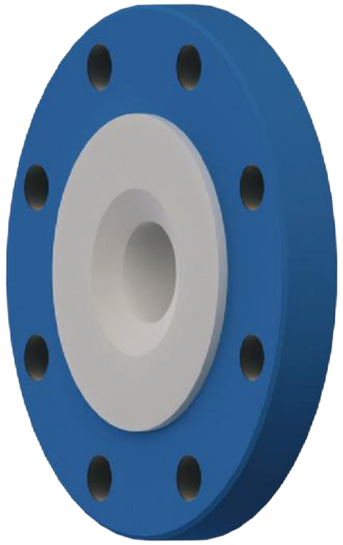
| Nominal Bore | | | | Face to Face | Centreline Offset | Large NB Raised Face | Small NB Raised Face | Heavy Duty PFA Liner Thickness Nominal[1] | HiPerFlon PTFE Liner Thickness Nominal[1] | Large Bore Nominal[2] | Small Bore Nominal[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A | B | Ø C | Ø D | T | T | Ø D | Ø E | | | |
| Inches | | | mm | mm | mm | mm | mm | mm | mm | mm | mm | Standard | To Order | kg |
| 10 | x | 8 | 250 x 200 | 305 | 27 | 324 | 270 | - | 9.1 | 237 | 186 | FT | - | 49 |
| 12 | x | 4 | 300 x 100 | 356 | 105 | 381 | 157 | 10.0 | - | 287 | 66 | FP | - | 58 |
| 12 | x | 6 | 300 x 150 | 356 | 78 | 381 | 216 | 10.0 | - | 287 | 137 | FP | - | 62 |
| 12 | x | 8 | 300 x 200 | 356 | 52 | 381 | 270 | 10.0 | - | 287 | 186 | FP | - | 66 |
| 12 | x | 10 | 300 x 250 | 356 | 25 | 381 | 324 | - | 10.4 | 287 | 237 | FT | - | 72 |
| 14 | x | 6 | 350 x 150 | 406 | 94 | 413 | 216 | 10.5 | - | 317 | 137 | FP | - | 81 |
| 14 | x | 8 | 350 x 200 | 406 | 68 | 413 | 270 | 10.5 | - | 317 | 186 | FP | - | 86 |
| 14 | x | 10 | 350 x 250 | 406 | 41 | 413 | 324 | 10.5 | - | 317 | 237 | FP | - | 91 |
| 14 | x | 12 | 350 x 300 | 406 | 16 | 413 | 381 | - | 8.3 | 317 | 287 | FT | - | 102 |

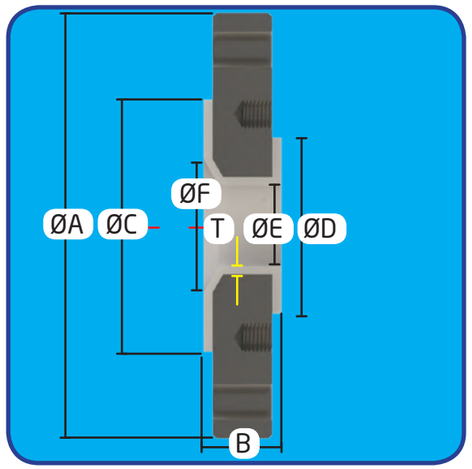
Construction Codes

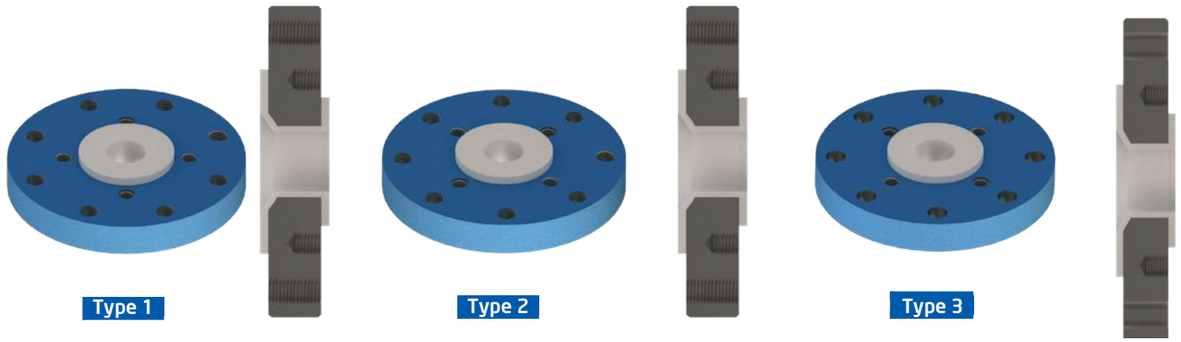
| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on schedule 40 or 30 steel pipe and PFA heavy duty liner. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.






A reducing flange is essentially a plate flange providing a sharp reduction in line bore of one or many size reductions.

A taper bore provides some transtion from one bore to another. These are generally PFA lined, but can be lined in PTFE. They provide a more space saving alternative to concentric reducers, but cannot present the same flow characteristics.

Reducing flanges can be grouped into three main configurations – type 1, 2 & 3. The configuration is dictated by the proximity of the small bore bolt holes to the large bore bolt holes. Each type is designed so that they do not clash and that the nuts can be fitted successfully. Type 3 flanges have through clearance holes for the large nominal bore bolts and blind threaded holes for the small nominal bore. These are used where there is a significant reduction in bores. Where the reduction is not so great and the periphery of the smaller bore mating flange would impinge on the nuts then a type 2 flange is employed with all threaded bolt holes (through holes for the large nominal bore and blind holes for the small nominal bore) negating the use of nuts. Finally where the reduction in bores is quite small the bolt holes are all threaded with through holes for the large nominal bore and blind holes for the small nominal bore. These have to be staggered on/off centres so that they don't clash – a type 1 reducing flange.

As a general rule, a type 3 is the default design. if this cannot be achieved because of the two joining flanges geometry, a type 2 is specified, and if this doesn't work, then a type 1.

If you have site reasons for wanting to select another style, then a type 1 or 2 will always work where a type 3 does and a type 1 where a type 2 does. As standard Type 2 and 3 bolt holes are off/off centres.

There is another style of reducing flange available where the inner pattern of holes is on a raised platform and the outer holes are scalloped from this. This enables one to use type 3 style drillings i.e. through bolts on the large side, removing the necessity to have double threaded holes on the reducing flange. This is useful where one is coming up against items such as a threaded pad flange on a vessel. CRP can produce these and many other special reducing flanges just call us to discuss.



Reducing Flange Taper Bore

## Reducing Flange Taper Bore

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

| Nominal Bore | | | | | Flange Type | Flange | Face to Face | Large NB Raised Face | Small NB Raised Face | Minimum Heavy Duty PFA Liner Thickness[1] | Minimum HiPerFlon PTFE Liner Thickness[1] | Large Bore[2] | Small Bore[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | | ø A | B | ø C | ø D | T | T | ø E | ø F | Standard | To Order | kg |
| ¾ | x | ½ | 20 | x 15 | Type 1 | 100 | 30 | 43 | 35 | 5 | 3 | 15 | 15 | FP | FT | 1.3 |
| 1 | x | ½ | 25 | x 15 | Type 1 | 110 | 30 | 51 | 35 | 5 | 3 | 18 | 15 | FP | FT | 1.6 |
| 1 | x | ¾ | 25 | x 20 | Type 1 | 110 | 30 | 51 | 43 | 5 | 3 | 18 | 15 | FP | FT | 1.6 |
| 1½ | x | ½ | 40 | x 15 | Type 2 | 125 | 30 | 73 | 35 | 5 | 3 | 32 | 15 | FP | FT | 2.1 |
| 1½ | x | ¾ | 40 | x 20 | Type 1 | 125 | 30 | 73 | 43 | 5 | 3 | 32 | 15 | FP | FT | 2.1 |
| 1½ | x | 1 | 40 | x 25 | Type 1 | 125 | 30 | 73 | 51 | 5 | 3 | 32 | 18 | FP | FT | 2.0 |
| 2 | x | ½ | 50 | x 15 | Type 2 | 150 | 30 | 92 | 35 | 5 | 3 | 43 | 15 | FP | FT | 3.0 |
| 2 | x | ¾ | 50 | x 20 | Type 2 | 150 | 30 | 92 | 43 | 5 | 3 | 43 | 15 | FP | FT | 3.0 |
| 2 | x | 1 | 50 | x 25 | Type 2 | 150 | 30 | 92 | 51 | 5 | 3 | 43 | 18 | FP | FT | 3.0 |
| 2 | x | 1½ | 50 | x 40 | Type 1 | 150 | 30 | 92 | 73 | 5 | 3 | 43 | 32 | FP | FT | 2.9 |
| 3 | x | ½ | 80 | x 15 | Type 3 | 190 | 35 | 127 | 35 | 5 | 3 | 70 | 15 | FP | FT | 6 |
| 3 | x | ¾ | 80 | x 20 | Type 3 | 190 | 35 | 127 | 43 | 5 | 3 | 70 | 15 | FP | FT | 6 |
| 3 | x | 1 | 80 | x 25 | Type 3 | 190 | 35 | 127 | 51 | 5 | 3 | 70 | 18 | FP | FT | 6 |
| 3 | x | 1½ | 80 | x 40 | Type 2 | 190 | 35 | 127 | 73 | 5 | 3 | 70 | 32 | FP | FT | 6 |
| 3 | x | 2 | 80 | x 50 | Type 1 | 190 | 35 | 127 | 92 | 5 | 3 | 70 | 43 | FP | FT | 6 |
| 4 | x | ½ | 100 | x 15 | Type 3 | 230 | 35 | 157 | 35 | 5 | 5 | 93 | 15 | FP | FT | 9 |
| 4 | x | ¾ | 100 | x 20 | Type 3 | 230 | 35 | 157 | 43 | 5 | 5 | 93 | 15 | FP | FT | 9 |
| 4 | x | 1 | 100 | x 25 | Type 3 | 230 | 35 | 157 | 51 | 5 | 5 | 93 | 18 | FP | FT | 9 |
| 4 | x | 1½ | 100 | x 40 | Type 3 | 230 | 35 | 157 | 73 | 5 | 5 | 93 | 32 | FP | FT | 9 |
| 4 | x | 2 | 100 | x 50 | Type 3 | 230 | 35 | 157 | 92 | 5 | 5 | 93 | 43 | FP | FT | 9 |
| 4 | x | 3 | 100 | x 80 | Type 1 | 230 | 35 | 157 | 127 | 5 | 5 | 93 | 70 | FP | FT | 8 |
| 6 | x | ½ | 150 | x 15 | Type 3 | 280 | 40 | 216 | 35 | 5 | 5 | 145 | 15 | FP | FT | 16 |
| 6 | x | ¾ | 150 | x 20 | Type 3 | 280 | 40 | 216 | 43 | 5 | 5 | 145 | 15 | FP | FT | 16 |
| 6 | x | 1 | 150 | x 25 | Type 3 | 280 | 40 | 216 | 51 | 5 | 5 | 145 | 18 | FP | FT | 16 |
| 6 | x | 1½ | 150 | x 40 | Type 3 | 280 | 40 | 216 | 73 | 5 | 5 | 145 | 32 | FP | FT | 16 |
| 6 | x | 2 | 150 | x 50 | Type 3 | 280 | 40 | 216 | 92 | 5 | 5 | 145 | 43 | FP | FT | 16 |
| 6 | x | 3 | 150 | x 80 | Type 3 | 280 | 40 | 216 | 127 | 5 | 5 | 145 | 70 | FP | FT | 15 |
| 6 | x | 4 | 150 | x 100 | Type 2 | 280 | 40 | 216 | 157 | 5 | 5 | 145 | 93 | FP | FT | 15 |
| 8 | x | ½ | 200 | x 15 | Type 3 | 345 | 40 | 270 | 35 | 5 | 5 | 196 | 15 | FT | FP | 25 |
| 8 | x | ¾ | 200 | x 20 | Type 3 | 345 | 40 | 270 | 43 | 5 | 5 | 196 | 15 | FT | FP | 25 |
| 8 | x | 1 | 200 | x 25 | Type 3 | 345 | 40 | 270 | 51 | 5 | 5 | 196 | 18 | FT | FP | 25 |
| 8 | x | 1½ | 200 | x 40 | Type 3 | 345 | 40 | 270 | 73 | 5 | 5 | 196 | 32 | FT | FP | 25 |
| 8 | x | 2 | 200 | x 50 | Type 3 | 345 | 40 | 270 | 92 | 5 | 5 | 196 | 43 | FT | FP | 25 |
| 8 | x | 3 | 200 | x 80 | Type 3 | 345 | 40 | 270 | 127 | 5 | 5 | 196 | 70 | FT | FP | 24 |
| 8 | x | 4 | 200 | x 100 | Type 3 | 345 | 40 | 270 | 157 | 5 | 5 | 196 | 93 | FT | FP | 24 |
| 8 | x | 6 | 200 | x 150 | Type 2 | 345 | 40 | 270 | 216 | 5 | 5 | 196 | 145 | FT | FP | 21 |
| 10 | x | ½ | 250 | x 15 | Type 3 | 405 | 35 | 324 | 35 | 5 | 5 | 250 | 15 | FT | FP | 35 |
| 10 | x | ¾ | 250 | x 20 | Type 3 | 405 | 35 | 324 | 43 | 5 | 5 | 250 | 15 | FT | FP | 35 |
| 10 | x | 1 | 250 | x 25 | Type 3 | 405 | 35 | 324 | 51 | 5 | 5 | 250 | 18 | FT | FP | 35 |
| 10 | x | 1½ | 250 | x 40 | Type 3 | 405 | 35 | 324 | 73 | 5 | 5 | 250 | 32 | FT | FP | 35 |
| 10 | x | 2 | 250 | x 50 | Type 3 | 405 | 35 | 324 | 92 | 5 | 5 | 250 | 43 | FT | FP | 35 |
| 10 | x | 3 | 250 | x 80 | Type 3 | 405 | 35 | 324 | 127 | 5 | 5 | 250 | 70 | FT | FP | 34 |

## Reducing Flange Taper Bore

| Nominal Bore (Inches) | Nominal Bore (mm) | Flange Type | Flange Ø A (mm) | Face to Face B (mm) | Large NB Raised Face Ø C (mm) | Small NB Raised Face ØD (mm) | Minimum Heavy Duty PFA Liner Thickness[1] T (mm) | Minimum HiPerFlon PTFE Liner Thickness[1] T (mm) | Large Bore[2] Ø E (mm) | Small Bore[2] Ø F (mm) | Construction Standard | Construction To Order | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 x 4 | 250 x 100 | Type 3 | 405 | 35 | 324 | 157 | 5 | 5 | 250 | 93 | FT | FP | 34 |
| 10 x 6 | 250 x 150 | Type 3 | 405 | 35 | 324 | 216 | 5 | 5 | 250 | 145 | FT | FP | 31 |
| 10 x 8 | 250 x 200 | Type 2 | 405 | 35 | 324 | 270 | 5 | 5 | 250 | 196 | FT | FP | 27 |
| 12 x ½ | 300 x 15 | Type 3 | 485 | 40 | 381 | 35 | 5 | 5 | 301 | 15 | FT | FP | 56 |
| 12 x ¾ | 300 x 20 | Type 3 | 485 | 40 | 381 | 43 | 5 | 5 | 301 | 15 | FT | FP | 56 |
| 12 x 1 | 300 x 25 | Type 3 | 485 | 40 | 381 | 51 | 5 | 5 | 301 | 18 | FT | FP | 56 |
| 12 x 1½ | 300 x 40 | Type 3 | 485 | 40 | 381 | 73 | 5 | 5 | 301 | 32 | FT | FP | 55 |
| 12 x 2 | 300 x 50 | Type 3 | 485 | 40 | 381 | 92 | 5 | 5 | 301 | 43 | FT | FP | 55 |
| 12 x 3 | 300 x 80 | Type 3 | 485 | 40 | 381 | 127 | 5 | 5 | 301 | 70 | FT | FP | 55 |
| 12 x 4 | 300 x 100 | Type 3 | 485 | 40 | 381 | 157 | 5 | 5 | 301 | 93 | FT | FP | 54 |
| 12 x 6 | 300 x 150 | Type 3 | 485 | 40 | 381 | 216 | 5 | 5 | 301 | 145 | FT | FP | 51 |
| 12 x 8 | 300 x 200 | Type 3 | 485 | 40 | 381 | 270 | 5 | 5 | 301 | 196 | FT | FP | 47 |
| 12 x 10 | 300 x 250 | Type 2 | 485 | 40 | 381 | 324 | 5 | 5 | 301 | 250 | FT | FP | 41 |
| 14 x ½ | 350 x 15 | Type 3 | 535 | 40 | 413 | 35 | 5 | 5 | 326 | 15 | FT | FP | 72 |
| 14 x ¾ | 350 x 20 | Type 3 | 535 | 40 | 413 | 43 | 5 | 5 | 326 | 15 | FT | FP | 72 |
| 14 x 1 | 350 x 25 | Type 3 | 535 | 40 | 413 | 51 | 5 | 5 | 326 | 18 | FT | FP | 72 |
| 14 x 1½ | 350 x 40 | Type 3 | 535 | 40 | 413 | 73 | 5 | 5 | 326 | 32 | FT | FP | 71 |
| 14 x 2 | 350 x 50 | Type 3 | 535 | 40 | 413 | 92 | 5 | 5 | 326 | 43 | FT | FP | 71 |
| 14 x 3 | 350 x 80 | Type 3 | 535 | 40 | 413 | 127 | 5 | 5 | 326 | 70 | FT | FP | 70 |
| 14 x 4 | 350 x 100 | Type 3 | 535 | 40 | 413 | 157 | 5 | 5 | 326 | 93 | FT | FP | 70 |
| 14 x 6 | 350 x 150 | Type 3 | 535 | 40 | 413 | 216 | 5 | 5 | 326 | 145 | FT | FP | 67 |
| 14 x 8 | 350 x 200 | Type 3 | 535 | 40 | 413 | 270 | 5 | 5 | 326 | 196 | FT | FP | 62 |
| 14 x 10 | 350 x 250 | Type 3 | 535 | 40 | 413 | 324 | 5 | 5 | 326 | 250 | FT | FP | 56 |
| 14 x 12 | 350 x 300 | Type 1 | 535 | 40 | 413 | 381 | 5 | 5 | 326 | 301 | FT | FP | 52 |
| 16 x ½ | 400 x 15 | Type 3 | 595 | 40 | 470 | 35 | 5 | 5 | 377 | 15 | FT | FP | 94 |
| 16 x ¾ | 400 x 20 | Type 3 | 595 | 40 | 470 | 43 | 5 | 5 | 377 | 15 | FT | FP | 94 |
| 16 x 1 | 400 x 25 | Type 3 | 595 | 40 | 470 | 51 | 5 | 5 | 377 | 18 | FT | FP | 94 |
| 16 x 1½ | 400 x 40 | Type 3 | 595 | 40 | 470 | 73 | 5 | 5 | 377 | 32 | FT | FP | 94 |
| 16 x 2 | 400 x 50 | Type 3 | 595 | 40 | 470 | 92 | 5 | 5 | 377 | 43 | FT | FP | 94 |
| 16 x 3 | 400 x 80 | Type 3 | 595 | 40 | 470 | 127 | 5 | 5 | 377 | 70 | FT | FP | 93 |
| 16 x 4 | 400 x 100 | Type 3 | 595 | 40 | 470 | 157 | 5 | 5 | 377 | 93 | FT | FP | 92 |
| 16 x 6 | 400 x 150 | Type 3 | 595 | 40 | 470 | 216 | 5 | 5 | 377 | 145 | FT | FP | 89 |
| 16 x 8 | 400 x 200 | Type 3 | 595 | 40 | 470 | 270 | 5 | 5 | 377 | 196 | FT | FP | 84 |
| 16 x 10 | 400 x 250 | Type 3 | 595 | 40 | 470 | 324 | 5 | 5 | 377 | 250 | FT | FP | 78 |
| 16 x 12 | 400 x 300 | Type 3 | 595 | 40 | 470 | 381 | 5 | 5 | 377 | 301 | FT | FP | 71 |
| 16 x 14 | 400 x 350 | Type 2 | 595 | 40 | 470 | 413 | 5 | 5 | 377 | 326 | FT | FP | 64 |
| 18 x ½ | 450 x 15 | Type 3 | 635 | 40 | 533 | 35 | 5 | 5 | 425 | 15 | FT | FP | 112 |
| 18 x ¾ | 450 x 20 | Type 3 | 635 | 40 | 533 | 43 | 5 | 5 | 425 | 15 | FT | FP | 112 |
| 18 x 1 | 450 x 25 | Type 3 | 635 | 40 | 533 | 51 | 5 | 5 | 425 | 18 | FT | FP | 112 |
| 18 x 1½ | 450 x 40 | Type 3 | 635 | 40 | 533 | 73 | 5 | 5 | 425 | 32 | FT | FP | 111 |
| 18 x 2 | 450 x 50 | Type 3 | 635 | 40 | 533 | 92 | 5 | 5 | 425 | 43 | FT | FP | 111 |
| 18 x 3 | 450 x 80 | Type 3 | 635 | 40 | 533 | 127 | 5 | 5 | 425 | 70 | FT | FP | 110 |
| 18 x 4 | 450 x 100 | Type 3 | 635 | 40 | 533 | 157 | 5 | 5 | 425 | 93 | FT | FP | 109 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



Reducing Flange Taper Bore

## Reducing Flange Taper Bore

| Nominal Bore (Inches) | Nominal Bore (mm) | Flange Type | Flange Ø A (mm) | Face to Face B (mm) | Large NB Raised Face Ø C (mm) | Small NB Raised Face Ø D (mm) | Minimum Heavy Duty PFA Liner Thickness[1] T (mm) | Minimum HiPerFlon PTFE Liner Thickness[1] T (mm) | Large Bore[2] Ø E (mm) | Small Bore[2] Ø F (mm) | Construction Standard | Construction To Order | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 x 6 | 450 x 150 | Type 3 | 635 | 40 | 533 | 216 | 5 | 5 | 425 | 145 | FT | FP | 106 |
| 18 x 8 | 450 x 200 | Type 3 | 635 | 40 | 533 | 270 | 5 | 5 | 425 | 196 | FT | FP | 101 |
| 18 x 10 | 450 x 250 | Type 3 | 635 | 40 | 533 | 324 | 5 | 5 | 425 | 250 | FT | FP | 95 |
| 18 x 12 | 450 x 300 | Type 3 | 635 | 40 | 533 | 381 | 5 | 5 | 425 | 301 | FT | FP | 87 |
| 18 x 14 | 450 x 350 | Type 2 | 635 | 40 | 533 | 413 | 5 | 5 | 425 | 326 | FT | FP | 81 |
| 18 x 16 | 450 x 400 | Type 1 | 635 | 40 | 533 | 470 | 5 | 5 | 425 | 377 | FT | FP | 103 |
| 20 x ½ | 500 x 15 | Type 3 | 700 | 53 | 584 | 35 | 5 | 5 | 473 | 15 | FT | FP | 153 |
| 20 x ¾ | 500 x 20 | Type 3 | 700 | 53 | 584 | 43 | 5 | 5 | 473 | 15 | FT | FP | 153 |
| 20 x 1 | 500 x 25 | Type 3 | 700 | 53 | 584 | 51 | 5 | 5 | 473 | 18 | FT | FP | 153 |
| 20 x 1½ | 500 x 40 | Type 3 | 700 | 53 | 584 | 73 | 5 | 5 | 473 | 32 | FT | FP | 153 |
| 20 x 2 | 500 x 50 | Type 3 | 700 | 53 | 584 | 92 | 5 | 5 | 473 | 43 | FT | FP | 153 |
| 20 x 3 | 500 x 80 | Type 3 | 700 | 53 | 584 | 127 | 5 | 5 | 473 | 70 | FT | FP | 152 |
| 20 x 4 | 500 x 100 | Type 3 | 700 | 53 | 584 | 157 | 5 | 5 | 473 | 93 | FT | FP | 151 |
| 20 x 6 | 500 x 150 | Type 3 | 700 | 53 | 584 | 216 | 5 | 5 | 473 | 145 | FT | FP | 147 |
| 20 x 8 | 500 x 200 | Type 3 | 700 | 53 | 584 | 270 | 5 | 5 | 473 | 196 | FT | FP | 142 |
| 20 x 10 | 500 x 250 | Type 3 | 700 | 53 | 584 | 324 | 5 | 5 | 473 | 250 | FT | FP | 134 |
| 20 x 12 | 500 x 300 | Type 3 | 700 | 53 | 584 | 381 | 5 | 5 | 473 | 301 | FT | FP | 126 |
| 20 x 14 | 500 x 350 | Type 3 | 700 | 53 | 584 | 413 | 5 | 5 | 473 | 326 | FT | FP | 118 |
| 20 x 16 | 500 x 400 | Type 2 | 700 | 53 | 584 | 470 | 5 | 5 | 473 | 377 | FT | FP | 143 |
| 20 x 18 | 500 x 450 | Type 1 | 700 | 53 | 584 | 533 | 5 | 5 | 473 | 425 | FT | FP | 141 |
| 24 x ½ | 600 x 15 | Type 3 | 815 | 57 | 692 | 35 | 5 | 5 | 571 | 15 | FT | FP | 229 |
| 24 x ¾ | 600 x 20 | Type 3 | 815 | 57 | 692 | 43 | 5 | 5 | 571 | 15 | FT | FP | 229 |
| 24 x 1 | 600 x 25 | Type 3 | 815 | 57 | 692 | 51 | 5 | 5 | 571 | 18 | FT | FP | 229 |
| 24 x 1½ | 600 x 40 | Type 3 | 815 | 57 | 692 | 73 | 5 | 5 | 571 | 32 | FT | FP | 228 |
| 24 x 2 | 600 x 50 | Type 3 | 815 | 57 | 692 | 92 | 5 | 5 | 571 | 43 | FT | FP | 228 |
| 24 x 3 | 600 x 80 | Type 3 | 815 | 57 | 692 | 127 | 5 | 5 | 571 | 70 | FT | FP | 227 |
| 24 x 4 | 600 x 100 | Type 3 | 815 | 57 | 692 | 157 | 5 | 5 | 571 | 93 | FT | FP | 226 |
| 24 x 6 | 600 x 150 | Type 3 | 815 | 57 | 692 | 216 | 5 | 5 | 571 | 145 | FT | FP | 222 |
| 24 x 8 | 600 x 200 | Type 3 | 815 | 57 | 692 | 270 | 5 | 5 | 571 | 196 | FT | FP | 216 |
| 24 x 10 | 600 x 250 | Type 3 | 815 | 57 | 692 | 324 | 5 | 5 | 571 | 250 | FT | FP | 208 |
| 24 x 12 | 600 x 300 | Type 3 | 815 | 57 | 692 | 381 | 5 | 5 | 571 | 301 | FT | FP | 198 |
| 24 x 14 | 600 x 350 | Type 3 | 815 | 57 | 692 | 413 | 5 | 5 | 571 | 326 | FT | FP | 190 |
| 24 x 16 | 600 x 400 | Type 3 | 815 | 57 | 692 | 470 | 5 | 5 | 571 | 377 | FT | FP | 218 |
| 24 x 18 | 600 x 450 | Type 3 | 815 | 57 | 692 | 533 | 5 | 5 | 571 | 425 | FT | FP | 215 |
| 24 x 20 | 600 x 500 | Type 2 | 815 | 57 | 692 | 584 | 5 | 5 | 571 | 473 | FT | FP | 212 |



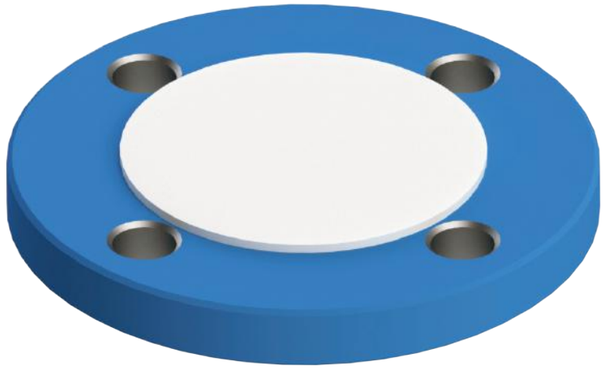
| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

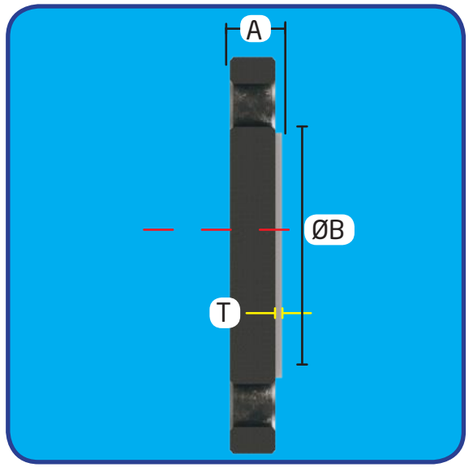


1 - Please note liner thicknesses are based on Virgin PFA or PTFE, for other materials consult the liner tables in the manual.

2 - Nominal bores are based on schedule 40 or 30 steel pipe and PFA heavy duty liner. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual.

# Blank Flange






The blank flange is an end of pipe line component. Usually manufactured from a blank forged flange, the blank flange has a disc of PTFE bonded to the raced face. They may be employed in sub-systems such as sampling or at junctions which in the future may lead to other piping systems.

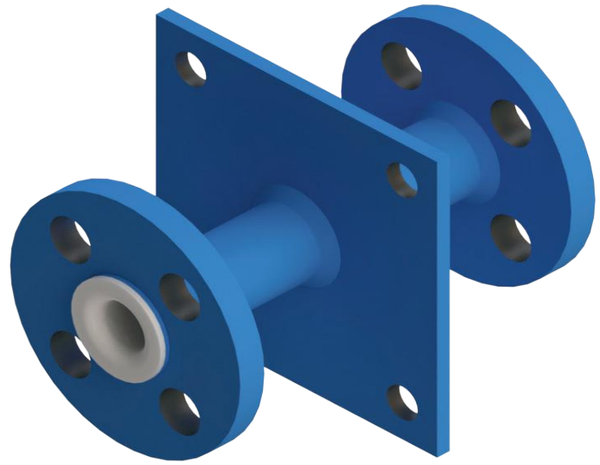
**Blank Flange**

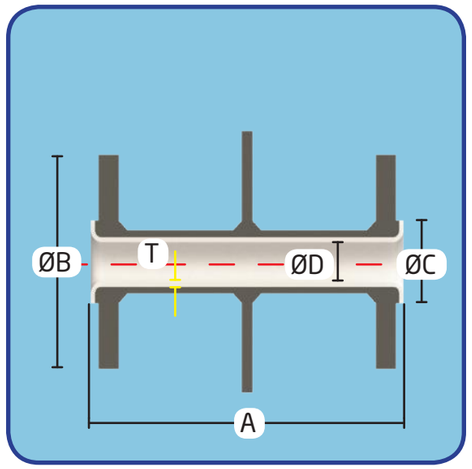
| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

| Nominal Bore | | Face to Face | Raised Face | HiPerFlon PTFE Liner Thickness | Construction | Weight |
|---|---|---|---|---|---|---|
| | | A | Ø B | T | | |
| Inches | mm | mm | mm | mm | Standard | kg |
| ½ | 15 | 14 | 35 | 4 | FT | 0.5 |
| ¾ | 20 | 15 | 43 | 4 | FT | 0.7 |
| 1 | 25 | 17 | 51 | 4 | FT | 1.0 |
| 1½ | 40 | 19 | 73 | 4 | FT | 1.6 |
| 2 | 50 | 22 | 92 | 4 | FT | 2.5 |
| 3 | 80 | 26 | 127 | 4 | FT | 5 |
| 4 | 100 | 26 | 157 | 4 | FT | 7 |
| 6 | 150 | 28 | 216 | 4 | FT | 12 |
| 8 | 200 | 31 | 270 | 4 | FT | 20 |
| 10 | 250 | 33 | 324 | 4 | FT | 29 |
| 12 | 300 | 34 | 381 | 4 | FT | 44 |
| 14 | 350 | 37 | 413 | 4 | FT | 60 |
| 16 | 400 | 39 | 470 | 4 | FT | 77 |
| 18 | 450 | 42 | 533 | 4 | FT | 96 |
| 20 | 500 | 43 | 584 | 4 | FT | 126 |
| 24 | 600 | 48 | 692 | 4 | FT | 191 |



# Puddle Flange Pipe Spool






CRP offer a range of puddle flange spools, typically comprising of a standard pipe spool (with all of the usual spool flange options) with one additional "puddle flange" located along its length (typically in the middle). The spools are usually used in circumstances where a spool has to penetrate through a wall, a bund or similar. A hole in the wall has to be made that is sufficiently large to allow the flange on the end of the spool to pass through it, and then the additional puddle flange is used to close up the hole, and so the puddle flange is typically somewhat larger in size than the flanges on the ends of the spool.

Puddle flanges can be circular, square or other shapes to suit particular customer requirements, and supplied with or without bolt holes. The thickness of these flanges is driven by their purpose. If they are simply to close over a hole to prevent the passage of air, then they can be quite thin. However, if they are also used as part of the pipework support, or have to take some other structural load, then they can be supplied with a greater thickness to suit. As an option, puddle flange spools can be supplied with a split flange on one end. The advantage of this is that since the split flange can be removed while the spool is being fitted through the wall, and the flange then refitted, the hole in the wall only needs to be large enough to pass the spool stub end through, and the puddle flange can also be smaller.

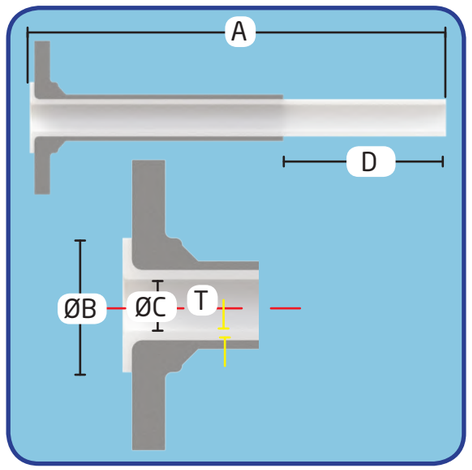
**Puddle Flange Spool**

| Nominal Bore | | Length | | Flange Outside | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | Lined Bore Nominal[2] |
|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum | | | | |
| | | A | | Ø B | Ø C | T | Ø D |
| Inches | mm | mm | mm | mm | mm | mm | mm |
| ½ | 15 | 155 | 6000 | 90 | 35 | 2.3 | 16 |
| ¾ | 20 | 170 | 6000 | 100 | 43 | 2.3 | 16 |
| 1 | 25 | 191 | 6000 | 110 | 51 | 3.2 | 20 |
| 1½ | 40 | 215 | 6000 | 125 | 73 | 3.2 | 34 |
| 2 | 50 | 243 | 6000 | 150 | 92 | 3.2 | 46 |
| 3 | 80 | 279 | 6000 | 190 | 127 | 3.2 | 70 |
| 4 | 100 | 307 | 6000 | 230 | 157 | 4.5 | 93 |
| 6 | 150 | 345 | 6000 | 280 | 216 | 5.5 | 143 |
| 8 | 200 | 385 | 3000 | 345 | 270 | 8.5 | 188 |
| 10 | 250 | 429 | 3000 | 405 | 324 | 9.1 | 247 |
| 12 | 300 | 473 | 3000 | 485 | 381 | 10.4 | 286 |
| 14 | 350 | 511 | 3000 | 535 | 413 | 8.3 | 319 |

1 - Liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.

2 - Because of the method of manufacture and tolerances on steel materials these are a guide. Please consult if you require a precise dimension for instrument, mixer or other insertion or a calibrated volume.

# Drain Leg




A drain leg is a single flanged pipe spool with an open end. The PTFE liner can be cut flush with the end, or protrude an amount to be specified by the customer.

As standard the protrusion is 100mm, and can be cut on site to suit. Longer protrusions can be specified. These are typically used for running product into surface drains, the steel pipe being run up to the drain cover.

| Drain Leg | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Length | | Raised Face | HiPerFlon PTFE Liner Thickness[1] | Lined Bore Nominal[2] | Protruding Length | Cut off Angle[3] |
| | | Minimum | Maximum | | | | | |
| Nominal Bore | | | A | Ø B | T | Ø C | D | |
| Inches | mm | mm | mm | mm | mm | mm | mm | ° |
| ½ | 15 | 90 | 6000 | 35 | 2.3 | 16 | 100 | 90 |
| ¾ | 20 | 90 | 6000 | 43 | 2.3 | 16 | 100 | 90 |
| 1 | 25 | 90 | 6000 | 51 | 3.2 | 20 | 100 | 90 |
| 1½ | 40 | 95 | 6000 | 73 | 3.2 | 34 | 100 | 90 |
| 2 | 50 | 110 | 6000 | 92 | 3.2 | 46 | 100 | 90 |
| 3 | 80 | 120 | 6000 | 127 | 3.2 | 70 | 100 | 90 |
| 4 | 100 | 125 | 6000 | 157 | 4.5 | 93 | 100 | 90 |
| 6 | 150 | 140 | 6000 | 216 | 5.5 | 143 | 100 | 90 |
| 8 | 200 | 150 | 3000 | 270 | 8.5 | 188 | 100 | 90 |
| 10 | 250 | 165 | 3000 | 324 | 9.1 | 247 | 100 | 90 |
| 12 | 300 | 170 | 3000 | 381 | 10.4 | 286 | 100 | 90 |
| 14 | 350 | 190 | 3000 | 413 | 8.3 | 319 | 100 | 90 |

1 - Liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.

2 - Because of the method of manufacture and tolerances on steel materials these are a guide. Please consult if you require a precise dimension for instrument, mixer or other insertion or a calibrated volume.

3 - Angle measured from centre line of protruding liner spool.



# Jacketed Pipe Spools & Fittings

It is possible to provide a source of heating or cooling to a lined piping system by using jackets around the equipment. Here the core pipe is completely surrounded by a jacket pipe. The process material travels through the lined pipe as normal, whilst the heating or cooling medium travels through the outer jacket.

Jackets typically contain steam, hot water or oil. These can be operated at temperatures of up to the maximum operating temperature of the lining - 200°C or the required process temperature if lower. Jackets can also work successfully at cryogenic temperatures, as long as the steelwork is specified appropriately.

On a straight pipe spool the jacket usually extends almost to the end of the pipe, leaving some room to introduce the necessary vent between the steel tube and the liner. If the line is to be subsequently insulated such vents require extensions to take them outside the lagging. Connections to the jacket can be flanged, threaded or whatever the customer specification requires.

Fittings and Valves can also be jacketed, but it may be that their short length allows the process to remain heated, simply by insulating them.

The advantages of jacketing are that heat can be applied evenly to the pipe without the danger of localised hot spots, which can lead to localised liner damage or liner expansion, both of which can lead to liner collapse. Also jacketing allows for a smooth ramp up of temperatures - a useful attribute given the poor heat conducting characteristics of PTFE and PFA.

## Steam Tracing

Direct steam tracing can be used by running a steam pipe alongside the steel tube or fitting outside the liner, securing it with steel strapping and insulating the line. It is important to limit the temperature to avoid damaging the liner and avoid creating localised hot spots where the trace is in contact with the pipe.

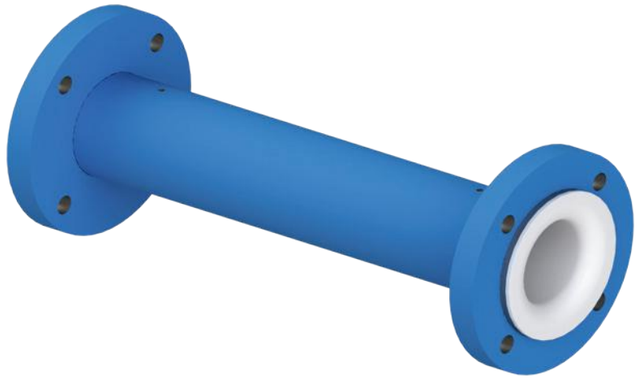
## Fluid Tracing

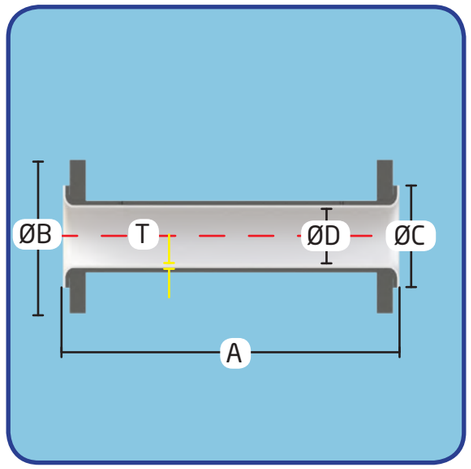
As with steam tracing this can be used, more often for closer temperature control or for cooling control.

## Electrical Tracing

Electrical tracing can be undertaken with heating tapes or cables, often used in conjunction with a heat conducting cement to aid dissipation. Again this can provide good temperature control, but often a low rate of temperature rise and of course is a risk in certain ATEX zones.

# Closing Pipe Spool






A closing pipe spool is not actually a different product, however, it is a key part of an approach to designing and installing lined piping systems with a view to the best construction methodology, yet managing the potential tolerance build up issues and simple design and installation errors that are inevitable with large complex construction projects. When one has tolerance errors causing piping elements not to fit, it is possible and acceptable to use spacers to complete gaps that present themselves. However, this does not allow one to eliminate materials if a spool or other fitting is too long and of course it introduces additional joints which are not desirable. The alternative approach is to specify closing or make-up pipe spools. Here, one identifies a relatively short length pipe spool on each horizontal or vertical run between elements that need to be fixed in space.

This spool is identified on isometric drawings or drawing take-offs as a closing spool and is still given its nominal length on the isometric or take-off. However, CRP will not manufacture these particular spools at the time of general supply. When the plant is assembled up to this point, a specific measurement is taken of the actual gap and CRP will then produce the spool required to final length and give it the relevant tag or other identifiers nominated at the time of original order.

Closing spools jump any other production queues and can usually be manufactured in a 24-48 hour period. It helps reduce manufacturing lead times to specifiy these as Van Stone spools, to keep them short and of smaller nominal bores. If time is really an issue, then they can be supplied unpainted. Other spool styles can be manufactured as closing spools.

**Van Stone Closing Pipe Spool** — UltraHiPerFlon®

| Nominal Bore | | Length | | Flange Outside Diameter | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | Superweight/ Heavy Duty UHP PTFE Liner Thickness Nominal[1] | Lined Bore Nominal[2] | Weight | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum | | | | | | Flange Pack | Per metre |
| | | A | | Ø B | Ø C | T | T | Ø D | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | mm | kg | kg |
| ½ | 15 | 250 | 6000 | 90 | 35 | 2.3 | 2.3 | 16 | 1.0 | 2.0 |
| ¾ | 20 | 250 | 6000 | 100 | 43 | 2.3 | 2.3 | 16 | 1.3 | 2.0 |
| 1 | 25 | 250 | 6000 | 110 | 51 | 3.2 | 4.5 | 20 | 3.0 | 2.8 |
| 1½ | 40 | 250 | 6000 | 125 | 73 | 3.2 | 4.5 | 34 | 4.0 | 5.0 |
| 2 | 50 | 250 | 6000 | 150 | 92 | 3.2 | 4.5 | 46 | 6.0 | 6.5 |
| 3 | 80 | 250 | 6000 | 190 | 127 | 3.2 | 4.8 | 70 | 10 | 12.3 |
| 4 | 100 | 250 | 6000 | 230 | 157 | 4.5 | 5.0 | 93 | 12 | 16.0 |
| 6 | 150 | 500 | 6000 | 280 | 216 | 5.5 | 6.0 | 143 | 22 | 32.0 |
| 8 | 200 | 500 | 3000 | 345 | 270 | 8.5 | 8.5 | 188 | 27 | 54.0 |

1 - Liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.

2 - Because of the method of manufacture and tolerances on steel materials these are a guide. Please consult if you require a precise dimension for instrument, mixer or other insertion or a calibrated volume.



# Field Flare Pipe Spools

## Introduction

Field flaring is a method by which finished pipe spools can be manufactured to length on site. In most cases this method is used for producing emergency spools in the case of a plant breakdown or for the convenience of small scale maintenance. It may also be used to produce the final closing spools for project work. Occasionally sites use it as a preferred method for producing all of their spools, usually for historic reasons or a geographic need to be very self-sufficient.

Before choosing to adopt field flaring as a site practice it is important to be aware of the downside of this. First, it is likely that the field manufactured spools are more expensive than factory finished spools. This is because the site work can never be as efficient as factory production and there is more materials wastage. Secondly, the spools are not produced in a clean controlled factory environment with the level of process control that the factory can provide, nor can the traceability of materials be maintained easily. Finally, the field flare is only as good as the operator and the equipment he is working with. Having said this, it can still be a very useful method to have available. Standard sizes for field flare are 1in to 4in.

## Sliding Fit Liner System

The sliding fit liner system is manufactured specially for field flare use and cannot use standard factory spools. Standard factory spools have liners fitted which are an interference fit with the steelwork – this provides support under vacuum conditions. The sliding fit liner is exactly the same as our factory finished spool liner. However the lined pipe spools go through a special size setting heat treatment cycle, prior to being dispatched. This makes the liner smaller in diameter, allowing them to be removed on site to allow the steelwork to be fabricated and the liner reinserted. This system makes it easier to fabricate spools on site using welded, threaded or Van Stone flanging. Once reinserted the PTFE liner has a tremendous memory and will recover in the presence of heat back to its original diameter to provide vacuum resistance. The key disadvantage of this liner type is that in warm or hot climates – even the UK – the liners will recover over time and become difficult or impossible to remove from the steel tube.

There are three types of heat set sliding fit liner, varying by their flange configuration. These types are our No Flanges, Van Stone flanging one end and welded stub end with rotating flange one end. We recommend having one end flanged as it makes the production of the field flare quicker and less expensive.

## Tight Fit Liner System

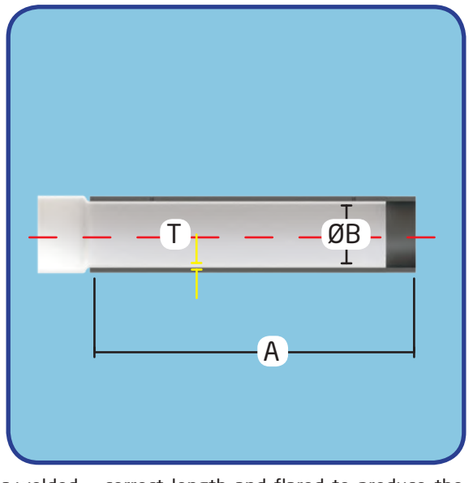
A tight fit liner system is manufactured specially for field flare use, because of the need to have vent holes in any spool that is produced as a result of field flaring. It is not possible to drill vent holes on site because of the potential damage to the liner. A spool type is available with vent holes drilled regularly along the length of the pipe to guarantee that any spool made from it has at least one vent hole; our specification ES1067. However, it is possible to use a standard factory finished spool to make a shorter tight fit field flare spool by cutting it up, but it is essential to ensure that there is at least one vent hole in the spool piece to be used.

This method does require some machinery for cutting and threading the pipe and there is a process risk of damaging the liner during the "parting off" activity.

A key advantage of tight fit liner spools are that they work in all climatic conditions and will provide the same vacuum performance as a factory made spool. The disadvantages are that threaded flanges only can be used in the field, as it is not possible to weld onto the spool with liner inside. Similarly it is not possible to fit lugs, studs, vent bosses or any sort of mounting bracket in the field. Also it is necessary to have a pipe threading and parting off machine in order to prepare the spool for flanging and flaring. CRP manufactures special "companion flanges" for use with these spools which not only provides the correct radius for flaring across at the flange face, but as importantly avoids the potential for a step between the pipe id and the flange id, which can be a stress raiser for the PTFE and cause premature failure.

| Sliding Fit Liner | | Tight Fit Liner | |
|---|---|---|---|
| × | Not suitable for hot climate | ✓ | Can use in any climate |
| × | Will recover after time depending on temperature | ✓ | Can be held on stock indefinitely |
| ✓ | Will provide same vacuum performance as factory made spool | ✓ | Will provide same vacuum performance as factory made spool |
| ✓ | Vent holes can be drilled on-site | × | Need to ensure vent holes |
| ✓ | Can fit welded accessories | × | Cannot fit studs, vent bosses etc. |
| ✓ | Can use Van Stone, Welded or Threaded Flange | × | Can only use special threaded flanges |
| ✓ | Can have fixed or rotating flange | × | Cannot have rotating flange easily |
| ✓ | Only requires a saw | × | Requires parting off and threading machinery |

# Field Flare Pipe Spool Slide Fit
## No Flanges




The spool can be supplied in lengths up to 3000mm long, the spool can be cut down as many times as practical and used to manufacture many shorter lengths, each time the pipe spool flanged ends must be fabricated on site. Flanges can be welded, used in conjunction with a welded stub end to provide a rotating flange or the pipe threaded and a threaded and hubbed flange fitted. Once the steelwork is finished the liner is introduced back into the steelwork and the PTFE cut to the correct length and flared to produce the finished spool. CRP can supply all types of flanges and stub ends along with the piping to fabricate the spool.

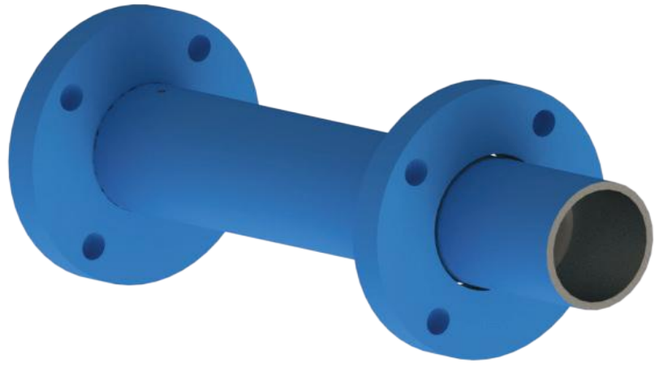
| Field Flare Spool Slide Fit - No Flanges | | | | | | |
|---|---|---|---|---|---|---|
| Produces R/R, F/R or F/F | | | | | | |
| Nominal Bore | | Order Length | Maximum Finished Spool Length | HiPerFlon PTFE Liner Thickness Nominal[1] | Lined Bore Nominal[2] | Weight per metre |
| | | A | | T | Ø B | |
| Inches | mm | mm | mm | mm | mm | kg |
| 1 | 25 | 3000 | 2800 | 3.2 | 20 | 2.8 |
| 1½ | 40 | 3000 | 2800 | 3.2 | 34 | 5.0 |
| 2 | 50 | 3000 | 2800 | 3.2 | 46 | 6.5 |
| 3 | 80 | 3000 | 2800 | 3.2 | 70 | 12.3 |
| 4 | 100 | 3000 | 2800 | 4.5 | 93 | 16.0 |

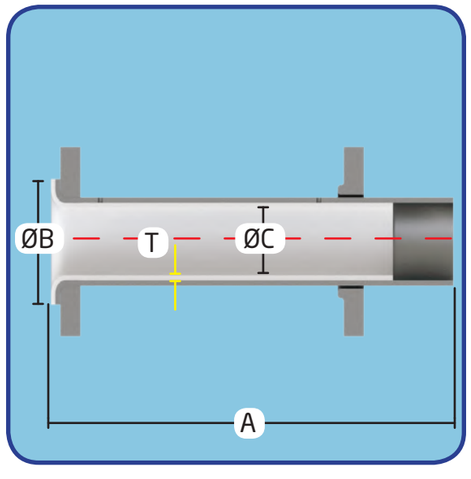
1 - Liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.

2 - Because of the method of manufacture and tolerances on steel materials these are a guide. Please consult if you require a precise dimension for instrument, mixer or other insertion or a calibrated volume.



# Field Flare Pipe Spool Slide Fit
## Van Stone Rotating Flange & Loose Slip On Flange





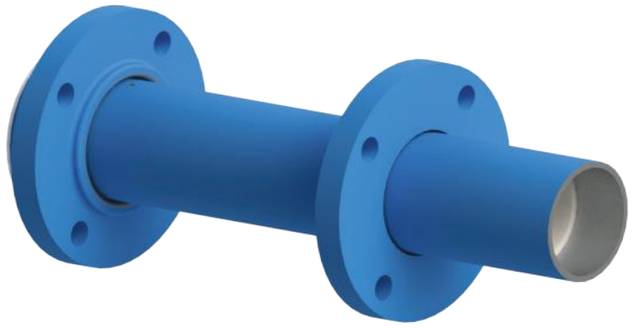

This field pipe spool has a fully factory finished Van Stone flanged end complete with rotating flange. The other end is supplied unfinished with a tacked on slip on weld flange. When ready to be fabricated the PTFE is slid away from the unfinished end, the steel is sawn to the correct length, the flanged welded on and then the PTFE reintroduced and field flared completing the pipe spool leaving a pipe spool with fixed / rotating flanges ready for installation.

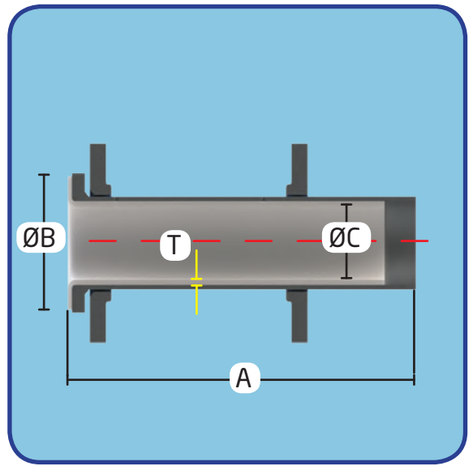
| Field Flare Pipe Spool Slide Fit-Van Stone Rotating Flange and Loose Slip on Flange<br>Produces F/R | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Nominal Bore | | Order Length | Maximum Finished Spool Length | Flange Outside | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | Lined Bore Nominal[2] | Weight | |
| | | A | | Ø B | Ø C | T | Ø D | Flange Pack | Per metre |
| Inches | mm | mm | mm | mm | mm | mm | mm | kg | kg |
| 1 | 25 | 2900 | 2800 | 110 | 51 | 3.2 | 20 | 3 | 2.8 |
| 1½ | 40 | 2900 | 2800 | 125 | 73 | 3.2 | 34 | 4 | 5.0 |
| 2 | 50 | 2900 | 2800 | 150 | 92 | 3.2 | 46 | 6 | 6.5 |
| 3 | 80 | 2900 | 2800 | 190 | 127 | 3.2 | 70 | 10 | 12.3 |
| 4 | 100 | 2900 | 2800 | 230 | 157 | 4.5 | 93 | 12 | 16.0 |

1 - Please note liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.

2 - Bore is based on virgin PTFE heavy duty liner, because of method of manufacture and steel tolerances this is a guide only,for other materials and thicknesses please consult the liner tables in the manual.

# Field Flare Pipe Spool Slide Fit
## Welded Rotating Flange & Loose Slip on Flange






This field flare pipe spool has a fully factory finished rotating flanged end with welded stub end. The other end is supplied unfinished with a tacked on slip on weld flange.

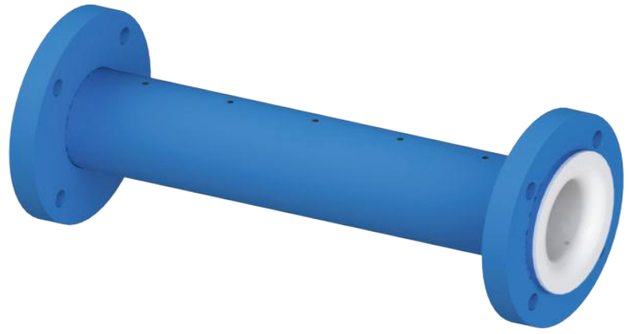
When ready to be fabricated the PTFE is slid away from the unfinished end, the steel is sawn to the correct length, the flanged welded on and then the PTFE reintroduced and field flared completing the pipe spool leaving a pipe spool with fixed / rotating flanges ready for installation.

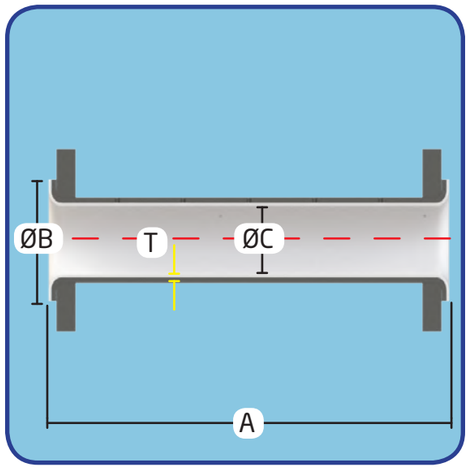
| Field Flare Spool Slide Fit- Welded Rotating Flange and Loose Slip on Flange<br>Produces F/R | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Order Length | Maximum Finished Spool Length | Flange Outside | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | Lined Bore Nominal[2] | Weight[3] | |
| Nominal Bore | | A | | Ø B | Ø C | T | Ø D | Flange Pack | Per metre |
| Inches | mm | mm | mm | mm | mm | mm | mm | kg | kg |
| 1 | 25 | 3000 | 2800 | 110 | 51 | 3.2 | 20 | 3 | 2.8 |
| 1½ | 40 | 3000 | 2800 | 125 | 73 | 3.2 | 34 | 4 | 5.0 |
| 2 | 50 | 3000 | 2800 | 150 | 92 | 3.2 | 46 | 6 | 6.5 |
| 3 | 80 | 3000 | 2800 | 190 | 127 | 3.2 | 70 | 10 | 12.3 |
| 4 | 100 | 3000 | 2800 | 230 | 157 | 4.5 | 93 | 12 | 16.0 |

1 - Please note liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.
2 - Bore is based on virgin PTFE heavy duty liner, because of method of manufacture and steel tolerances this is a guide only,for other materials and thicknesses please consult the liner tables in the manual.
3- This does not include the weight of the flanges that will be required for installation.



# Field Flare Pipe Spool Tight Fit
## Van Stone Rotating Flanges





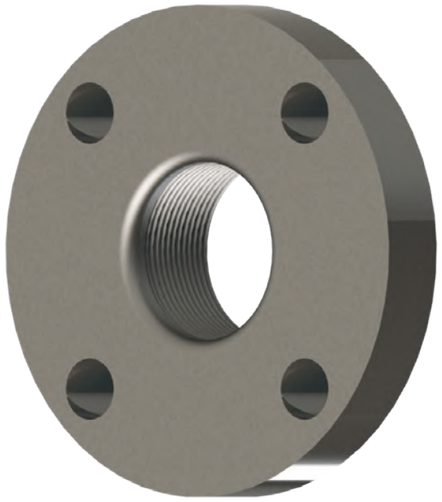

This spool can be supplied in 3000mm or 6000mm lengths. It has vent holes drilled at 300mm intervals and can be cut down as many times as is practical to manufacture many shorter lengths. Because this is a tight fit liner, it can only be used by having a threading and parting off machine to expose the liner for flaring and to provide the thread for a flange. Only threaded flanges can be used. This product is ideal for use in hot climates where slide fit liners would not be suitable. CRP can supply special design threaded companion flanges to use with these spools.

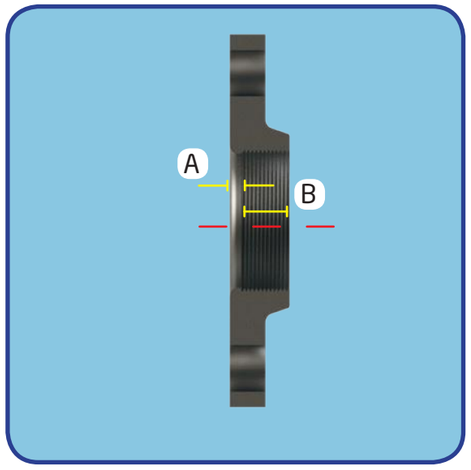
Please note that this product does require some machinery for cutting and threading the pipe and there is a process risk of damaging the liner during the "parting off" activity.

| Field Flare Pipe Spool Tight Fit - Van Stone<br>Produces F/R for use with Field Flare Threaded Flange | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Order Length[1] | Maximum Finished Spool Length | Flange Outside | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[2] | Lined Bore Nominal[3] | Weight | |
| Nominal Bore | | A | | Ø B | Ø C | T | Ø D | 3000mm | 6000mm |
| Inches | mm | mm | mm | mm | mm | mm | mm | kg | kg |
| 1 | 25 | 3000 or 6000 | 2800 or 5800 | 110 | 51 | 3.2 | 20 | 12 | 20 |
| 1½ | 40 | 3000 or 6000 | 2800 or 5800 | 125 | 73 | 3.2 | 34 | 19 | 34 |
| 2 | 50 | 3000 or 6000 | 2800 or 5800 | 150 | 92 | 3.2 | 46 | 26 | 45 |
| 3 | 80 | 3000 or 6000 | 2800 or 5800 | 190 | 127 | 3.2 | 70 | 47 | 84 |
| 4 | 100 | 3000 or 6000 | 2800 or 5800 | 230 | 157 | 4.5 | 93 | 60 | 108 |

1 - Please note liner thicknesses are based on Virgin PTFE heavy duty liner for other materials consult the liner tables in the manual.
2 - Bore is based on virgin PTFE heavy duty liner, because of method of manufacture and steel tolerances this is a guide only,for other materials and thicknesses please consult the liner tables in the manual.

# Field Flare Threaded Companion Flange






Companion flanges are used in conjunction with tight fit field flare pipe spools to enable the field fitting of a flange without welding which could serve to damage the liner inside the pipe. These flanges are specific to lined pipe, as they are designed for threading onto the spool, but with a smooth radiussed transition from the pipe steel bore to the raised face. This is critical to prevent the liner becoming stressed when flared over this junction. It is important to thread the pipe sufficiently to run the flange fully home. The table below shows the thread length on the flange and the amount by which to reduce the spool steel length to allow for the flange and lining - assuming flanges on both ends.

| Field Flare Threaded Companion Flange | | | | | | |
|---|---|---|---|---|---|---|
| Nominal Bore | | | Flange Face to Thread Start | HiPerFlon PTFE Flare Thickness | Cut Pipe Length to Finished Spool Length | Axial Length of Thread |
| | | | A | | | B |
| Inches | mm | Thread | mm | mm | mm | mm |
| 1 | 25 | 1" BSPP | 6.3 | 3.2 | -19 | 18 |
| 1½ | 40 | 1½" BSPP | 6.3 | 3.2 | -19 | 22 |
| 2 | 50 | 2" BSPP | 6.3 | 3.2 | -19 | 25 |
| 3 | 80 | 3" BSPP | 6.3 | 3.2 | -19 | 32 |
| 4 | 100 | 4" BSPP | 6.3 | 4.5 | -22 | 33 |
| 6 | 150 | 6" BSPP | 6.3 | 5.5 | -24 | 40 |



# Field Flare Equipment

## Heated Tool Expanding Mandrel Flaring

This flaring system can work with either tight fit or sliding fit liners. The system works by first inserting an expanding mandrel into the bore of the liner to be flared. This presses the liner out to the inside of the steel tube and provides a threaded part onto which the tooling can be mounted. The flaring operation is carried out using aluminium flaring heads that have been heated indirectly either using a gas burner or gas torch, electric hot plates, or a gas or electric oven. The flaring heads are supported on the expanding mandrel and are then slowly pressed on to the exposed PTFE allowing the heat from the flaring head to sink into the PTFE and allow it to be flared. The advantage of this type is that it is quite cost-effective in terms of equipment. It is possible to buy individual kits for each nominal bore of 1in, 1.1/2in, 2in, 3in and 4in. The disadvantage is that it is not particularly quick in use, but is fine for occasional spools.

## Hot Air Hub Pulling Flaring

This method is designed for working with tight fit liners, but with a small amount of additional tooling can work with sliding fit liners. The flaring operation is carried out by heating the PTFE liner directly using a hot air gun and special heating cones designed to provide the heat at the correct places. Once the liner is heated the flaring is undertaken first by using a hand held cone to push out the liner to around 45 degrees. Then a shaped tool is used, pulled into place using a hub puller mounted on the flange. The key difference is that this method requires the PTFE to be pre-heated to its gel temperature, so requires the hot air equipment. The tooling is cold.

This method has the advantage of being significantly quicker than the heated tool method and less subject to operator error. The equipment is more expensive and is only available as a complete set for 1in to 4in. It is the ideal method for a customer that wishes to manufacture a significant number of spools efficiently.

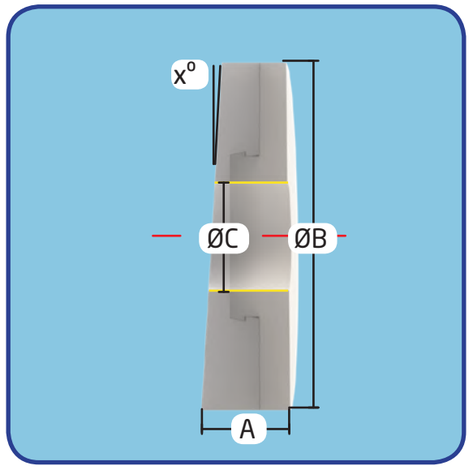
CRP recommends this as the method by which the most consistent product can be manufactured, having the most repeatable process.

| Heated Tool Expanding Mandrel Flaring | | Hot Air Hub Pulling Flaring | |
|---|---|---|---|
| ✓ | Lower cost | × | Higher cost |
| ✓ | Can be purchased size by size | × | All sizes purchased together |
| × | Relatively Slow | ✓ | Much faster |
| × | Requires careful use of skills | ✓ | More easily trained |
| ✓ | Will work with sliding and tight fit liners | ✓ | Will work with sliding and tight fit liners |

## Training

It is critical that operators are properly trained and to this end we can offer either in house or on-site training for your construction teams. This will ensure the piping is produced safely and correctly on site. Please email enquiry@crp.co.uk for details.

# Spacer Type 1 Variable Angle

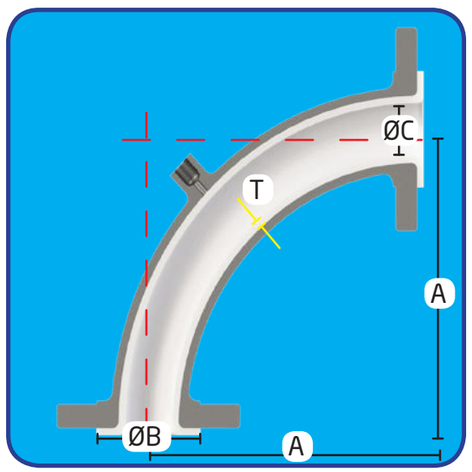



The variable angle spacer comprises two interlocking PTFE wedges that can rotate from parallel to a maximum 7.5° (nominal bore dependent) to compensate for small gaps required to deal with a change in piping angle and ideal for the pipe fitters tool bag as they can assist with awkward installations.

| Spacer Type 1 Variable Taper | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Length | | | | | |
| | | Minimum | Maximum | Outside | Bore Nominal | | Possible Angles |
| Nominal Bore | | | A | Ø B | Ø C | Weight | |
| Inches | mm | mm | mm | mm | mm | kg/mm | ° |
| 1 | 25 | 11 | 25 | 64 | 20 | 0.006 | 0-7.5 |
| 1½ | 40 | 11 | 25 | 83 | 38 | 0.009 | 0-7.5 |
| 2 | 50 | 11 | 25 | 102 | 51 | 0.013 | 0-7.5 |
| 3 | 80 | 11 | 25 | 133 | 76 | 0.020 | 0-7.5 |
| 4 | 100 | 11 | 25 | 171 | 102 | 0.032 | 0-4 |
| 6 | 150 | 11 | 25 | 219 | 152 | 0.042 | 0-3 |



# 90° Elbow 5D




5D elbows have a significantly larger radius than standard elbows. This helps reduce the pressure drop around the bend and makes it easier for more viscous fluids such as slurries to pass without product hold-up. They can also serve to reduce the erosion of the lining if there are any abrasive materials in the fluid. These are lined in paste extruded PTFE.

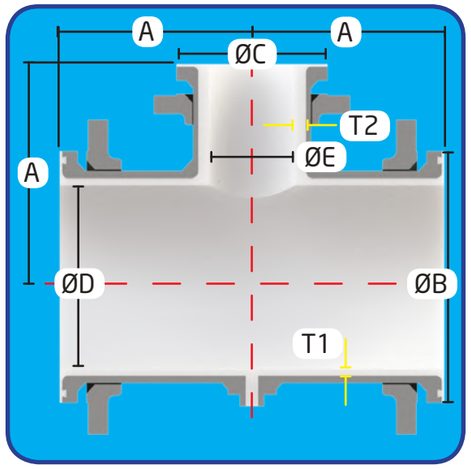
| 90° Elbow 5D | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Centre Line to Face | Raised Face | HiPerFlon PTFE Liner Thickness Nominal[1] | PTFE Liner Bore Nominal[2] | | | |
| Nominal Bore[3] | | A | Ø B | T | Ø C | Construction | Weight | |
| Inches | mm | mm | mm | mm | mm | Standard | kg | |
| 1 | 25 | 127 | 51 | 3.2 | 20 | FT | 2.5 | |
| 1½ | 40 | 191 | 73 | 3.2 | 34 | FT | 4.7 | |
| 2 | 50 | 254 | 92 | 3.2 | 46 | FT | 7.6 | |
| 3 | 80 | 381 | 127 | 3.2 | 70 | FT | 15 | |
| 4 | 100 | 508 | 157 | 4.5 | 93 | FT | 26 | |
| 6 | 150 | 762 | 216 | 5.5 | 143 | FT | 63 | |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PTFE heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on Virgin PTFE heavy duty liner and schedule 40 steel pipe. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a calibrated volume in the product please consult us.

3 - Larger sizes available on request.




This design of tee has three rotating flanges captured behind stub ends. This design makes installation easy and provides versatility. The tee design is ideal as a stock item for maintenance requirements.

## Reducing Tee Rotating Flanges

| Nominal Bore | | | | | | | Centre Line to Face | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch PFA Heavy Duty Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Bore Nominal[2] | Construction | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | | mm | | | A | B | Ø C | T1 | T2 | Ø D | Ø E | Standard | kg |
| ¾ | x | ½ | | 20 | x | 15 | 75 | 43 | 35 | 4.5 | 4.5 | 12 | 12 | FP | 2.0 |
| 1 | x | ½ | | 25 | x | 15 | 89 | 51 | 35 | 4.0 | 4.5 | 20 | 12 | FP | 2.7 |
| 1 | x | ¾ | | 25 | x | 20 | 89 | 51 | 43 | 4.0 | 4.5 | 20 | 12 | FP | 3.0 |
| 1½ | x | ½ | | 40 | x | 15 | 102 | 73 | 35 | 4.5 | 4.5 | 33 | 12 | FP | 4.2 |
| 1½ | x | ¾ | | 40 | x | 20 | 102 | 73 | 43 | 4.5 | 4.5 | 33 | 12 | FP | 4.5 |
| 1½ | x | 1 | | 40 | x | 25 | 102 | 73 | 51 | 4.5 | 4.0 | 33 | 20 | FP | 4.8 |
| 2 | x | ½ | | 50 | x | 15 | 114 | 92 | 35 | 4.8 | 4.5 | 44 | 12 | FP | 6.4 |
| 2 | x | ¾ | | 50 | x | 20 | 114 | 92 | 43 | 4.8 | 4.5 | 44 | 12 | FP | 6.6 |
| 2 | x | 1 | | 50 | x | 25 | 114 | 92 | 51 | 4.8 | 4.0 | 44 | 20 | FP | 6.9 |
| 2 | x | 1½ | | 50 | x | 40 | 114 | 92 | 73 | 4.8 | 4.5 | 44 | 33 | FP | 7.7 |
| 3 | x | ½ | | 80 | x | 15 | 140 | 127 | 35 | 6.5 | 4.5 | 66 | 12 | FP | 12 |
| 3 | x | ¾ | | 80 | x | 20 | 140 | 127 | 43 | 6.5 | 4.5 | 66 | 12 | FP | 13 |
| 3 | x | 1 | | 80 | x | 25 | 140 | 127 | 51 | 6.0 | 4.0 | 66 | 20 | FP | 13 |
| 3 | x | 1½ | | 80 | x | 40 | 140 | 127 | 73 | 6.5 | 4.5 | 66 | 33 | FP | 14 |
| 3 | x | 2 | | 80 | x | 50 | 140 | 127 | 92 | 6.5 | 4.8 | 66 | 44 | FP | 15 |
| 4 | x | ½ | | 100 | x | 15 | 165 | 157 | 35 | 9.0 | 4.5 | 86 | 12 | FP | 18 |
| 4 | x | ¾ | | 100 | x | 20 | 165 | 157 | 43 | 9.0 | 4.5 | 86 | 12 | FP | 19 |
| 4 | x | 1 | | 100 | x | 25 | 165 | 157 | 51 | 9.0 | 4.0 | 86 | 20 | FP | 19 |
| 4 | x | 1½ | | 100 | x | 40 | 165 | 157 | 73 | 9.0 | 4.5 | 86 | 33 | FP | 20 |
| 4 | x | 2 | | 100 | x | 50 | 165 | 157 | 92 | 9.0 | 4.8 | 86 | 44 | FP | 21 |
| 4 | x | 3 | | 100 | x | 80 | 165 | 157 | 127 | 9.0 | 4.5 | 86 | 66 | FP | 24 |
| 6 | x | ½ | | 150 | x | 15 | 203 | 216 | 35 | 11.0 | 4.8 | 137 | 12 | FP | 31 |
| 6 | x | ¾ | | 150 | x | 20 | 203 | 216 | 43 | 11.0 | 6.5 | 137 | 12 | FP | 31 |

Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



Reducing Tee Rotating Flanges

## Reducing Tee Rotating Flanges

| Nominal Bore | | | | | | | Centre Line to Face | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch PFA Heavy Duty Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Bore Nominal[2] | Construction | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | | mm | | | A | B | Ø C | T1 | T2 | Ø D | Ø E | Standard | kg |
| 6 | x | 1 | | 150 | x | 25 | 203 | 216 | 51 | 11.0 | 4.0 | 137 | 20 | FP | 32 |
| 6 | x | 1½ | | 150 | x | 40 | 203 | 216 | 73 | 11.0 | 4.5 | 137 | 33 | FP | 33 |
| 6 | x | 2 | | 150 | x | 50 | 203 | 216 | 92 | 11.0 | 4.8 | 137 | 44 | FP | 34 |
| 6 | x | 3 | | 150 | x | 80 | 203 | 216 | 127 | 11.0 | 6.5 | 137 | 66 | FP | 37 |
| 6 | x | 4 | | 150 | x | 100 | 203 | 216 | 157 | 11.0 | 9.0 | 137 | 86 | FP | 40 |
| 8 | x | 1 | | 200 | x | 25 | 229 | 270 | 51 | 10.0 | 4.0 | 186 | 20 | FP | 48 |
| 8 | x | 1½ | | 200 | x | 40 | 229 | 270 | 73 | 10.0 | 4.5 | 186 | 33 | FP | 49 |
| 8 | x | 2 | | 200 | x | 50 | 229 | 270 | 92 | 10.0 | 4.8 | 186 | 44 | FP | 50 |
| 8 | x | 3 | | 200 | x | 80 | 229 | 270 | 127 | 10.0 | 6.5 | 186 | 66 | FP | 54 |
| 8 | x | 4 | | 200 | x | 100 | 229 | 270 | 157 | 10.0 | 9.0 | 186 | 86 | FP | 57 |
| 8 | x | 6 | | 200 | x | 150 | 229 | 270 | 216 | 10.0 | 11.0 | 186 | 137 | FP | 63 |
| 10 | x | 1 | | 250 | x | 25 | 279 | 324 | 51 | 10.0 | 4.0 | 237 | 20 | FP | 72 |
| 10 | x | 1½ | | 250 | x | 40 | 279 | 324 | 73 | 10.0 | 4.5 | 237 | 33 | FP | 73 |
| 10 | x | 2 | | 250 | x | 50 | 279 | 324 | 92 | 10.0 | 4.8 | 237 | 44 | FP | 74 |
| 10 | x | 3 | | 250 | x | 80 | 279 | 324 | 127 | 10.0 | 6.5 | 237 | 66 | FP | 78 |
| 10 | x | 4 | | 250 | x | 100 | 279 | 324 | 157 | 10.0 | 9.0 | 237 | 86 | FP | 82 |
| 10 | x | 6 | | 250 | x | 150 | 279 | 324 | 216 | 10.0 | 11.0 | 237 | 137 | FP | 88 |
| 10 | x | 8 | | 250 | x | 200 | 279 | 324 | 270 | 10.0 | 10.0 | 237 | 186 | FP | 96 |
| 12 | x | 1 | | 300 | x | 25 | 305 | 381 | 51 | 10.0 | 4.0 | 287 | 20 | FP | 105 |
| 12 | x | 1½ | | 300 | x | 40 | 305 | 381 | 73 | 10.0 | 4.5 | 287 | 33 | FP | 106 |
| 12 | x | 2 | | 300 | x | 50 | 305 | 381 | 92 | 10.0 | 4.8 | 287 | 44 | FP | 107 |
| 12 | x | 3 | | 300 | x | 80 | 305 | 381 | 127 | 10.0 | 6.5 | 287 | 66 | FP | 112 |
| 12 | x | 4 | | 300 | x | 100 | 305 | 381 | 157 | 10.0 | 9.0 | 287 | 86 | FP | 115 |
| 12 | x | 6 | | 300 | x | 150 | 305 | 381 | 216 | 10.0 | 11.0 | 287 | 137 | FP | 122 |
| 12 | x | 8 | | 300 | x | 200 | 305 | 381 | 270 | 10.0 | 10.0 | 287 | 186 | FP | 130 |
| 12 | x | 10 | | 300 | x | 250 | 305 | 381 | 324 | 10.0 | 10.0 | 287 | 237 | FP | 140 |
| 14 | x | 1 | | 350 | x | 25 | 356 | 413 | 51 | 10.5 | 4.0 | 317 | 20 | FP | 143 |
| 14 | x | 1½ | | 350 | x | 40 | 356 | 413 | 73 | 10.5 | 4.5 | 317 | 33 | FP | 144 |
| 14 | x | 2 | | 350 | x | 50 | 356 | 413 | 92 | 10.5 | 4.8 | 317 | 44 | FP | 146 |
| 14 | x | 3 | | 350 | x | 80 | 356 | 413 | 127 | 10.5 | 6.5 | 317 | 66 | FP | 150 |
| 14 | x | 4 | | 350 | x | 100 | 356 | 413 | 157 | 10.5 | 9.0 | 317 | 86 | FP | 154 |
| 14 | x | 6 | | 350 | x | 150 | 356 | 413 | 216 | 10.5 | 11.0 | 317 | 137 | FP | 162 |
| 14 | x | 8 | | 350 | x | 200 | 356 | 413 | 270 | 10.5 | 10.0 | 317 | 186 | FP | 171 |
| 14 | x | 10 | | 350 | x | 250 | 356 | 413 | 324 | 10.5 | 10.0 | 317 | 237 | FP | 182 |
| 14 | x | 12 | | 350 | x | 300 | 356 | 413 | 381 | 10.5 | 10.0 | 317 | 287 | FP | 197 |

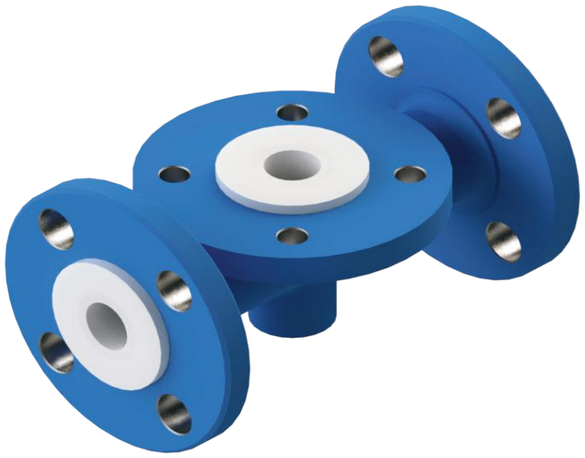
Construction Codes

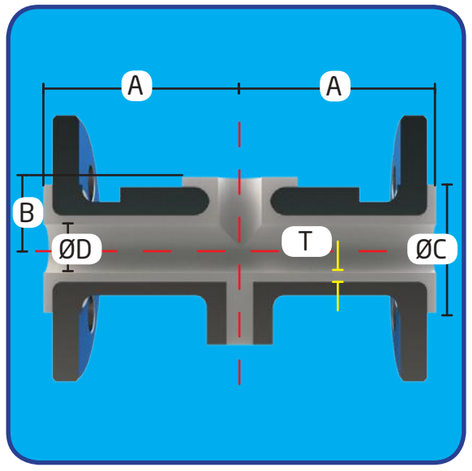
| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on Virgin PFA heavy duty liner and schedule 40 or 30 steel pipe. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.

# Short Stack Tee






A short stack tee is the equivalent of an equal tee, but instead of a branch, a pad flange is mounted directly onto the main pipeline. This can be very useful if space is a limiting factor such as around the top of reactors. Also they are often used for mounting instruments into the main flow and can make up a key part of manifold systems when space is at a premium. They are a key part of surface mounted sampling systems for large line sizes; where a sample can be taken directly from a pipeline without the need for a large flanged or wafer in-line sampling device.

The branch flange holes are supplied threaded UNC and the metric equivalents are available. Short stack tee's can also be manufactured as reducing tee's with the branch size smaller than the main bore.

Short Stack Tee

| Nominal Bore | | Centre Line to Face | Centre Line to Face | Raised Face | PFA Heavy Duty Liner Thickness Nominal[1] | PFA Liner Bore Nominal[2] | Construction | Weight |
|---|---|---|---|---|---|---|---|---|
| | | A | B | Ø C | T | Ø D | | |
| Inches | mm | mm | mm | mm | mm | mm | Standard | kg |
| 1 | 25 | 89 | 30 | 51 | 4.0 | 20 | CP | 3.1 |
| 1½ | 40 | 102 | 37 | 73 | 4.5 | 33 | CP | 5.1 |
| 2 | 50 | 114 | 43 | 92 | 4.8 | 44 | CP | 8.2 |
| 3 | 80 | 140 | 56 | 127 | 6.5 | 66 | CP | 17 |
| 4 | 100 | 165 | 67 | 157 | 9.0 | 86 | CP | 24 |
| 6 | 150 | 203 | 105 | 216 | 11.0 | 137 | FP | 42 |

Construction Codes

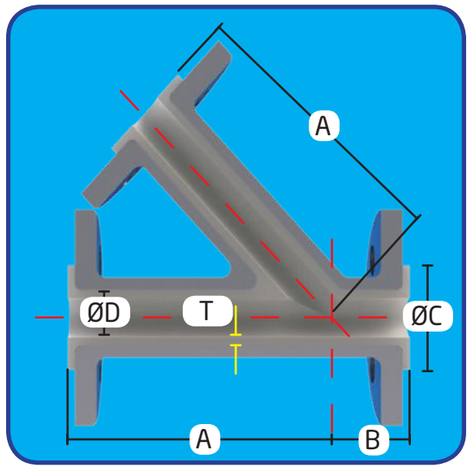
| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on Virgin PFA heavy duty liner and schedule 40 or 30 steel pipe. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.



# Equal Lateral Tee




An equal lateral tee provides the same functionality as an equal tee with the exception that the branch leaves the main body at 45° close to one end of the main body. They are often used to provide run-off from reactor outlets and to soften changes in flow direction creating less turbulent flow than the 90° branch of an equal tee.

Equal Lateral Tee

| Nominal Bore | | Centre Line to Face | Centre Line to Face | Raised Face | PFA Heavy Duty Liner Thickness Nominal[1] | PFA Liner Bore Nominal[2] | Construction | Weight |
|---|---|---|---|---|---|---|---|---|
| | | A | B | Ø C | T | Ø D | | |
| Inches | mm | mm | mm | mm | mm | mm | Standard | kg |
| 1 | 25 | 146 | 44 | 51 | 4.0 | 20 | FP | 3.5 |
| 1½ | 40 | 178 | 51 | 73 | 4.5 | 33 | FP | 6.0 |
| 2 | 50 | 203 | 64 | 92 | 4.8 | 44 | FP | 9.6 |
| 3 | 80 | 254 | 76 | 127 | 6.5 | 66 | FP | 20 |
| 4 | 100 | 305 | 76 | 157 | 9.0 | 86 | FP | 31 |
| 6 | 150 | 368 | 89 | 216 | 11.0 | 137 | FP | 53 |
| 8 | 200 | 444 | 114 | 270 | 10.0 | 186 | FP | 85 |
| 10 | 250 | 521 | 127 | 324 | 10.0 | 237 | FP | 128 |
| 12 | 300 | 622 | 140 | 381 | 10.0 | 287 | FP | 194 |
| 14 | 350 | 686 | 152 | 413 | 10.5 | 317 | FP | 258 |

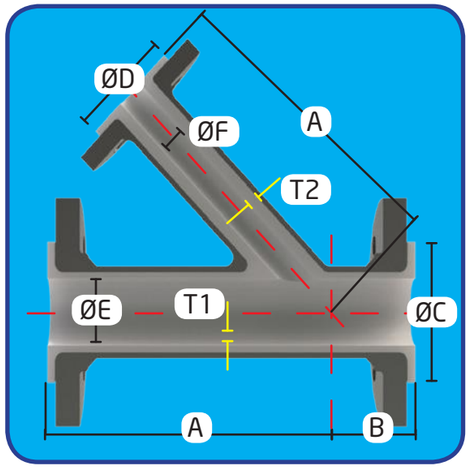
Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on Virgin PFA heavy duty liner and schedule 40 or 30 steel pipe. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.

# Reducing Lateral Tee




A reducing lateral tee provides the same functionality as an equal tee with the exception that the branch leaves the main body at 45° close to one end of the main body. They are often used to provide run-off from reactor outlets and to soften changes in flow direction creating less turbulent flow than the 90° branch of a reducing tee.

## Reducing Lateral Tee

| Nominal Bore | | Centre Line to Face | Centre Line to Face | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch PFA Heavy Duty Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Bore Nominal[2] | Construction | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | mm | A | B | Ø C | Ø D | T1 | T2 | Ø E | Ø F | Standard | kg |
| 1 x ½ | 25 x 15 | 146 | 44 | 51 | 35 | 4.0 | 4.5 | 20 | 12 | FP | 2.8 |
| 1 x ¾ | 25 x 20 | 146 | 44 | 51 | 43 | 4.0 | 4.5 | 20 | 12 | FP | 3.1 |
| 1½ x ½ | 40 x 15 | 178 | 51 | 73 | 35 | 4.5 | 4.5 | 33 | 12 | FP | 4.4 |
| 1½ x ¾ | 40 x 20 | 178 | 51 | 73 | 43 | 4.5 | 4.5 | 33 | 12 | FP | 4.8 |
| 1½ x 1 | 40 x 25 | 178 | 51 | 73 | 51 | 4.5 | 4.0 | 33 | 20 | FP | 5.1 |
| 2 x ½ | 50 x 15 | 203 | 64 | 92 | 35 | 4.5 | 4.5 | 44 | 12 | FP | 6.8 |
| 2 x ¾ | 50 x 20 | 203 | 64 | 92 | 43 | 4.5 | 4.5 | 44 | 12 | FP | 7.1 |
| 2 x 1 | 50 x 25 | 203 | 64 | 92 | 51 | 4.5 | 4.0 | 44 | 20 | FP | 7.5 |
| 2 x 1½ | 50 x 40 | 203 | 64 | 92 | 73 | 4.5 | 4.5 | 44 | 33 | FP | 8.4 |
| 3 x ½ | 80 x 15 | 254 | 76 | 127 | 35 | 6.5 | 4.5 | 66 | 12 | FP | 13 |
| 3 x ¾ | 80 x 20 | 254 | 76 | 127 | 43 | 6.5 | 4.5 | 66 | 12 | FP | 14 |
| 3 x 1 | 80 x 25 | 254 | 76 | 127 | 51 | 6.5 | 4.0 | 66 | 20 | FP | 14 |
| 3 x 1½ | 80 x 40 | 254 | 76 | 127 | 73 | 6.5 | 4.5 | 66 | 33 | FP | 15 |
| 3 x 2 | 80 x 50 | 254 | 76 | 127 | 92 | 6.5 | 4.8 | 66 | 44 | FP | 16 |
| 4 x ½ | 100 x 15 | 305 | 76 | 157 | 35 | 9.0 | 4.5 | 86 | 12 | FP | 20 |
| 4 x ¾ | 100 x 20 | 305 | 76 | 157 | 43 | 9.0 | 4.5 | 86 | 12 | FP | 20 |
| 4 x 1 | 100 x 25 | 305 | 76 | 157 | 51 | 9.0 | 4.0 | 86 | 20 | FP | 21 |
| 4 x 1½ | 100 x 40 | 305 | 76 | 157 | 73 | 9.0 | 4.5 | 86 | 33 | FP | 22 |
| 4 x 2 | 100 x 50 | 305 | 76 | 157 | 92 | 9.0 | 4.8 | 86 | 44 | FP | 23 |
| 4 x 3 | 100 x 80 | 305 | 76 | 157 | 127 | 9.0 | 6.5 | 86 | 66 | FP | 27 |
| 6 x ½ | 150 x 15 | 368 | 89 | 216 | 35 | 11.0 | 4.5 | 137 | 12 | FP | 33 |
| 6 x ¾ | 150 x 15 | 368 | 89 | 216 | 35 | 11.0 | 4.5 | 137 | 12 | FP | 34 |
| 6 x 1 | 150 x 25 | 368 | 89 | 216 | 51 | 11.0 | 4.0 | 137 | 12 | FP | 34 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



# Reducing Lateral Tee

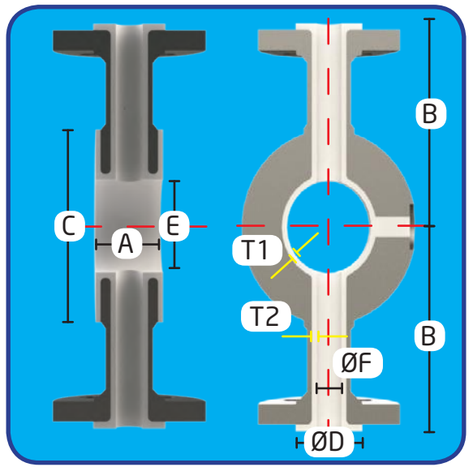
## Reducing Lateral Tee

| Nominal Bore | | Centre Line to Face | Centre Line to Face | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch PFA Heavy Duty Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Bore Nominal[2] | Construction | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | mm | A | B | Ø C | Ø D | T1 | T2 | Ø E | Ø F | Standard | kg |
| 6 x 1½ | 150 x 40 | 368 | 89 | 216 | 73 | 11.0 | 4.5 | 137 | 33 | FP | 35 |
| 6 x 2 | 150 x 50 | 368 | 89 | 216 | 92 | 11.0 | 4.8 | 137 | 44 | FP | 37 |
| 6 x 3 | 150 x 80 | 368 | 89 | 216 | 127 | 11.0 | 6.5 | 137 | 66 | FP | 41 |
| 6 x 4 | 150 x 100 | 368 | 89 | 216 | 157 | 11.0 | 9.0 | 137 | 86 | FP | 45 |
| 8 x 1 | 200 x 25 | 444 | 114 | 270 | 51 | 10.0 | 4.0 | 186 | 20 | FP | 53 |
| 8 x 1½ | 200 x 40 | 444 | 114 | 270 | 73 | 10.0 | 4.5 | 186 | 33 | FP | 55 |
| 8 x 2 | 200 x 50 | 444 | 114 | 270 | 92 | 10.0 | 4.8 | 186 | 44 | FP | 56 |
| 8 x 3 | 200 x 80 | 444 | 114 | 270 | 127 | 10.0 | 6.5 | 186 | 66 | FP | 62 |
| 8 x 4 | 200 x 100 | 444 | 114 | 270 | 157 | 10.0 | 9.0 | 186 | 86 | FP | 66 |
| 8 x 6 | 200 x 150 | 444 | 114 | 270 | 216 | 10.0 | 11.0 | 186 | 137 | FP | 75 |
| 10 x 1 | 250 x 25 | 521 | 127 | 324 | 51 | 10.0 | 4.0 | 237 | 20 | FP | 79 |
| 10 x 1½ | 250 x 40 | 521 | 127 | 324 | 73 | 10.0 | 4.5 | 237 | 33 | FP | 80 |
| 10 x 2 | 250 x 50 | 521 | 127 | 324 | 92 | 10.0 | 4.8 | 237 | 44 | FP | 82 |
| 10 x 3 | 250 x 80 | 521 | 127 | 324 | 127 | 10.0 | 6.5 | 237 | 66 | FP | 88 |
| 10 x 4 | 250 x 100 | 521 | 127 | 324 | 157 | 10.0 | 9.0 | 237 | 86 | FP | 93 |
| 10 x 6 | 250 x 150 | 521 | 127 | 324 | 216 | 10.0 | 11.0 | 237 | 137 | FP | 103 |
| 10 x 8 | 250 x 200 | 521 | 127 | 324 | 270 | 10.0 | 10.0 | 237 | 186 | FP | 114 |
| 12 x 1 | 300 x 25 | 622 | 140 | 381 | 51 | 10.0 | 4.0 | 287 | 20 | FP | 119 |
| 12 x 1½ | 300 x 40 | 622 | 140 | 381 | 73 | 10.0 | 4.5 | 287 | 33 | FP | 120 |
| 12 x 2 | 300 x 50 | 622 | 140 | 381 | 92 | 10.0 | 4.8 | 287 | 44 | FP | 122 |
| 12 x 3 | 300 x 80 | 622 | 140 | 381 | 127 | 10.0 | 6.5 | 287 | 66 | FP | 129 |
| 12 x 4 | 300 x 100 | 622 | 140 | 381 | 157 | 10.0 | 9.0 | 287 | 86 | FP | 135 |
| 12 x 6 | 300 x 150 | 622 | 140 | 381 | 216 | 10.0 | 11.0 | 287 | 137 | FP | 147 |
| 12 x 8 | 300 x 200 | 622 | 140 | 381 | 270 | 10.0 | 10.0 | 287 | 186 | FP | 158 |
| 12 x 10 | 300 x 250 | 622 | 140 | 381 | 324 | 10.0 | 10.0 | 287 | 237 | FP | 174 |
| 14 x 1 | 350 x 25 | 686 | 152 | 413 | 51 | 10.5 | 4.0 | 317 | 20 | FP | 157 |
| 14 x 1½ | 350 x 40 | 686 | 152 | 413 | 73 | 10.5 | 4.5 | 317 | 33 | FP | 159 |
| 14 x 2 | 350 x 50 | 686 | 152 | 413 | 92 | 10.5 | 4.8 | 317 | 44 | FP | 161 |
| 14 x 3 | 350 x 80 | 686 | 152 | 413 | 127 | 10.5 | 6.5 | 317 | 66 | FP | 168 |
| 14 x 4 | 350 x 100 | 686 | 152 | 413 | 157 | 10.5 | 9.0 | 317 | 86 | FP | 174 |
| 14 x 6 | 350 x 150 | 686 | 152 | 413 | 216 | 10.5 | 11.0 | 317 | 137 | FP | 187 |
| 14 x 8 | 350 x 200 | 686 | 152 | 413 | 270 | 10.5 | 10.0 | 317 | 186 | FP | 199 |
| 14 x 10 | 350 x 250 | 686 | 152 | 413 | 324 | 10.5 | 10.0 | 317 | 237 | FP | 216 |
| 14 x 12 | 350 x 300 | 686 | 152 | 413 | 381 | 10.5 | 10.0 | 317 | 287 | FP | 237 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on Virgin PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.
2 - Nominal bores are based on Virgin PFA heavy duty liner and schedule 40 or 30 steel pipe. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.

# Double Branch Instrument Tee




Double branch instrument tees are in reality crosses with two ordinary branches attached to a wafer style line (a short line without flanges). They are used in place of crosses when space is an issue. If required for the mounting of instruments and a specific bore is required for an instrument please discuss this at the time of ordering as sizes are nominal.

## Double Branch Instrument Tee

| Nominal Bore | | | | | | Body Face to Face | Centre Line to Face Branch | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch Heavy Duty PFA Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal | Branch PFA Liner Bore Nominal | Construction | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | | A | B | Ø C | Ø D | T1 | T2 | Ø E | Ø F | Standard | kg |
| ½ | x | ½[3] | 15 | x | 15 | 51 | 65 | 35 | 35 | 4.5 | 4.5 | 12 | 12 | FP | 1.5 |
| ¾ | x | ½[3] | 20 | x | 15 | 51 | 75 | 43 | 35 | 4.5 | 4.5 | 12 | 12 | FP | 1.8 |
| ¾ | x | ¾[4] | 20 | x | 20 | 51 | 75 | 43 | 43 | 4.5 | 4.5 | 12 | 12 | FP | 2.3 |
| 1 | x | ½[3] | 25 | x | 15 | 51 | 89 | 51 | 35 | 4.0 | 4.5 | 20 | 12 | FP | 2.4 |
| 1 | x | ¾[4] | 25 | x | 20 | 51 | 89 | 51 | 43 | 4.0 | 4.5 | 20 | 12 | FP | 2.7 |
| 1 | x | 1[5] | 25 | x | 25 | 51 | 89 | 51 | 51 | 4.0 | 4.0 | 20 | 20 | FP | 3.4 |
| 1½ | x | ½[3] | 40 | x | 15 | 51 | 102 | 73 | 35 | 4.5 | 4.5 | 33 | 12 | FP | 2.7 |
| 1½ | x | ¾[4] | 40 | x | 20 | 51 | 102 | 73 | 43 | 4.5 | 4.5 | 33 | 12 | FP | 3.3 |
| 1½ | x | 1 | 40 | x | 25 | 51 | 102 | 73 | 51 | 4.5 | 4.0 | 33 | 20 | FP | 4.1 |
| 1½ | x | 1½ | 40 | x | 40 | 76 | 102 | 73 | 73 | 4.5 | 4.5 | 33 | 33 | FP | 5.6 |
| 2 | x | ½[3] | 50 | x | 15 | 51 | 114 | 92 | 35 | 4.8 | 4.5 | 44 | 12 | FP | 3.6 |
| 2 | x | ¾[4] | 50 | x | 20 | 51 | 114 | 92 | 43 | 4.8 | 4.5 | 44 | 12 | FP | 4.2 |
| 2 | x | 1 | 50 | x | 25 | 51 | 114 | 92 | 51 | 4.8 | 4.0 | 44 | 20 | FP | 5.0 |
| 2 | x | 1½ | 50 | x | 40 | 76 | 114 | 92 | 73 | 4.8 | 4.5 | 44 | 33 | FP | 7.0 |
| 2 | x | 2 | 50 | x | 50 | 89 | 114 | 92 | 92 | 4.8 | 4.8 | 44 | 44 | FP | 9.4 |
| 3 | x | ½[3] | 80 | x | 15 | 51 | 140 | 127 | 35 | 6.5 | 4.5 | 66 | 12 | FP | 5 |
| 3 | x | ¾[4] | 80 | x | 20 | 51 | 140 | 127 | 43 | 6.5 | 4.5 | 66 | 12 | FP | 6 |
| 3 | x | 1 | 80 | x | 25 | 51 | 140 | 127 | 51 | 6.5 | 4.0 | 66 | 20 | FP | 7 |
| 3 | x | 1½ | 80 | x | 40 | 76 | 140 | 127 | 73 | 6.5 | 4.5 | 66 | 33 | FP | 9 |
| 3 | x | 2 | 80 | x | 50 | 89 | 140 | 127 | 92 | 6.5 | 4.8 | 66 | 44 | FP | 12 |
| 3 | x | 3 | 80 | x | 80 | 150 | 140 | 127 | 127 | 6.5 | 6.5 | 66 | 66 | FP | 22 |
| 4 | x | ½[3] | 100 | x | 15 | 51 | 165 | 157 | 35 | 9.0 | 4.5 | 86 | 12 | FP | 8 |
| 4 | x | ¾[4] | 100 | x | 20 | 51 | 165 | 157 | 43 | 9.0 | 4.5 | 86 | 12 | FP | 9 |
| 4 | x | 1 | 100 | x | 25 | 51 | 165 | 157 | 51 | 9.0 | 4.0 | 86 | 20 | FP | 10 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



# Double Branch Instrument Tee

## Double Branch Instrument Tee

| Nominal Bore | | | | | | Body Face to Face | Centre Line to Face Branch | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch Heavy Duty PFA Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal | Branch PFA Liner Bore Nominal | Construction | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | | A | B | Ø C | Ø D | T1 | T2 | Ø E | Ø F | Standard | kg |
| 6 | x | ½[3] | 150 | x | 15 | 51 | 203 | 216 | 35 | 11.0 | 4.5 | 137 | 12 | FP | 10 |
| 6 | x | ¾[4] | 150 | x | 20 | 51 | 203 | 216 | 43 | 11.0 | 4.5 | 137 | 12 | FP | 10 |
| 6 | x | 1 | 150 | x | 25 | 51 | 203 | 216 | 51 | 11.0 | 4.0 | 137 | 20 | FP | 12 |
| 6 | x | 1½ | 150 | x | 40 | 76 | 203 | 216 | 73 | 11.0 | 4.5 | 137 | 33 | FP | 16 |
| 6 | x | 2 | 150 | x | 50 | 89 | 203 | 216 | 92 | 11.0 | 4.8 | 137 | 44 | FP | 20 |
| 6[7] | x | 3 | 150 | x | 80 | 150 | 203 | 216 | 127 | 11.0 | 6.5 | 137 | 66 | FP | 36 |
| 8 | x | 1 | 200 | x | 25 | 51 | 229 | 270 | 51 | 10.0 | 4.0 | 186 | 20 | FP | 8 |
| 8 | x | 1½ | 200 | x | 40 | 76 | 229 | 270 | 73 | 10.0 | 4.5 | 186 | 33 | FP | 10 |
| 8 | x | 2 | 200 | x | 50 | 89 | 229 | 270 | 92 | 10.0 | 4.8 | 186 | 44 | FP | 13 |
| 8 | x | 3 | 200 | x | 80 | 150 | 229 | 270 | 127 | 10.0 | 6.5 | 186 | 66 | FP | 24 |
| 10 | x | 1 | 250 | x | 25 | 51 | 279 | 324 | 51 | 10.0 | 4.0 | 237 | 20 | FP | 21 |
| 10 | x | 1½ | 250 | x | 40 | 76 | 279 | 324 | 73 | 10.0 | 4.5 | 237 | 33 | FP | 29 |
| 10 | x | 2 | 250 | x | 50 | 89 | 279 | 324 | 92 | 10.0 | 4.8 | 237 | 44 | FP | 36 |
| 12 | x | 1 | 300 | x | 25 | 51 | 305 | 381 | 51 | 10.0 | 4.0 | 287 | 20 | FP | 27 |
| 12 | x | 1½ | 300 | x | 40 | 76 | 305 | 381 | 73 | 10.0 | 4.5 | 287 | 33 | FP | 38 |
| 12 | x | 2 | 300 | x | 50 | 89 | 305 | 381 | 92 | 10.0 | 4.8 | 287 | 44 | FP | 46 |
| 12[7] | x | 3 | 300 | x | 80 | 150 | 305 | 381 | 127 | 10.0 | 6.5 | 287 | 66 | FP | 79 |
| 14 | x | 1 | 350 | x | 25 | 51 | 356 | 413 | 51 | 10.5 | 4.0 | 317 | 20 | FP | 32 |
| 14 | x | 1½ | 350 | x | 40 | 76 | 356 | 413 | 73 | 10.5 | 4.5 | 317 | 33 | FP | 46 |
| 14 | x | 2 | 350 | x | 50 | 89 | 356 | 413 | 92 | 10.5 | 4.8 | 317 | 44 | FP | 56 |
| 14 | x | 3 | 350 | x | 80 | 150 | 356 | 413 | 127 | 10.5 | 6.5 | 317 | 66 | FP | 96 |

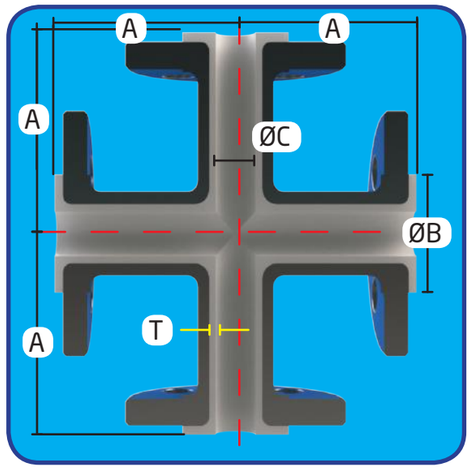


| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



1 - Please note liner thicknesses are based on Virgin PFA, for other materials consult the liner tables in the manual.
2 - Bore is based on Virgin PFA, because of method of manufacture and steel tolerances this is a guide only, for other materials and thicknesses please consult the liner tables in the manual.
3 - On 1/2in branch a 3/4in pipe is used.
4 - On 3/4in branch a 1in pipe is used.
5 - Because of the need to pass through the line bolts the branch has a reduced bore in a 1.1/2in pipe.
6 - Because of the need to pass through the line bolts the branch has a reduced bore in a 2in pipe.
7 - Only with UNC bolting.

# Equal Cross




These provide an additional branch to an equal tee and are based on the same dimensional format. Special components of differing branch length or exit angle can be manufactured.

Equal Cross

| Nominal Bore | | Centre Line to Face | Raised Face | Heavy Duty PFA Liner Thickness Nominal[1] | PFA Liner Bore Nominal[2] | Construction | Weight |
|---|---|---|---|---|---|---|---|
| Inches | mm | A | Ø B | T | Ø C | Standard | kg |
| ½ | 15 | 65 | 35 | 4.5 | 12 | FP | 2.0 |
| ¾ | 20 | 75 | 43 | 4.5 | 12 | FP | 3.1 |
| 1 | 25 | 89 | 51 | 4.0 | 20 | FP | 4.3 |
| 1½ | 40 | 102 | 73 | 4.5 | 33 | FP | 7.3 |
| 2 | 50 | 114 | 92 | 4.8 | 44 | FP | 11.6 |
| 3 | 80 | 140 | 127 | 6.5 | 66 | FP | 24 |
| 4 | 100 | 165 | 157 | 9.0 | 86 | FP | 35 |
| 6 | 150 | 203 | 216 | 11.0 | 137 | FP | 60 |
| 8 | 200 | 229 | 270 | 10.0 | 186 | FP | 93 |
| 10 | 250 | 279 | 324 | 10.0 | 237 | FP | 141 |
| 12 | 300 | 305 | 381 | 10.0 | 287 | FP | 206 |
| 14 | 350 | 356 | 413 | 10.5 | 317 | FP | 283 |

Construction Codes

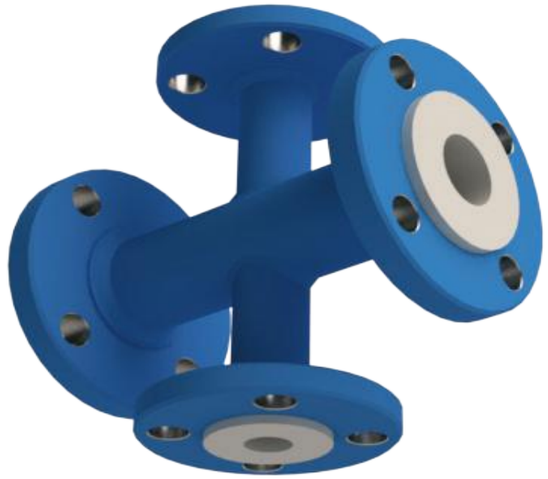
| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

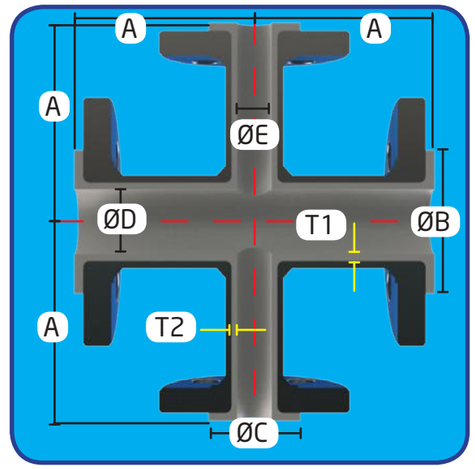
1 - Liner thicknesses are based on PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on schedule 40 or 30 steel pipe and PFA heavy duty liner. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.



# Reducing Cross






These provide an additional branch to reducing tee and are based on the same dimensional format. Special components of differing branch length or exit angle can be manufactured.

Reducing Cross

| Nominal Bore | | | | | Centre Line to Face | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch Heavy Duty PFA Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Bore Nominal[2] | Materials | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | A | Ø B | Ø C | T1 | T2 | Ø D | Ø E | Standard | kg |
| ¾ | x | ½ | 20 | x 15 | 75 | 43 | 35 | 4.5 | 4.5 | 12 | 12 | FP | 2.6 |
| 1 | x | ½ | 25 | x 15 | 89 | 51 | 35 | 4.0 | 4.5 | 20 | 12 | FP | 3.2 |
| 1 | x | ¾ | 25 | x 20 | 89 | 51 | 43 | 4.0 | 4.5 | 20 | 12 | FP | 3.8 |
| 1½ | x | ½ | 40 | x 15 | 102 | 73 | 35 | 4.5 | 4.5 | 33 | 12 | FP | 4.8 |
| 1½ | x | ¾ | 40 | x 20 | 102 | 73 | 43 | 4.5 | 4.5 | 33 | 12 | FP | 5.3 |
| 1½ | x | 1 | 40 | x 25 | 102 | 73 | 51 | 4.5 | 4.0 | 33 | 20 | FP | 5.9 |
| 2 | x | ½ | 50 | x 15 | 114 | 92 | 35 | 4.8 | 4.5 | 44 | 12 | FP | 6.9 |
| 2 | x | ¾ | 50 | x 20 | 114 | 92 | 43 | 4.8 | 4.5 | 44 | 12 | FP | 7.5 |
| 2 | x | 1 | 50 | x 25 | 114 | 92 | 51 | 4.8 | 4.0 | 44 | 20 | FP | 8.1 |
| 2 | x | 1½ | 50 | x 40 | 114 | 92 | 73 | 4.8 | 4.5 | 44 | 33 | FP | 9.6 |
| 3 | x | ½ | 80 | x 15 | 140 | 127 | 35 | 6.5 | 4.5 | 66 | 12 | FP | 13 |
| 3 | x | ¾ | 80 | x 20 | 140 | 127 | 43 | 6.5 | 4.5 | 66 | 12 | FP | 14 |
| 3 | x | 1 | 80 | x 25 | 140 | 127 | 51 | 6.5 | 4.0 | 66 | 20 | FP | 14 |
| 3 | x | 1½ | 80 | x 40 | 140 | 127 | 73 | 6.5 | 4.5 | 66 | 33 | FP | 16 |
| 3 | x | 2 | 80 | x 50 | 140 | 127 | 92 | 6.5 | 4.8 | 66 | 44 | FP | 18 |
| 4 | x | ½ | 100 | x 15 | 165 | 157 | 35 | 9.0 | 4.5 | 86 | 12 | FP | 19 |
| 4 | x | ¾ | 100 | x 20 | 165 | 157 | 43 | 9.0 | 4.5 | 86 | 12 | FP | 20 |
| 4 | x | 1 | 100 | x 25 | 165 | 157 | 51 | 9.0 | 4.0 | 86 | 20 | FP | 20 |
| 4 | x | 1½ | 100 | x 40 | 165 | 157 | 73 | 9.0 | 4.5 | 86 | 33 | FP | 22 |
| 4 | x | 2 | 100 | x 50 | 165 | 157 | 92 | 9.0 | 4.8 | 86 | 44 | FP | 24 |
| 4 | x | 3 | 100 | x 80 | 165 | 157 | 127 | 9.0 | 6.5 | 86 | 66 | FP | 30 |
| 6 | x | ½ | 150 | x 15 | 203 | 216 | 35 | 11.0 | 4.5 | 137 | 12 | FP | 32 |
| 6 | x | ¾ | 150 | x 20 | 203 | 216 | 43 | 11.0 | 4.5 | 137 | 12 | FP | 32 |

Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

# Reducing Cross

## Reducing Cross

| Nominal Bore | | | | | Centre Line to Face | Line Raised Face | Branch Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Branch Heavy Duty PFA Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Bore Nominal[2] | Materials | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | A | Ø B | Ø C | T1 | T2 | Ø D | Ø E | Standard | kg |
| 6 | x | 1½ | 150 | x 40 | 203 | 216 | 73 | 11.0 | 4.5 | 137 | 33 | FP | 35 |
| 6 | x | 2 | 150 | x 50 | 203 | 216 | 92 | 11.0 | 4.8 | 137 | 44 | FP | 37 |
| 6 | x | 3 | 150 | x 80 | 203 | 216 | 127 | 11.0 | 6.5 | 137 | 66 | FP | 44 |
| 6 | x | 4 | 150 | x 100 | 203 | 216 | 157 | 11.0 | 9.0 | 137 | 86 | FP | 50 |
| 8 | x | 1 | 200 | x 25 | 229 | 270 | 51 | 10.0 | 4.0 | 186 | 20 | FP | 49 |
| 8 | x | 1½ | 200 | x 40 | 229 | 270 | 73 | 10.0 | 4.5 | 186 | 33 | FP | 51 |
| 8 | x | 2 | 200 | x 50 | 229 | 270 | 92 | 10.0 | 4.8 | 186 | 44 | FP | 54 |
| 8 | x | 3 | 200 | x 80 | 229 | 270 | 127 | 10.0 | 6.5 | 186 | 66 | FP | 61 |
| 8 | x | 4 | 200 | x 100 | 229 | 270 | 157 | 10.0 | 9.0 | 186 | 86 | FP | 67 |
| 8 | x | 6 | 200 | x 150 | 229 | 270 | 216 | 10.0 | 11.0 | 186 | 137 | FP | 79 |
| 10 | x | 1 | 250 | x 25 | 279 | 324 | 51 | 10.0 | 4.0 | 237 | 20 | FP | 74 |
| 10 | x | 1½ | 250 | x 40 | 279 | 324 | 73 | 10.0 | 4.5 | 237 | 33 | FP | 76 |
| 10 | x | 2 | 250 | x 50 | 279 | 324 | 92 | 10.0 | 4.8 | 237 | 44 | FP | 78 |
| 10 | x | 3 | 250 | x 80 | 279 | 324 | 127 | 10.0 | 6.5 | 237 | 66 | FP | 86 |
| 10 | x | 4 | 250 | x 100 | 279 | 324 | 157 | 10.0 | 9.0 | 237 | 86 | FP | 93 |
| 10 | x | 6 | 250 | x 150 | 279 | 324 | 216 | 10.0 | 11.0 | 237 | 137 | FP | 106 |
| 10 | x | 8 | 250 | x 200 | 279 | 324 | 270 | 10.0 | 10.0 | 237 | 186 | FP | 122 |
| 12 | x | 1 | 300 | x 25 | 305 | 381 | 51 | 10.0 | 4.0 | 287 | 20 | FP | 107 |
| 12 | x | 1½ | 300 | x 40 | 305 | 381 | 73 | 10.0 | 4.5 | 287 | 33 | FP | 109 |
| 12 | x | 2 | 300 | x 50 | 305 | 381 | 92 | 10.0 | 4.8 | 287 | 44 | FP | 112 |
| 12 | x | 3 | 300 | x 80 | 305 | 381 | 127 | 10.0 | 6.5 | 287 | 66 | FP | 120 |
| 12 | x | 4 | 300 | x 100 | 305 | 381 | 157 | 10.0 | 9.0 | 287 | 86 | FP | 127 |
| 12 | x | 6 | 300 | x 150 | 305 | 381 | 216 | 10.0 | 11.0 | 287 | 137 | FP | 141 |
| 12 | x | 8 | 300 | x 200 | 305 | 381 | 270 | 10.0 | 10.0 | 287 | 186 | FP | 157 |
| 12 | x | 10 | 300 | x 250 | 305 | 381 | 324 | 10.0 | 10.0 | 287 | 237 | FP | 177 |
| 14 | x | 1 | 350 | x 25 | 356 | 413 | 51 | 10.5 | 4.0 | 317 | 20 | FP | 145 |
| 14 | x | 1½ | 350 | x 40 | 356 | 413 | 73 | 10.5 | 4.5 | 317 | 33 | FP | 148 |
| 14 | x | 2 | 350 | x 50 | 356 | 413 | 92 | 10.5 | 4.8 | 317 | 44 | FP | 150 |
| 14 | x | 3 | 350 | x 80 | 356 | 413 | 127 | 10.5 | 6.5 | 317 | 66 | FP | 159 |
| 14 | x | 4 | 350 | x 100 | 356 | 413 | 157 | 10.5 | 9.0 | 317 | 86 | FP | 167 |
| 14 | x | 6 | 350 | x 150 | 356 | 413 | 216 | 10.5 | 11.0 | 317 | 137 | FP | 183 |
| 14 | x | 8 | 350 | x 200 | 356 | 413 | 270 | 10.5 | 10.0 | 317 | 186 | FP | 200 |
| 14 | x | 10 | 350 | x 250 | 356 | 413 | 324 | 10.5 | 10.0 | 317 | 237 | FP | 222 |
| 14 | x | 12 | 350 | x 300 | 356 | 413 | 381 | 10.5 | 10.0 | 317 | 287 | FP | 253 |

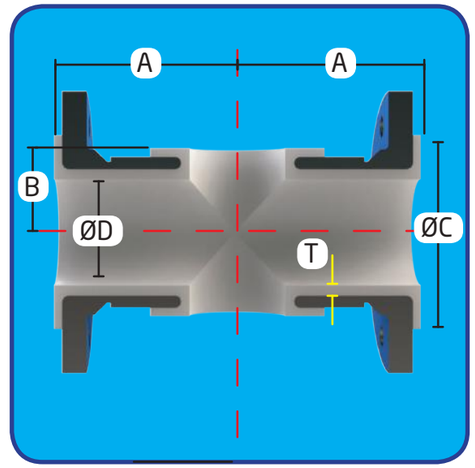
| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on schedule 40 or 30 steel pipe and PFA heavy duty liner. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.



# Short Stack Cross




A short stack cross provides the functionality of a cross, but with much more space saving, so tends to be selected where space is at a premium.

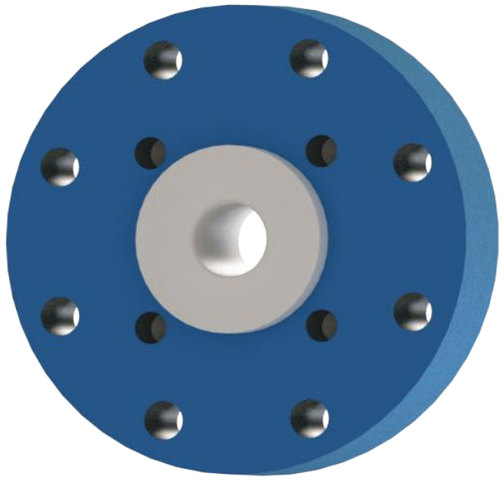
## Short Stack Cross

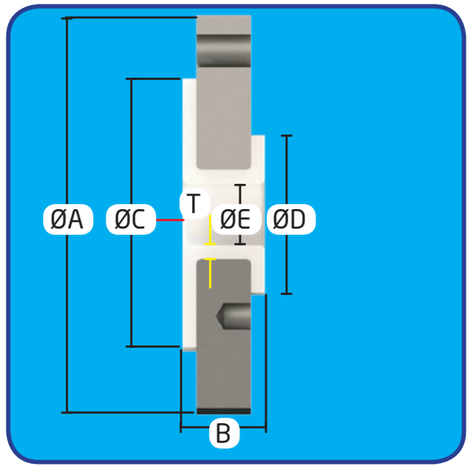
| Nominal Bore | | Centre Line to Face | Centre Line to Face | Raised Face | Heavy Duty PFA Liner Thickness Nominal[1] | PFA Liner Bore Nominal[2] | Materials | Weight |
|---|---|---|---|---|---|---|---|---|
| Inches | mm | A | B | Ø C | T | Ø D | Standard | kg |
| 1 | 25 | 89 | 30 | 51 | 4.0 | 20 | FP | 3.9 |
| 1½ | 40 | 102 | 37 | 73 | 4.5 | 33 | FP | 6.6 |
| 2 | 50 | 114 | 43 | 92 | 4.8 | 44 | FP | 10.6 |
| 3 | 80 | 140 | 56 | 127 | 6.5 | 66 | FP | 21 |
| 4 | 100 | 165 | 67 | 157 | 9.0 | 86 | FP | 31 |
| 6 | 150 | 203 | 105 | 216 | 11.0 | 137 | FP | 53 |

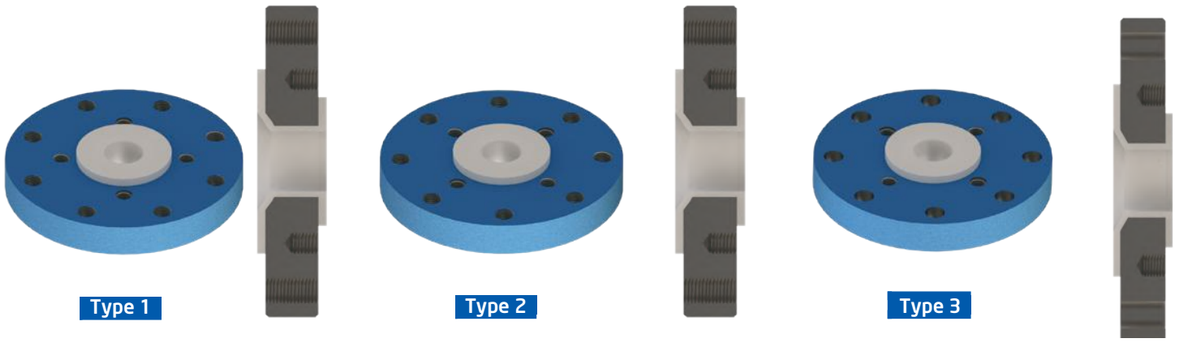
| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Liner thicknesses are based on PFA heavy duty liner. For other materials consult the liner dimension tables in this manual.

2 - Nominal bores are based on schedule 40 or 30 steel pipe and PFA heavy duty liner. Because of the method of manufacture and steel tolerances this can be a guide only. For other materials and thicknesses please consult the liner dimension tables in this manual. If you require a precise dimension for instrument, mixer or other insertion or a calibrated volume in the product please consult us.






A reducing flange is essentially a plate flange providing a sharp reduction in line bore of one or many size reductions.

A parallel bore gives the most abrupt transition from one bore to the next, but can be specified where more support to other materials is required from the flange. These are often used against brick lined piping.

These are generally PTFE lined, but can be lined in PFA. They provide a more space saving alternative to concentric reducers, but cannot present the same flow characteristics.

Reducing flanges can be grouped into three main configurations - type 1, 2 & 3. The configuration is dictated by the proximity of the small bore bolt holes to the large bore bolt holes. Each type is designed so that they do not clash and that the nuts can be fitted successfully. Type 3 flanges have through clearance holes for the large nominal bore bolts and blind threaded holes for the small nominal bore. These are used where there is a significant reduction in bores. Where the reduction is not so great and the periphery of the smaller bore mating flange would impinge on the nuts then a type 2 flange is employed with all threaded bolt holes (through holes for the large nominal bore and blind holes for the small nominal bore) negating the use of nuts. Finally where the reduction in bores is quite small the bolt holes are all threaded with through holes for the large nominal bore and blind holes for the small nominal bore. These have to be staggered on/off centres so that they don't clash - a type 1 reducing flange.

As a general rule, a type 3 is the default design. if this cannot be achieved because of the two joining flanges geometry, a type 2 is specified, and if this doesn't work, then a type 1.

If you have site reasons for wanting to select another style, then a type 1 or 2 will always work where a type 3 does and a type 1 where a type 2 does. As standard Type 2 and 3 bolt holes are off/off centres.

There is another style of reducing flange available where the inner pattern of holes is on a raised platform and the outer holes are scalloped from this. This enables one to use type 3 style drillings i.e. through bolts on the large side, removing the necessity to have double threaded holes on the reducing flange. This is useful where one is coming up against items such as a threaded pad flange on a vessel. CRP can produce these and many other special reducing flanges just call us to discuss.



Reducing Flange Parallel Bore

## Reducing Flange Parallel Bore

| Nominal Bore (Inches) | Nominal Bore (mm) | Flange Type | Flange Ø A (mm) | Face to Face B (mm) | Large NB Raised Face Ø C (mm) | Small NB Raised Face Ø D (mm) | Minimum Heavy Duty PFA Liner Thickness[1] T (mm) | Minimum HiPerFlon PTFE Liner Thickness[1] T (mm) | Bore Nominal[2] Ø E (mm) | Construction Standard | Construction To Order | Weight kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ¾ x ½ | 20 x 15 | Type 1 | 100 | 30 | 43 | 35 | 5 | 3 | 15 | FP | FT | 1.3 |
| 1 x ½ | 25 x 15 | Type 1 | 110 | 30 | 51 | 35 | 5 | 3 | 15 | FP | FT | 1.6 |
| 1 x ¾ | 25 x 20 | Type 1 | 110 | 30 | 51 | 43 | 5 | 3 | 15 | FP | FT | 1.6 |
| 1½ x ½ | 40 x 15 | Type 2 | 125 | 30 | 73 | 35 | 5 | 3 | 15 | FP | FT | 2.1 |
| 1½ x ¾ | 40 x 20 | Type 1 | 125 | 30 | 73 | 43 | 5 | 3 | 15 | FP | FT | 2.1 |
| 1½ x 1 | 40 x 25 | Type 1 | 125 | 30 | 73 | 51 | 5 | 3 | 18 | FP | FT | 2.0 |
| 2 x ½ | 50 x 15 | Type 2 | 150 | 30 | 92 | 35 | 5 | 3 | 15 | FP | FT | 3.0 |
| 2 x ¾ | 50 x 20 | Type 2 | 150 | 30 | 92 | 43 | 5 | 3 | 15 | FP | FT | 3.0 |
| 2 x 1 | 50 x 25 | Type 2 | 150 | 30 | 92 | 51 | 5 | 3 | 18 | FP | FT | 3.0 |
| 2 x 1½ | 50 x 40 | Type 1 | 150 | 30 | 92 | 73 | 5 | 3 | 32 | FP | FT | 2.9 |
| 3 x ½ | 80 x 15 | Type 3 | 190 | 35 | 127 | 35 | 5 | 3 | 15 | FP | FT | 6 |
| 3 x ¾ | 80 x 20 | Type 3 | 190 | 35 | 127 | 43 | 5 | 3 | 15 | FP | FT | 6 |
| 3 x 1 | 80 x 25 | Type 3 | 190 | 35 | 127 | 51 | 5 | 3 | 18 | FP | FT | 6 |
| 3 x 1½ | 80 x 40 | Type 2 | 190 | 35 | 127 | 73 | 5 | 3 | 32 | FP | FT | 6 |
| 3 x 2 | 80 x 50 | Type 1 | 190 | 35 | 127 | 92 | 5 | 3 | 43 | FP | FT | 6 |
| 4 x ½ | 100 x 15 | Type 3 | 230 | 35 | 157 | 35 | 5 | 5 | 15 | FP | FT | 9 |
| 4 x ¾ | 100 x 20 | Type 3 | 230 | 35 | 157 | 43 | 5 | 5 | 15 | FP | FT | 9 |
| 4 x 1 | 100 x 25 | Type 3 | 230 | 35 | 157 | 51 | 5 | 5 | 18 | FP | FT | 9 |
| 4 x 1½ | 100 x 40 | Type 3 | 230 | 35 | 157 | 73 | 5 | 5 | 32 | FP | FT | 9 |
| 4 x 2 | 100 x 50 | Type 3 | 230 | 35 | 157 | 92 | 5 | 5 | 43 | FP | FT | 9 |
| 4 x 3 | 100 x 80 | Type 1 | 230 | 35 | 157 | 127 | 5 | 5 | 70 | FP | FT | 8 |
| 6 x ½ | 150 x 15 | Type 3 | 280 | 40 | 216 | 35 | 5 | 5 | 15 | FP | FT | 16 |
| 6 x ¾ | 150 x 20 | Type 3 | 280 | 40 | 216 | 43 | 5 | 5 | 15 | FP | FT | 16 |
| 6 x 1 | 150 x 25 | Type 3 | 280 | 40 | 216 | 51 | 5 | 5 | 18 | FP | FT | 16 |
| 6 x 1½ | 150 x 40 | Type 3 | 280 | 40 | 216 | 73 | 5 | 5 | 32 | FP | FT | 16 |
| 6 x 2 | 150 x 50 | Type 3 | 280 | 40 | 216 | 92 | 5 | 5 | 43 | FP | FT | 16 |
| 6 x 3 | 150 x 80 | Type 3 | 280 | 40 | 216 | 127 | 5 | 5 | 70 | FP | FT | 15 |
| 6 x 4 | 150 x 100 | Type 2 | 280 | 40 | 216 | 157 | 5 | 5 | 93 | FP | FT | 15 |
| 8 x ½ | 200 x 15 | Type 3 | 345 | 40 | 270 | 35 | 5 | 5 | 15 | FT | FP | 25 |
| 8 x ¾ | 200 x 20 | Type 3 | 345 | 40 | 270 | 43 | 5 | 5 | 15 | FT | FP | 25 |
| 8 x 1 | 200 x 25 | Type 3 | 345 | 40 | 270 | 51 | 5 | 5 | 18 | FT | FP | 25 |
| 8 x 1½ | 200 x 40 | Type 3 | 345 | 40 | 270 | 73 | 5 | 5 | 32 | FT | FP | 25 |
| 8 x 2 | 200 x 50 | Type 3 | 345 | 40 | 270 | 92 | 5 | 5 | 43 | FT | FP | 25 |
| 8 x 3 | 200 x 80 | Type 3 | 345 | 40 | 270 | 127 | 5 | 5 | 70 | FT | FP | 24 |
| 8 x 4 | 200 x 100 | Type 3 | 345 | 40 | 270 | 157 | 5 | 5 | 93 | FT | FP | 24 |
| 8 x 6 | 200 x 150 | Type 2 | 345 | 40 | 270 | 216 | 5 | 5 | 145 | FT | FP | 21 |
| 10 x ½ | 250 x 15 | Type 3 | 405 | 35 | 324 | 35 | 5 | 5 | 15 | FT | FP | 35 |
| 10 x ¾ | 250 x 20 | Type 3 | 405 | 35 | 324 | 43 | 5 | 5 | 15 | FT | FP | 35 |
| 10 x 1 | 250 x 25 | Type 3 | 405 | 35 | 324 | 51 | 5 | 5 | 18 | FT | FP | 35 |
| 10 x 1½ | 250 x 40 | Type 3 | 405 | 35 | 324 | 73 | 5 | 5 | 32 | FT | FP | 35 |
| 10 x 2 | 250 x 50 | Type 3 | 405 | 35 | 324 | 92 | 5 | 5 | 43 | FT | FP | 35 |

Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

## Reducing Flange Parallel Bore

| Nominal Bore | | | | | | Flange Type | Flange | Face to Face | Large NB Raised Face | Small NB Raised Face | Minimum Heavy Duty PFA Liner Thickness[1] | Minimum HiPerFlon PTFE Liner Thickness[1] | Bore Nominal[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | | | Ø A | B | Ø C | Ø D | T | T | Ø E | Standard | To Order | kg |
| 10 | x | 3 | 250 | x | 80 | Type 3 | 405 | 35 | 324 | 127 | 5 | 5 | 70 | FT | FP | 34 |
| 10 | x | 4 | 250 | x | 100 | Type 3 | 405 | 35 | 324 | 157 | 5 | 5 | 93 | FT | FP | 34 |
| 10 | x | 6 | 250 | x | 150 | Type 3 | 405 | 35 | 324 | 216 | 5 | 5 | 145 | FT | FP | 31 |
| 10 | x | 8 | 250 | x | 200 | Type 2 | 405 | 35 | 324 | 270 | 5 | 5 | 196 | FT | FP | 27 |
| 12 | x | ½ | 300 | x | 15 | Type 3 | 485 | 40 | 381 | 35 | 5 | 5 | 15 | FT | FP | 56 |
| 12 | x | ¾ | 300 | x | 20 | Type 3 | 485 | 40 | 381 | 43 | 5 | 5 | 15 | FT | FP | 56 |
| 12 | x | 1 | 300 | x | 25 | Type 3 | 485 | 40 | 381 | 51 | 5 | 5 | 18 | FT | FP | 56 |
| 12 | x | 1½ | 300 | x | 40 | Type 3 | 485 | 40 | 381 | 73 | 5 | 5 | 32 | FT | FP | 55 |
| 12 | x | 2 | 300 | x | 50 | Type 3 | 485 | 40 | 381 | 92 | 5 | 5 | 43 | FT | FP | 55 |
| 12 | x | 3 | 300 | x | 80 | Type 3 | 485 | 40 | 381 | 127 | 5 | 5 | 70 | FT | FP | 55 |
| 12 | x | 4 | 300 | x | 100 | Type 3 | 485 | 40 | 381 | 157 | 5 | 5 | 93 | FT | FP | 54 |
| 12 | x | 6 | 300 | x | 150 | Type 3 | 485 | 40 | 381 | 216 | 5 | 5 | 145 | FT | FP | 51 |
| 12 | x | 8 | 300 | x | 200 | Type 3 | 485 | 40 | 381 | 270 | 5 | 5 | 196 | FT | FP | 47 |
| 12 | x | 10 | 300 | x | 250 | Type 2 | 485 | 40 | 381 | 324 | 5 | 5 | 250 | FT | FP | 41 |
| 14 | x | ½ | 350 | x | 15 | Type 3 | 535 | 40 | 413 | 35 | 5 | 5 | 15 | FT | FP | 72 |
| 14 | x | ¾ | 350 | x | 20 | Type 3 | 535 | 40 | 413 | 43 | 5 | 5 | 15 | FT | FP | 72 |
| 14 | x | 1 | 350 | x | 25 | Type 3 | 535 | 40 | 413 | 51 | 5 | 5 | 18 | FT | FP | 72 |
| 14 | x | 1½ | 350 | x | 40 | Type 3 | 535 | 40 | 413 | 73 | 5 | 5 | 32 | FT | FP | 71 |
| 14 | x | 2 | 350 | x | 50 | Type 3 | 535 | 40 | 413 | 92 | 5 | 5 | 43 | FT | FP | 71 |
| 14 | x | 3 | 350 | x | 80 | Type 3 | 535 | 40 | 413 | 127 | 5 | 5 | 70 | FT | FP | 70 |
| 14 | x | 4 | 350 | x | 100 | Type 3 | 535 | 40 | 413 | 157 | 5 | 5 | 93 | FT | FP | 70 |
| 14 | x | 6 | 350 | x | 150 | Type 3 | 535 | 40 | 413 | 216 | 5 | 5 | 145 | FT | FP | 67 |
| 14 | x | 8 | 350 | x | 200 | Type 3 | 535 | 40 | 413 | 270 | 5 | 5 | 196 | FT | FP | 62 |
| 14 | x | 10 | 350 | x | 250 | Type 3 | 535 | 40 | 413 | 324 | 5 | 5 | 250 | FT | FP | 56 |
| 14 | x | 12 | 350 | x | 300 | Type 1 | 535 | 40 | 413 | 381 | 5 | 5 | 301 | FT | FP | 52 |
| 16 | x | ½ | 400 | x | 15 | Type 3 | 595 | 40 | 470 | 35 | 5 | 5 | 15 | FT | FP | 94 |
| 16 | x | ¾ | 400 | x | 20 | Type 3 | 595 | 40 | 470 | 43 | 5 | 5 | 15 | FT | FP | 94 |
| 16 | x | 1 | 400 | x | 25 | Type 3 | 595 | 40 | 470 | 51 | 5 | 5 | 18 | FT | FP | 94 |
| 16 | x | 1½ | 400 | x | 40 | Type 3 | 595 | 40 | 470 | 73 | 5 | 5 | 32 | FT | FP | 94 |
| 16 | x | 2 | 400 | x | 50 | Type 3 | 595 | 40 | 470 | 92 | 5 | 5 | 43 | FT | FP | 94 |
| 16 | x | 3 | 400 | x | 80 | Type 3 | 595 | 40 | 470 | 127 | 5 | 5 | 70 | FT | FP | 93 |
| 16 | x | 4 | 400 | x | 100 | Type 3 | 595 | 40 | 470 | 157 | 5 | 5 | 93 | FT | FP | 92 |
| 16 | x | 6 | 400 | x | 150 | Type 3 | 595 | 40 | 470 | 216 | 5 | 5 | 145 | FT | FP | 89 |
| 16 | x | 8 | 400 | x | 200 | Type 3 | 595 | 40 | 470 | 270 | 5 | 5 | 196 | FT | FP | 84 |
| 16 | x | 10 | 400 | x | 250 | Type 3 | 595 | 40 | 470 | 324 | 5 | 5 | 250 | FT | FP | 78 |
| 16 | x | 12 | 400 | x | 300 | Type 3 | 595 | 40 | 470 | 381 | 5 | 5 | 301 | FT | FP | 71 |
| 16 | x | 14 | 400 | x | 350 | Type 2 | 595 | 40 | 470 | 413 | 5 | 5 | 326 | FT | FP | 64 |
| 18 | x | ½ | 450 | x | 15 | Type 3 | 635 | 40 | 533 | 35 | 5 | 5 | 15 | FT | FP | 112 |
| 18 | x | ¾ | 450 | x | 20 | Type 3 | 635 | 40 | 533 | 43 | 5 | 5 | 15 | FT | FP | 112 |
| 18 | x | 1 | 450 | x | 25 | Type 3 | 635 | 40 | 533 | 51 | 5 | 5 | 18 | FT | FP | 112 |
| 18 | x | 1½ | 450 | x | 40 | Type 3 | 635 | 40 | 533 | 73 | 5 | 5 | 32 | FT | FP | 111 |
| 18 | x | 2 | 450 | x | 50 | Type 3 | 635 | 40 | 533 | 92 | 5 | 5 | 43 | FT | FP | 111 |
| 18 | x | 3 | 450 | x | 80 | Type 3 | 635 | 40 | 533 | 127 | 5 | 5 | 70 | FT | FP | 110 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



Reducing Flange Parallel Bore

## Reducing Flange Parallel Bore

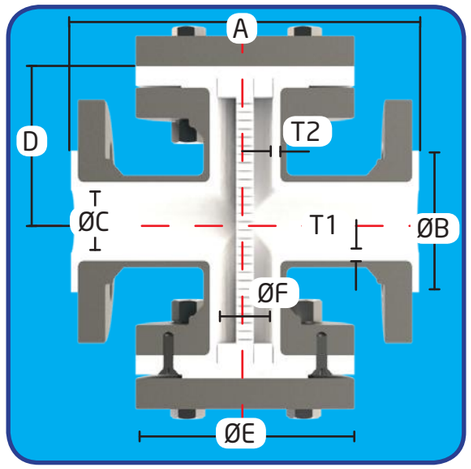
| 145Nominal Bore196 | | | | | | Flange Type | Flange | Face to Face | Large NB Raised Face | Small NB Raised Face | Minimum. Heavy Duty PFA Liner Thickness[1] | Minimum. HiPerFlon PTFE Liner Thickness[1] | Bore Nominal[2] | Construction | | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inches | | | mm | | | | Ø A | B | Ø C | Ø D | T | T | Ø E | Standard | To Order | kg |
| 18 | x | 4 | 450 | x | 100 | Type 3 | 635 | 40 | 533 | 157 | 5 | 5 | 93 | FT | FP | 109 |
| 18 | x | 6 | 450 | x | 150 | Type 3 | 635 | 40 | 533 | 216 | 5 | 5 | 145 | FT | FP | 106 |
| 18 | x | 8 | 450 | x | 200 | Type 3 | 635 | 40 | 533 | 270 | 5 | 5 | 196 | FT | FP | 101 |
| 18 | x | 10 | 450 | x | 250 | Type 3 | 635 | 40 | 533 | 324 | 5 | 5 | 250 | FT | FP | 95 |
| 18 | x | 12 | 450 | x | 300 | Type 3 | 635 | 40 | 533 | 381 | 5 | 5 | 301 | FT | FP | 87 |
| 18 | x | 14 | 450 | x | 350 | Type 2 | 635 | 40 | 533 | 413 | 5 | 5 | 326 | FT | FP | 81 |
| 18 | x | 16 | 450 | x | 400 | Type 1 | 635 | 40 | 533 | 470 | 5 | 5 | 377 | FT | FP | 103 |
| 20 | x | ½ | 500 | x | 15 | Type 3 | 700 | 53 | 584 | 35 | 5 | 5 | 15 | FT | FP | 153 |
| 20 | x | ¾ | 500 | x | 20 | Type 3 | 700 | 53 | 584 | 43 | 5 | 5 | 15 | FT | FP | 153 |
| 20 | x | 1 | 500 | x | 25 | Type 3 | 700 | 53 | 584 | 51 | 5 | 5 | 18 | FT | FP | 153 |
| 20 | x | 1½ | 500 | x | 40 | Type 3 | 700 | 53 | 584 | 73 | 5 | 5 | 32 | FT | FP | 153 |
| 20 | x | 2 | 500 | x | 50 | Type 3 | 700 | 53 | 584 | 92 | 5 | 5 | 43 | FT | FP | 153 |
| 20 | x | 3 | 500 | x | 80 | Type 3 | 700 | 53 | 584 | 127 | 5 | 5 | 70 | FT | FP | 152 |
| 20 | x | 4 | 500 | x | 100 | Type 3 | 700 | 53 | 584 | 157 | 5 | 5 | 93 | FT | FP | 151 |
| 20 | x | 6 | 500 | x | 150 | Type 3 | 700 | 53 | 584 | 216 | 5 | 5 | 145 | FT | FP | 147 |
| 20 | x | 8 | 500 | x | 200 | Type 3 | 700 | 53 | 584 | 270 | 5 | 5 | 196 | FT | FP | 142 |
| 20 | x | 10 | 500 | x | 250 | Type 3 | 700 | 53 | 584 | 324 | 5 | 5 | 250 | FT | FP | 134 |
| 20 | x | 12 | 500 | x | 300 | Type 3 | 700 | 53 | 584 | 381 | 5 | 5 | 301 | FT | FP | 126 |
| 20 | x | 14 | 500 | x | 350 | Type 3 | 700 | 53 | 584 | 413 | 5 | 5 | 326 | FT | FP | 118 |
| 20 | x | 16 | 500 | x | 400 | Type 2 | 700 | 53 | 584 | 470 | 5 | 5 | 377 | FT | FP | 143 |
| 20 | x | 18 | 500 | x | 450 | Type 1 | 700 | 53 | 584 | 533 | 5 | 5 | 425 | FT | FP | 141 |
| 24 | x | ½ | 600 | x | 15 | Type 3 | 815 | 57 | 692 | 35 | 5 | 5 | 15 | FT | FP | 229 |
| 24 | x | ¾ | 600 | x | 20 | Type 3 | 815 | 57 | 692 | 43 | 5 | 5 | 15 | FT | FP | 229 |
| 24 | x | 1 | 600 | x | 25 | Type 3 | 815 | 57 | 692 | 51 | 5 | 5 | 18 | FT | FP | 229 |
| 24 | x | 1½ | 600 | x | 40 | Type 3 | 815 | 57 | 692 | 73 | 5 | 5 | 32 | FT | FP | 228 |
| 24 | x | 2 | 600 | x | 50 | Type 3 | 815 | 57 | 692 | 92 | 5 | 5 | 43 | FT | FP | 228 |
| 24 | x | 3 | 600 | | 80 | Type 3 | 815 | 57 | 692 | 127 | 5 | 5 | 70 | FT | FP | 227 |
| 24 | x | 4 | 600 | | 100 | Type 3 | 815 | 57 | 692 | 157 | 5 | 5 | 93 | FT | FP | 226 |
| 24 | x | 6 | 600 | | 150 | Type 3 | 815 | 57 | 692 | 216 | 5 | 5 | 145 | FT | FP | 222 |
| 24 | x | 8 | 600 | | 200 | Type 3 | 815 | 57 | 692 | 270 | 5 | 5 | 196 | FT | FP | 216 |
| 24 | x | 10 | 600 | | 250 | Type 3 | 815 | 57 | 692 | 324 | 5 | 5 | 250 | FT | FP | 208 |
| 24 | x | 12 | 600 | | 300 | Type 3 | 815 | 57 | 692 | 381 | 5 | 5 | 301 | FT | FP | 198 |
| 24 | x | 14 | 600 | | 350 | Type 3 | 815 | 57 | 692 | 413 | 5 | 5 | 326 | FT | FP | 190 |
| 24 | x | 16 | 600 | | 400 | Type 3 | 815 | 57 | 692 | 470 | 5 | 5 | 377 | FT | FP | 218 |
| 24 | x | 18 | 600 | | 450 | Type 3 | 815 | 57 | 692 | 533 | 5 | 5 | 425 | FT | FP | 215 |
| 24 | x | 20 | 600 | | 500 | Type 2 | 815 | 57 | 692 | 584 | 5 | 5 | 473 | FT | FP | 212 |

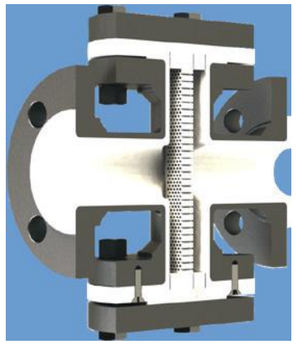
Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

1 - Please note liner thicknesses are based on Virgin PTFE, for other materials consult the liner tables in the manual.
2 - Bore is based on Virgin PTFE, because of method of manufacture and steel tolerances this is a guide only, for other materials and thicknesses please consult the liner tables in the manual.

# Strainer Cross



These are crosses with a PTFE strainer plate down the centre of them to filter the mixture flowing through it. Various hole sizes and free area are available. Please note whilst we've tried to get as close as possible to 100% open area to help negate the pressure drop across the PTFE plate for larger sizes this is not possible.

**Strainer Cross**

| | | Line Face to Face | Raised Face | Line Heavy Duty PFA Liner Thickness Nominal[1] | Line PFA Liner Bore Nominal[2] | Branch PFA Liner Nominal Bore | | Branch Centre Line to Face | Branch Outer Diameter | Branch PFA Heavy Duty Liner Thickness Nominal[1] | Branch PFA Liner Bore Nominal[2] | Construction | Max Open Area | Open Area | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | Ø B | T1 | Ø C | | | D | Ø E | T2 | Ø F | | | | |
| Inches | mm | mm | mm | mm | mm | Inches | mm | mm | mm | mm | mm | Standard | mm² | % | kg |
| 1 | 25 | 178 | 51 | 4.0 | 20 | 2 | 50 | 114 | 60 | 4.8 | 44 | FP | 746 | 247 | 7.5 |
| 1½ | 40 | 204 | 73 | 4.5 | 33 | 3 | 80 | 140 | 89 | 6.5 | 66 | FP | 1610 | 188 | 12.8 |
| 2 | 50 | 228 | 92 | 4.8 | 44 | 3 | 80 | 140 | 89 | 6.5 | 66 | FP | 1610 | 106 | 20.1 |
| 3 | 80 | 300 | 127 | 6.5 | 66 | 6 | 150 | 203 | 168 | 11.0 | 137 | FP | 5655 | 165 | 44 |
| 4 | 100 | 340 | 157 | 9.0 | 86 | 8 | 200 | 229 | 219 | 10.0 | 186 | FP | 8875 | 153 | 67 |
| 6 | 150 | 406 | 216 | 11.0 | 137 | 10 | 250 | 279 | 273 | 10.0 | 237 | FP | 14883 | 101 | 117 |
| 8 | 200 | 500 | 270 | 10.0 | 186 | 14 | 350 | 356 | 356 | 10.5 | 317 | FP | 25486 | 94 | 190 |
| 10 | 250 | 558 | 324 | 10.0 | 237 | 14 | 350 | 356 | 356 | 10.5 | 317 | FP | 25486 | 58 | 279 |
| 12 | 300 | 610 | 381 | 10.0 | 287 | 14 | 350 | 356 | 356 | 10.5 | 317 | FP | 25486 | 39 | 404 |
| 14 | 350 | 712 | 413 | 10.5 | 317 | 14 | 350 | 356 | 356 | 10.5 | 317 | FP | 25486 | 32 | 556 |

| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |



# Lined Piping Specials

There is a significant choice when it comes to special items. The table below indicates some of the most popular variants on lined pipe and fittings, whist the phtographs on the next page show some of the capability of the bsusiness. CRP does not see itself as a "catalogue" company. Our approach is one of problem solving and just because it hasn't been made before doesn't mean that it isn't required or cannot be made. Please discuss your corrosion problems with us and let us find a solution if we can.

| Spool & Fitting Options | |
|---|---|
| Lining | HiPerFlon PTFE |
| | UHP PTFE |
| | Static-Dissipating PTFE |
| | Static-Dissipating PFA |
| | Super Vacuum Resistant (SVR) |
| Flanges | Fixed/Rotating |
| | Rotating/Rotating |
| | Different bolt centres e.g. ON/OFF |
| | Metric drillings |
| | Non-standard bolt hole orientation |
| | Mixed flanges |
| | Flange not perpendicualr to pipe |
| Flange Design | ASME B16.5 Class 300 |
| | DIN PN10/16 |
| | JIS |
| | Customer special |
| Geometry | Longer or shorter radius |
| | Non standard cetreline to face dimensions |
| | Non standard face to face dimensions |
| | Different angles |
| | Dissimilar centreline to face on each leg |
| | Lugged wafer fittings |
| Flare Face | Full face lining |
| Housing Materials | Stainless steels |
| | Low temperature carbon steel |
| | Exotic metals |

Multibranch Reactor Charging Manifold

Double Branch Reducing Tee

180 Degree Elbow

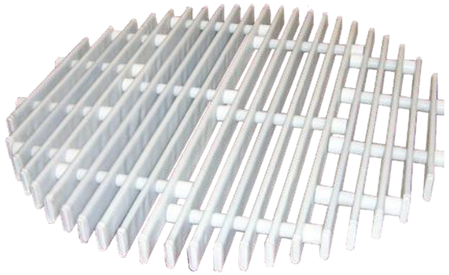
Reducing Crosss with Offset Branches

Support Foot

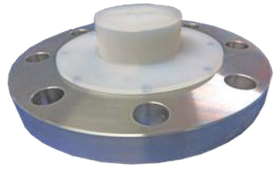
Azeotropic Separation Vessel

Instrument Probe Housing

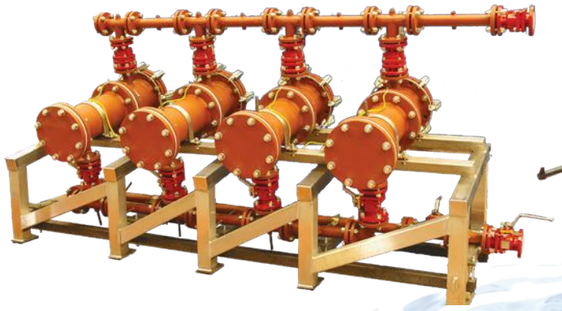
Tri-Clamp PTFE Lined Spool



PTFE-Incoloy Column Support Grid



PFA Top Hat Blank Flange



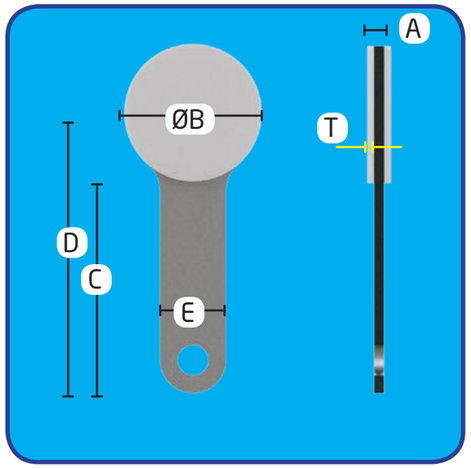
Filtration System

Charge Pot

Azeotropic Separation Vessel








A handy aid for blanking off pumps, valves and sections of piping; the function of blanking spades or paddle blanks is to separate shut-off plant systems from pressurised or operational systems and protect parts of systems from being subjected to higher pressures than their rated cut-off pressure. Blanking spades can also be used in connection with test pressurisation. They can also provide an additional layer of protection during maintenance work, guarding against leaking valves or the negligent opening of an isolation valve.

A wafer fitting, the disc is sized to fit inside the bolt circle for the relevant nominal bore. Both sides of the fitting have PTFE bonded to a stainless steel plate. A hole in the handle is for tagging the item if required. They are also available fully lined including the handle.

Ring spacers or paddle spacers can also be provided to maintain the piping position at times when blanking spades are not in use. These have a handle and outside diameter as the blanking spade but a bore to suit the pipe line internal diameter.

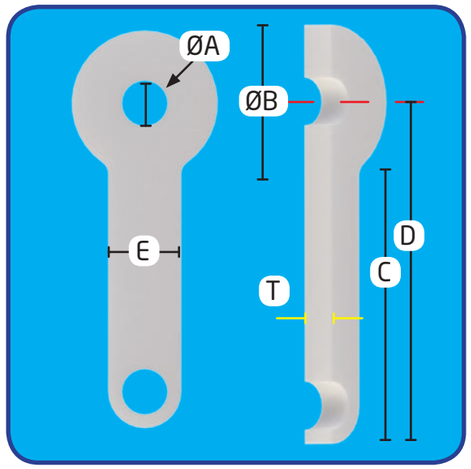
CRP blanking spades are manufactured as a 7mm thick assembly to facilitate their use in existing piping systems through prising two flanges apart. However on larger nominal bores this thickness is insufficient to take the full potential line pressure and we recommend the selection of spectacle blinds.

**Blanking Spade**

| Nominal Bore | | Face to Face | Spade OD | PTFE Liner Thickness | Handle Length | Length to Centre | Handle Width | | Max Pressure Rating Class 150 | Actual Max Pressure Ratings[1] | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | ∅ B | T | C | D | E | | | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | Construction | bar (g) | bar (g) | kg |
| ½ | 15 | | 44 | | 80 | 102 | | SS/PTFE | 19.6 | 31.0 | 0.1 |
| ¾ | 20 | | 54 | | 83 | 110 | | SS/PTFE | 19.6 | 31.0 | 0.1 |
| 1 | 25 | | 62 | | 117 | 148 | | SS/PTFE | 19.6 | 31.0 | 0.1 |
| 1½ | 40 | | 81 | | 116 | 156 | | SS/PTFE | 19.6 | 31.0 | 0.2 |
| 2 | 50 | | 100 | | 112 | 162 | | SS/PTFE | 19.6 | 22.0 | 0.3 |
| 3 | 80 | | 132 | | 112 | 178 | | SS/PTFE | 10.0 | 10.0 | 0.4 |
| 4 | 100 | 7 | 170 | 2 | 109 | 194 | 26 | SS/PTFE | 5.9 | 5.9 | 0.7 |
| 6 | 150 | | 217 | | 112 | 220 | | SS/PTFE | 2.6 | 2.6 | 1.2 |
| 8 | 200 | | 274 | | 113 | 250 | | SS/PTFE | 1.5 | 1.5 | 2 |
| 10 | 250 | | 337 | | 132 | 300 | | SS/PTFE | 0.9 | 0.9 | 3 |
| 12 | 300 | | 407 | | 137 | 340 | | SS/PTFE | 0.6 | 0.6 | 4 |
| 14 | 350 | | 447 | | 147 | 370 | | SS/PTFE | 0.5 | 0.5 | 5 |
| 16 | 400 | | 511 | | 145 | 400 | | SS/PTFE | 0.4 | 0.4 | 7 |

1 - Maximum pressures when used in systems rated higher than 150lb (10 bar(g)).

# Orifice Plate



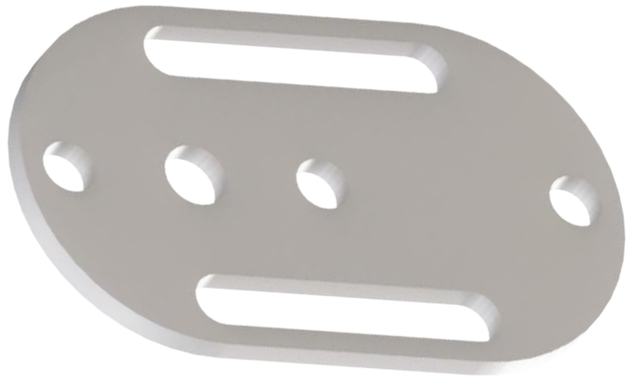

Orifice plates can be used for measuring flow rate, reducing line pressure or restricting flow. These are generally manufactured in solid PTFE with a hole sized to suit the application. The handle hole is usually made to the same diameter to indicate what is in the line. Thicknesses are customer specified and are determined by the pressure rating, typically between 3 and 25mm. They are also available for higher pressure ratings as a PFA lined stainless steel component.

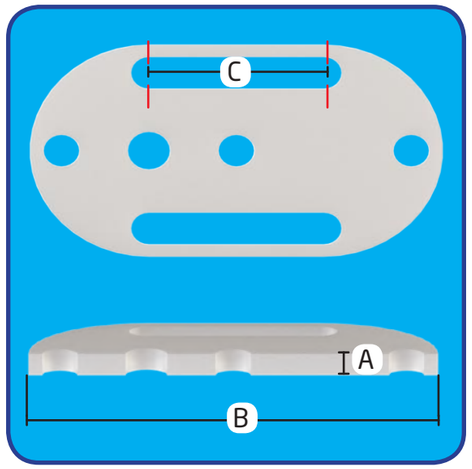
| Orifice Plate | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal Bore | | Maximum Hole[1] | Plate OD | Handle Length | Length to Centre | Handle Width | | Max Weight |
| | | Ø A | Ø B | C | D | E | | |
| Inches | mm | mm | mm | mm | mm | mm | Construction | kg |
| ½ | 15 | 12 | 42 | 131 | 152 | 20 | PTFE | 0.1 |
| ¾ | 20 | 12 | 51 | 130 | 156 | 20 | PTFE | 0.1 |
| 1 | 25 | 20 | 61 | 130 | 161 | 20 | PTFE | 0.1 |
| 1½ | 40 | 33 | 80 | 130 | 170 | 20 | PTFE | 0.2 |
| 2 | 50 | 44 | 99 | 128 | 178 | 30 | PTFE | 0.3 |
| 3 | 80 | 56 | 130 | 130 | 195 | 40 | PTFE | 0.4 |
| 4 | 100 | 69 | 169 | 130 | 215 | 40 | PTFE | 0.6 |
| 6 | 150 | 91 | 217 | 112 | 220 | 40 | PTFE | 0.9 |
| 8 | 200 | 111 | 274 | 113 | 250 | 40 | PTFE | 1.4 |

1 - Hole size is customer specified.



# Sliding Blind



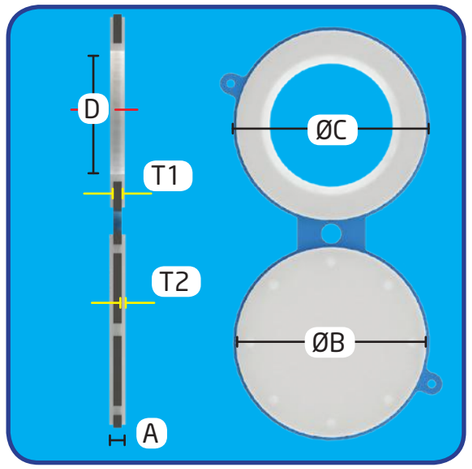



Sliding blinds are a more permanent form of blanking spade, combining the function of the blanking spade with that of a ring spacer. They are built into the pipeline as a wafer fitting and require the flange bolting to be loosened in order for it to be slid into either position. Manufactured from solid PTFE in their open state they allow unhindered flow through the pipeline, when slid into their closed position they effectively seal the pipeline. They have the advantage over blanking spades of it being quite clear as to whether the blind is in the open or closed position. The slotted holes fit the bolting and align the blind. For a more robust permanent blind please select the Spectacle Blind.

| Sliding Blind | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Nominal Bore | | Face to Face | Blind Height | Blind Travel | Pressure Rating 23°C | Pressure Rating 100°C | Pressure Rating 200°C | | Weight |
| | | A | B | C | | | | | |
| Inches | mm | mm | mm | mm | bar (g) | bar (g) | bar (g) | Construction | kg |
| ½ | 15 | 10 | 89 | 60 | 19.6[1,2] | 17.7[2] | 13.8[2] | PTFE | 0.2 |
| ¾ | 20 | 10 | 99 | 70 | 19.6[2] | 17.7[2] | 13.8[2] | PTFE | 0.3 |
| 1 | 25 | 10 | 108 | 79 | 19.6[2] | 17.7[2] | 13.8[2] | PTFE | 0.4 |
| 1½ | 40 | 10 | 127 | 98 | 19.6[2] | 11.5 | 6.4 | PTFE | 0.5 |
| 2 | 50 | 16 | 152 | 121 | 19.6[2] | 17.7[2] | 9.9 | PTFE | 0.8 |
| 3 | 80 | 16 | 190 | 152 | 17.8 | 8.1 | 4.5 | PTFE | 2.0 |
| 4 | 100 | 27 | 229 | 191 | 19.6[2] | 13.4 | 7.4 | PTFE | 5.0 |
| 6 | 150 | 27 | 279 | 241 | 12.9 | 5.9 | 3.3 | PTFE | 7.5 |
| 8 | 200 | 27 | 343 | 298 | 7.3 | 3.3 | 1.8 | PTFE | 11 |
| 10 | 250 | 25 | 430 | 445 | 4.6 | 2.1 | 1.2 | PTFE | 18 |
| 12 | 300 | 27 | 483 | 529 | 3.3 | 1.5 | 0.8 | PTFE | 26 |

1- Please note pressures are thickness dependant, if you require a higher pressure rating please contact us.
2 -The pressure rating of the sliding blind is greater than the pressure rating of the same size of Class 150 flange, so pressure ratings shown are for the flange. These items are highlighted in green.

# Spectacle Blind



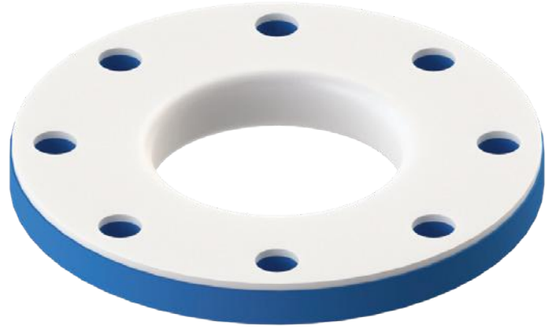

Spectacle blinds are a more permanent form of blanking spade, designed to be left installed within the pipeline. The spectacle blind or Figure 8 blank is a wafer fitting designed to swivel around one of the flange bolts. They have the advantage over blanking spades of it being quite clear as to whether the blind is in the open or closed position. The CRP design is extremely robust with a stainless steel core lined in PFA and does not suffer from PTFE movement of the flared faces which can occur with other designs preventing the blind from being inserted after a period out of line .

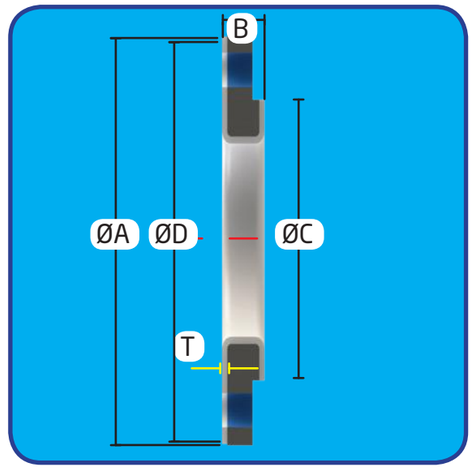
**Spectacle Blind**

| Nominal Bore | | Face to Face | Raised Face | Steelwork Outer | Steelwork Thickness | PFA Liner Bore Nominal | Steelwork Inner | PFA Liner Thickness Nominal | Rotation Centre to Edge | Spin Centre to centre | Construction | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | A | Ø B | Ø C | T1 | Ø D | Ø E | T2 | | | | |
| Inches | mm | mm | mm | mm | mm | mm | mm | mm | mm | mm | | kg |
| ½ | 15 | 11 | 35 | 44 | 6 | 13 | 18 | 2.5 | 70 | 30 | SS/PFA | 0.1 |
| ¾ | 20 | 11 | 43 | 54 | 6 | 16 | 22 | 2.5 | 80 | 35 | SS/PFA | 0.2 |
| 1 | 25 | 14 | 51 | 64 | 6 | 19 | 27 | 4.0 | 87 | 39 | SS/PFA | 0.3 |
| 1½ | 40 | 14 | 73 | 83 | 6 | 33 | 41 | 4.0 | 108 | 49 | SS/PFA | 0.5 |
| 2 | 50 | 14 | 92 | 102 | 6 | 44 | 53 | 4.0 | 130 | 61 | SS/PFA | 0.7 |
| 3 | 80 | 14 | 127 | 134 | 6 | 66 | 78 | 4.0 | 161 | 76 | SS/PFA | 1.2 |
| 4 | 100 | 16 | 157 | 172 | 8 | 86 | 102 | 4.0 | 200 | 96 | SS/PFA | 2.2 |
| 6 | 150 | 22 | 216 | 219 | 13 | 137 | 154 | 4.8 | 248 | 121 | SS/PFA | 4.6 |
| 8 | 200 | 28 | 270 | 276 | 15 | 186 | 203 | 6.5 | 305 | 149 | SS/PFA | 9 |
| 10 | 250 | 28 | 324 | 337 | 20 | 250 | 260 | 4.0 | 367 | 181 | SS/PFA | 12 |
| 12 | 300 | 28 | 381 | 406 | 20 | 290 | 300 | 4.0 | 438 | 216 | SS/PFA | 19 |
| 14 | 350 | 28 | 413 | 447 | 20 | 327 | 337 | 4.0 | 482 | 238 | SS/PFA | 24 |
| 16 | 400 | 33 | 470 | 511 | 25 | 377 | 387 | 5.0 | 546 | 269 | SS/PFA | 28 |



# Full Face Adapter Flange






Occasionally lined piping is joined to weaker dissimilar flange materials. A common application is to join to GRP/FRP or thermoset and thermoplastic plastic flanges. These may be piping elements or often valves. It is a mistake to consider that one can achieve a seal simply by fitting a gasket. This is because such products usually have a flat face that needs to seal on to the lined piping. When bolted up in service this flat face bends along the edge of the PTFE or PFA raised face and does not achieve a seal on this lip. Further tightening just bends the weak flange and damages the soft PTFE or PFA raised face. The solution to this is to fit a full face adapter flange which is lined across the full face.

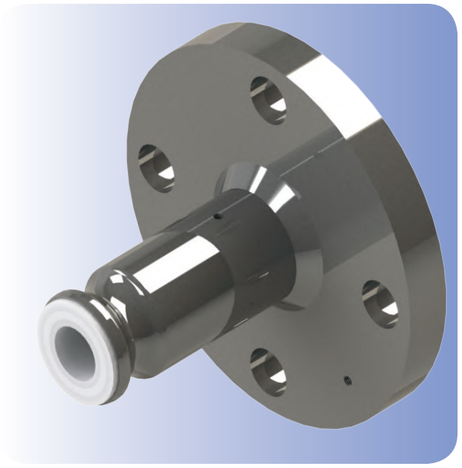
**Full Face Adapter Flange**

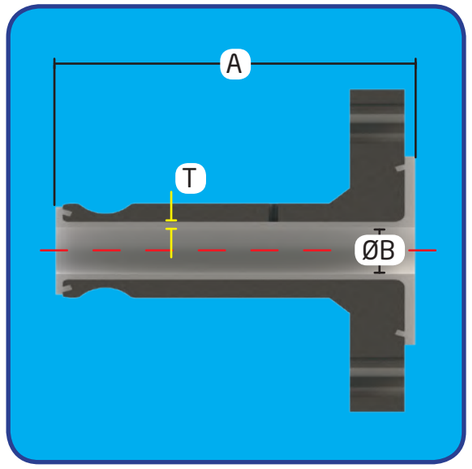
| Nominal Bore | | Flange OD | Face to Face | Raised Face Diameter | PFA Full Face Diameter | Heavy Duty PFA Liner Thickness Nominal | Construction | Weight |
|---|---|---|---|---|---|---|---|---|
| | | Ø A | Ø B | Ø C | Ø D | T | | |
| Inches | mm | mm | mm | mm | mm | mm | | kg |
| ½ | 15 | 90 | 21 | 35 | 88 | 5.0 | FP | 0.5 |
| ¾ | 20 | 100 | 23 | 43 | 98 | 5.0 | FP | 0.7 |
| 1 | 25 | 110 | 24 | 51 | 108 | 5.0 | FP | 1.0 |
| 1½ | 40 | 125 | 28 | 73 | 123 | 5.0 | FP | 1.6 |
| 2 | 50 | 150 | 29 | 92 | 148 | 5.0 | FP | 2.5 |
| 3 | 80 | 190 | 34 | 127 | 188 | 5.0 | FP | 5 |
| 4 | 100 | 230 | 33 | 157 | 228 | 5.0 | FP | 6 |
| 6 | 150 | 280 | 35 | 216 | 278 | 5.0 | FP | 9 |
| 8 | 200 | 345 | 38 | 270 | 343 | 5.0 | FP | 15 |
| 10 | 250 | 405 | 40 | 324 | 403 | 5.0 | FP | 20 |
| 12 | 300 | 485 | 42 | 381 | 483 | 5.0 | FP | 31 |

Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

# Camlock Hose Adapter






Hose adaptors are used to connect hoses to piping systems, they are usually made using stainless steel and PFA. Typically the hose adaptor connects to the hose using a tri-clamp, threaded, camlock or other hose fitting, leaving a flanged end to connect to the fixed PTFE lined piping system. The data below is for male camlock connectors – the least expensive quick release hose coupling, but a variety of industry standard hose fittings can be fitted, however one must consider whether the fitting geometry allows for PFA lining.

| Camlock Hose Adapter | | | | | | |
|---|---|---|---|---|---|---|
| Camlock Nominal Size | | Length A | Lined Bore Nominal Ø B | PFA Liner Thickness T | Construction | Weight |
| Inches | mm | mm | mm | mm | | kg |
| ½ | 15 | 100 | 15.0 | 3.0 | Stainless/PFA | 2.9 |
| ¾ | 20 | 100 | 15.0 | 5.2 | Stainless/PFA | 3.1 |
| 1 | 25 | 100 | 18.0 | 2.3 | Stainless/PFA | 3.7 |
| 1½ | 40 | 110 | 27.0 | 2.5 | Stainless/PFA | 5.1 |
| 2 | 50 | 110 | 36.0 | 3.0 | Stainless/PFA | 6.2 |
| 3 | 80 | 110 | 54.0 | 4.3 | Stainless/PFA | 8 |



# Venting Systems

## Introduction

Inappropriate or no venting can lead to premature failure of lined piping and therefore cause both unnecessary plant cost and present a safety hazard. CRP has an all-inclusive approach for managing both permeant and non-permeant services and insulated and uninsulated lines. This will provide longevity in service - assisting in preventing liner failure and external steelwork corrosion.

## Venting Function

Venting is required in the two key PTFE lined pipe and fittings specifications ASTM F1545 and DIN2874. There are two user reasons for venting:

- First, to vent the space between liner and steelwork of any material (liquid or gas) that may collect behind the liner. Such liquid or gas build up can occur by means of permeation through the liner. Permeation rates can be significantly affected by the choice of which PTFE or PFA to use – CRP would always recommend PFA for pipe fittings and UltraHiPerFlon (UHP) for PTFE lined piping. However, even with such lining systems it is still necessary to guard against the effects of permeation.
- Secondly, as an early indicator of failure. In the unlikely event of a liner failure the steel housing is likely to corrode evenly within the pipe and cause a catastrophic and unannounced failure of the complete pipe. With a venting system, the leaking materials should show at the vent first, providing some opportunity to take the equipment out of service before massive failure.

## Basic Vent Hole

CRP as standard provides 5mm vent holes versus the more traditional 3mm (1/8"). These are much more effective, being less likely to get blocked by paint, steel corrosion or the crystallisation of permeant media and therefore prevent catastrophic failure through liner collapse.

Cut steel pipe showing PTFE lined collapse through blocked vent holes

Corrosion of the vent hole area following permeation and no particular corrosion protection

# Venting Types

## Selection

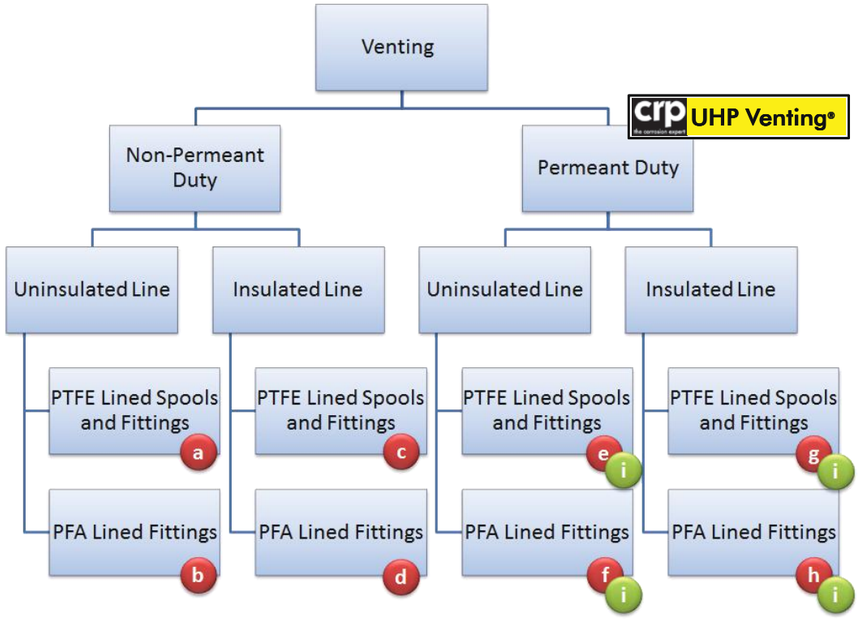
The key consideration is whether the duty is for a permeating or non-permeating duty. If the duty is non-permeating then the venting system only needs to provide the leak detection function. However, if it is permeating then it has to be capable of managing the removal of permeant materials from the inside of the item without weakening the steelwork. If not, the steelwork will be weakened to the point of making it unsafe as in the photograph previously.

Once the duty has been determined one needs to decide if the line is to be insulated or not. Insulation may be selected for process control reasons – keeping the process cold or hot, or to assist in managing permeation by moving the dew point out of the lining material. Either way whether the line is or is not carrying a permeant media it is necessary to carry the vent to the outside of the insulation such that leakage or permeation is not discharged within the insulation.

Some variation in the system is then driven by whether the component is PTFE or PFA lined and in the case of pipe spools by their length.

## CRP Designation

If your requirement is for a non-permeant duty and is uninsulated, then you need not advise specially, we will provide our standard venting automatically (a+b below), If non-permeant, but insulated (c+d below), If permeant, then specify UHP venting - our generic term for for the permeant service venting system, again advising us whether lines are uninsulated (e+f below) or insulated (g+h below). The variable angle vent (i below) can be retrofitted onto any PTFE vent plug.



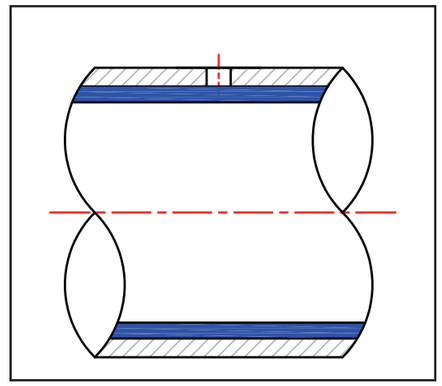




# Non-Permeant Duty
## Uninsulated Line

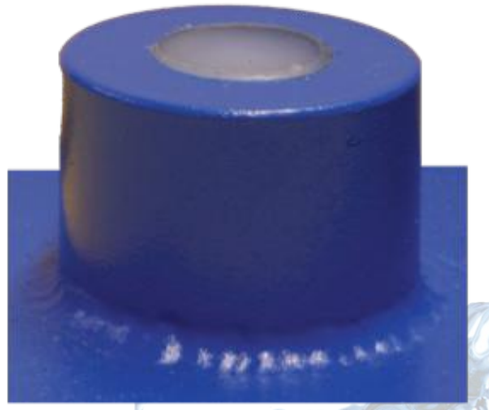
## PTFE Lined Spools and Fittings [a]

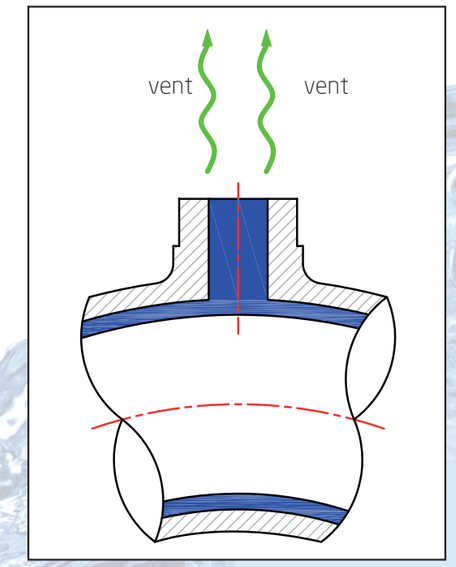
PTFE lined fittings generally have a single 5mm vent hole located centrally on the item, whilst pipe spools less than 500mm in length also have a single vent hole. Longer spools have two holes on the same side of the spool 150mm from the rear side of the flange face. Venting on one side enables the spool to be rotated to put the venting in the most advantageous position and the location longitudinally is chosen to make the routing of vents through insulation jackets easy.



## PFA Lined Fittings Vent [b]

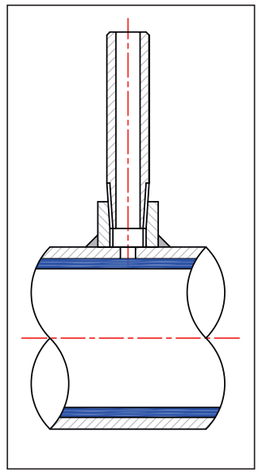
The injection port on a PFA fitting works as a vent in its own right, with a route to atmosphere around the circumference of the PFA.





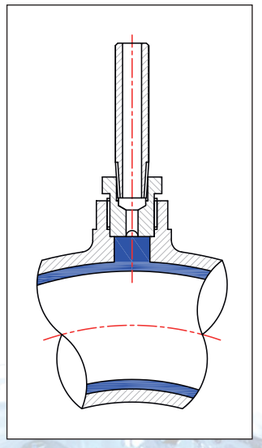
## PTFE Lined Pipe Spools and Fittings [c]

A simple threaded ¼" BSPP half coupling is welded over each 5mm vent hole and a carbon steel taper threaded pipe is provided to screw into this. The assembled length is 70mm but special lengths can be supplied.



## PFA Lined Fittings [d]

A steel reducer is fitted to the PFA injection boss of the fitting and a carbon steel 1/4" BSPT threaded pipe is provided to screw into this. The reducer has a cross slot in a flat bottomed base to provide a route from the lining/steel boundary to atmosphere. The assembled length is 85mm, but special lengths can be supplied.

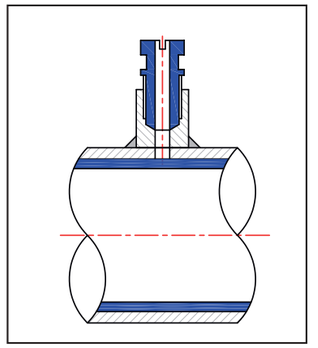






## PTFE Lined Pipe Spools and Fittings [e]

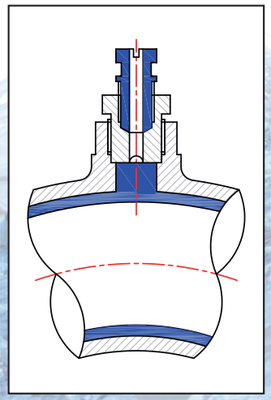
A purpose made 5mm hole vent boss is welded to the pipe, with a tapered internal geometry to prevent any dead space arising in the assembly. Into this is fitted a PTFE vent plug, with a screwdriver slot for fixing and a drip lip to prevent potentially corrosive liquor vented from the plug running back along the outside of the plug and corroding the vent boss. This system for managing permeation in the following sections (e - i) is referred to as UHP Venting.



This is designed to accept a 5mm PTFE tube for carrying any corrosive liquor to somewhere more harmless to the plant.

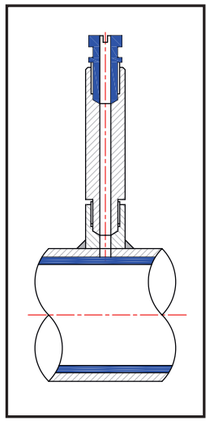
## PFA Lined Fittings [f]

The injection port on a PFA lined fitting works as a vent in its own right, with a route to atmosphere around the circumference of the PFA. No other measures are required as permeation through PFA lined fittings is none or very limited. For those customers requiring support for the PFA injection boss a steel adaptor is fitted to the injection port incorporating a flat bottom and cross slot in the base. This prevents the vent route from sealing and avoids dead space within the fitting. A PTFE vent plug is fitted to this adaptor. This design therefore manages permeation if present, together with providing mechanical support for the PFA injection boss.



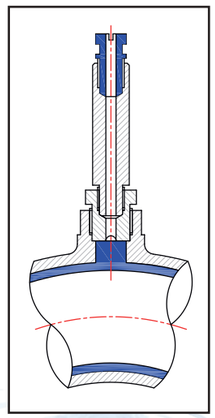
## PTFE Lined Pipe Spools and Fittings [g]

A purpose made 5mm hole vent boss is welded to the pipe, with a tapered internal geometry to prevent any dead space arising in the assembly. A steel vent extension is fitted with the same geometry as the vent boss. Into this is fitted a PTFE vent plug, with a screwdriver slot for fixing and a drip lip to prevent potentially corrosive liquor vented from the plug running back along the outside of the plug and corroding the vent boss. The assembled length of the steel vent extension is 80mm but special lengths can be supplied.



## PFA Lined Fittings [h]

A steel adaptor is fitted to the injection port and incorporates a flat bottom and cross slot in the base. The new adaptor has a 5mm hole to prevent blockage. A vent extension with a 5mm hole is fitted and the new style PTFE vent plug with 5mm hole, drip lip mounted above. The assembled length of the steel vent extension is 90mm but, special lengths can be supplied.

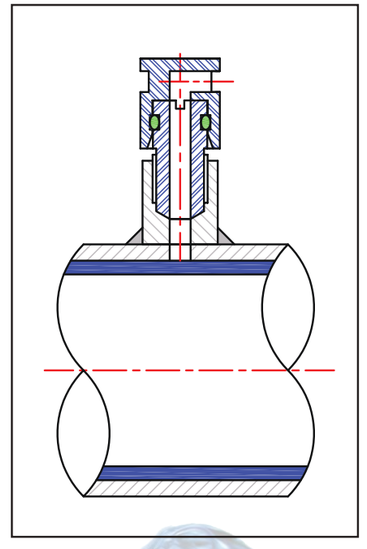






## Variable Angle Vent [i]

It is not always possible to direct the vents on lined piping away from walkways, stairwells or open floors. Also vents are often positioned pointing upwards which can allow atmospheric moisture to pool in the hole. This can assist corrosion and cause staff to think they have a process leak when they don't. To resolve these a vent has been developed which simply clips onto the top of the PTFE vent plug and can be directed in any particular direction with a simple twist. The vent is designed with a drip lip to prevent corrosive liquor running down the side of the plug and corroding the vent boss. Again, this is designed to accept a 5mm PTFE tube for carrying any corrosive liquor to somewhere more harmless to the plant.



It is good practice to ensure electrical continuity and good bonding to earth of all lined piping on site to prevent any build up of static charge or in the case of any electrical equipment failure prevent any metallic components from becoming live and causing an electrical shock to any operator. In particular a static charge can build to several tens of thousands of volts which can spark and ignite flammable atmospheres with catastrophic results.

The generally accepted value of resistance to avoid problems with plant charging is that there should never be more than 10Ω resistance between any point on the plant and ground. One solution to plant earthing is to use earthing studs or lugs.

## Earthing Studs and Lugs

All of the piping products we offer at CRP can be supplied complete with earthing studs - typically M6 x 20mm or earthing lugs generally to the customers own specification

For pipes spools longer than 500mm we would recommend an earthing stud / lug is located at each end of the spool. It commonly accepted that all separate parts of a spool or fitting have a stud / lug welded in place, for example whilst a spool three metres long with one rotating flange might have three studs - one on each flange and one on the pipe close to the rotating flange, a cross with all rotating flanges should have five studs - one on each flange and one on the body.

When installed on site the studs / lugs are joined to the adjacent components using common earth jumping connectors much the same as unlined piping and finally properly bonded to a good plant earth.

Please note that it is important not to confuse plant earthing with static dissipation and the use of static-dissipating piping does not negate the need to earth the piping, indeed it is even more critical as any charge dissipated through the steelwork still needs to find an earth.

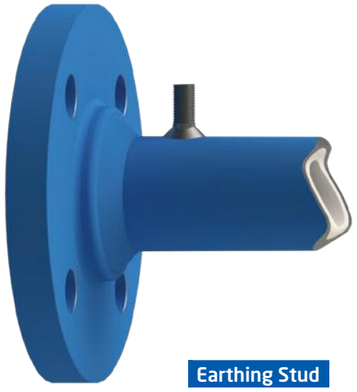
Conversely, earthing the piping will not on its own manage static charging within the piping - please see the section on static dissipating (anti-static) lined piping.

## Spikies

Spikies used on rotating flanges and star washers employed on bolted joints can provide good earth continuity without the need for studs, lugs or earthing straps. Please see the relevant page.

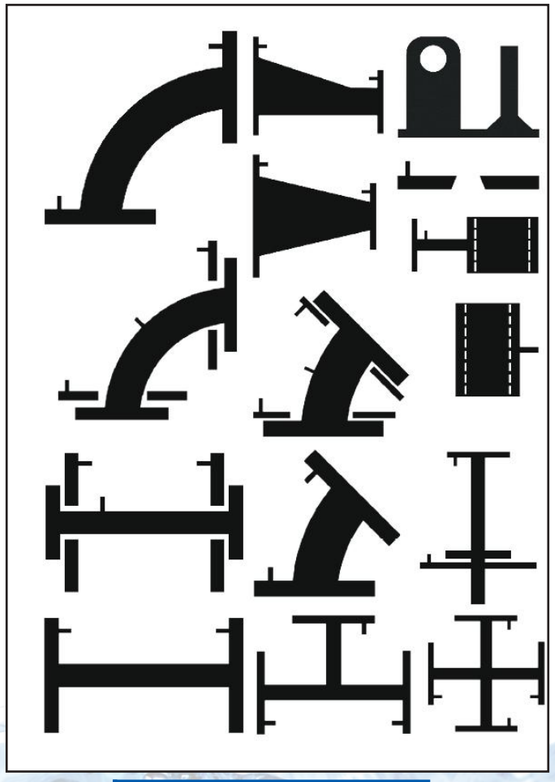
## Fixed Flanges

Although fixed flanges and star washers may remove the need for spikies or earthing straps, their exclusive use has the disadvantage of the challenges of installing pipe spools with fixed/ fixed flanges which cannot accomodate accumulated misalignment that will occur in installation. Please check local regulations for earthing standards.



Earthing Stud

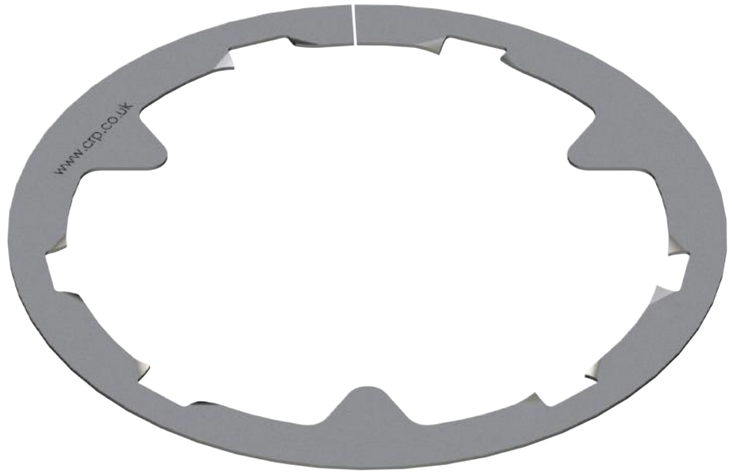
Earthing Lug



Standard Stud or Lug Positioning







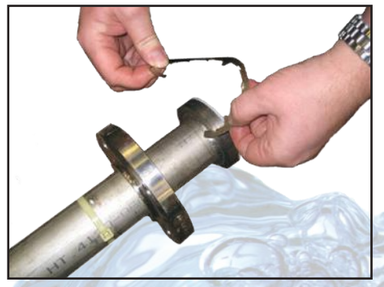

In order to address the issue of earthing rotating flanged components CRP has developed its range of Spikies®.

Spikies® are simply slipped into place between the loose flange and stub end on a pipe spool or fitting, and the joint made using star washers and studs as on a fixed flange joint. Once in place the centring lugs ensure that the raised points on the Spikies® are positioned to bite into the front of the flange face and the back of the stub end, thus providing earth continuity from rotating flange to fitting / spool.

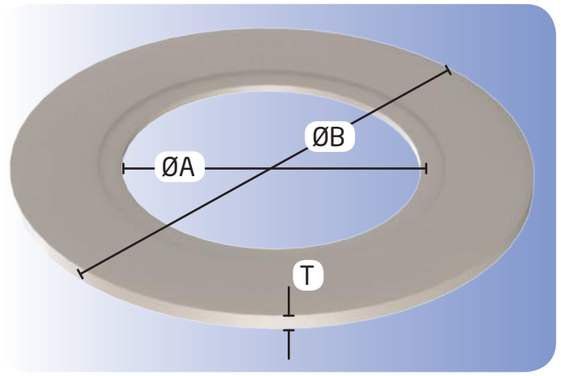
The extensive design, development and testing programme for Spikies® has ensured that the optimum spring steel substrate and nickel corrosion protection coating materials have been used, along with a design that makes Spikies® a truly durable fit and forget solution to process plant pipework earth continuity issues. The spikie provides a robust and cost effective solution to achieving earth continuity between the pipe body and a rotating flange. It can be supplied factory fitted or can easily be retro-fit in the field.

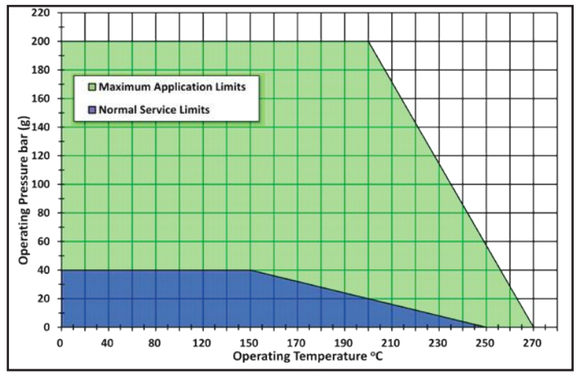
| Nominal Bore | | To suit Pipe NB |
|---|---|---|
| Inches | mm | NPS[1] |
| ½ | 15 | ¾ |
| ¾ | 20 | |
| 1 | 25 | 1 |
| 1.1/4 | 32 | 1.1/4 |
| 1½ | 40 | 1½ |
| 2 | 50 | 2 |
| 3 | 80 | 3 |
| 4 | 100 | 4 |
| 6 | 150 | 6 |
| 8 | 200 | 8 |
| 10 | 250 | 10 |
| 12 | 300 | 12 |

1 - NPS is Nominal Pipe Size as per ASME B36.1 and ASME B36.19.



# Fluorogask




## Overview

Fluorogask represents the state of the art in gasket technology, a pre-compressed piping gasket produced wholly from multi-directionally expanded PTFE. It is designed for use across the pharmaceutical and chemicals industry combining the corrosion performance and inertness of PTFE with a physical construction that produces an excellent gasket material.

PTFE and PFA lined piping systems do not usually require gaskets for securely closing their joints. However, there are exceptions to this rule where joints are made and broken regularly, where lined equipment is joined to dissimilar materials or simply when gasketing has been selected as a site wide standard.

Fluorogask fulfills not only the gasketing needs of a lined piping system, but can also be used as the gasket of choice across all piping applications. Capable of meeting all types of flange standards, having almost universal corrosion resistance and handling a wide temperature, pressure and vacuum range they have countless applications. The multi-directional expanded PTFE improves the mechanical properties of PTFE making it highly conformable enabling it to achieve incredible tightness across a comprehensive range of materials and joint types.

## Typical Joint Materials

PTFE and PFA Lined

Glass Lined

GRP/FRP (Please consult)

Glass (Please consult)

Plastic

Metal

## Performance

The highly conformable material enables it to seal at low torques and makes it ideal for fragile or glass lined flanges. It is even capable of sealing most damaged flange sufaces.

Its wide application across piping systems enables a large degree of site standardisation and the comfort of knowing that an incorrect gasket hasn't been fitted.

PTFE is non-ageing, weather and UV resistant and can provide a long service life without the need for retorqueing.

A pre-compressed core to the gasket reduces diffusion, cross-contamination and migration.

## Installation

Manufactured to the requirements of ASME B16.21 the gasket fits the inside bolt circle making it easy to centre and clear that there is a gasket present.

The multi-directionally expanded PTFE has exceptional mechanical strength allowing operation with minimal creep at elevated temperatures.

It is dimensionally stable with the gasket size remaining the same when under load.

The pre-compressed core to the gasket increases its rigidity.

Used gaskets can be removed easily and without residue on the flange surfaces.

## Food and Pharmaceutical Use

Manufactured according to GMP requirements and being both FDA and EU1935/2004 compliant the gasket can be used in both the food and pharmaceutical industry.

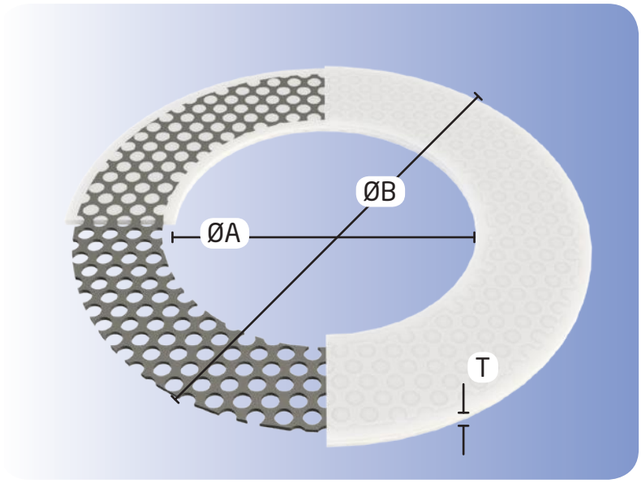
The pre-compressed bore prevents cross-contamination as pores are not present to trap media.

The gasket can withstand both CIP and SIP processes.

| Dimensions ASME 150 Piping System | | | | |
|---|---|---|---|---|
| Nominal Bore | | Thick T | ID ØA | OD ØB |
| Inches | mm | mm | mm | mm |
| ½ | 15 | 3.0 | 21 | 48 |
| ¾ | 20 | 3.0 | 27 | 57 |
| 1 | 25 | 3.0 | 33 | 67 |
| 1½ | 40 | 3.0 | 48 | 86 |
| 2 | 50 | 3.0 | 60 | 105 |
| 2½ | 65 | 3.0 | 73 | 124 |
| 3 | 80 | 3.0 | 89 | 137 |
| 4 | 100 | 3.0 | 114 | 175 |
| 6 | 150 | 3.0 | 168 | 222 |
| 8 | 200 | 3.0 | 219 | 279 |
| 10 | 250 | 3.0 | 273 | 340 |
| 12 | 300 | 3.0 | 324 | 410 |



# Toughgask




Toughgask reusable gaskets can be used in nearly all applications to seal metallic flange joints. They are far superior and cost effective compared with other designs such as envelope gaskets as they are reusable many times. They are extremely robust and very easy to install.

The Toughgask gasket offers superior performance than a standard virgin PTFE gasket as its inherent stainless steel core prevents cold flow of the PTFE which can lead to joint failure.

Due to the use of PTFE with it's universal corrosion resistance the gasket can aid greatly with site standardisation being suitable for a varied range of applications across the plant.

Lined piping systems do not generally require gaskets to seal between the flange joints; the PTFE / PFA flange faces provide the seal.

This gasket is suitable for unlined systems and is not specifically designed for lined piping. For gaskets in lined piping service please see our Fluorogask literature.

| Toughgask | | | | | | |
|---|---|---|---|---|---|---|
| Nominal Bore | | Thickness T | ID ØA | OD ØB | Torque | Weight |
| Inches | mm | mm | mm | mm | Nm | gm |
| ½ | 15 | 2.5 | 21 | 45 | 20 | 7 |
| ¾ | 20 | 2.5 | 27 | 57 | 20 | 11 |
| 1 | 25 | 2.5 | 33 | 66 | 20 | 14 |
| 1½ | 40 | 2.5 | 48 | 85 | 20 | 21 |
| 2 | 50 | 2.5 | 60 | 104 | 27 | 31 |
| 2½ | 65 | 2.5 | 73 | 123 | 34 | 42 |
| 3 | 80 | 2.5 | 89 | 136 | 34 | 45 |
| 4 | 100 | 2.5 | 114 | 174 | 47 | 73 |
| 6 | 150 | 2.5 | 168 | 222 | 60 | 89 |
| 8 | 200 | 2.5 | 219 | 279 | 68 | 127 |
| 10 | 250 | 2.5 | 273 | 339 | 75 | 171 |
| 12 | 300 | 2.5 | 324 | 409 | 82 | 264 |
| 14 | 350 | 3.0 | 356 | 450 | 95 | 386 |
| 16 | 400 | 3.0 | 406 | 514 | 102 | 506 |
| 18 | 450 | 3.0 | 457 | 549 | 108 | 471 |
| 20 | 500 | 3.0 | 508 | 606 | 115 | 556 |
| 24 | 600 | 3.0 | 610 | 717 | 122 | 723 |

# Safety Shields
## Flange Shields

### Introduction

Safety Shields are designed to minimise the impact of a leak or spray out from a piping system joint through pressure dissipation. In the case of a small leak the temporary containment they give can provide valuable time to enable detection of the leak and shut down the system before it becomes more serious. In the case of a catastrophic failure causing spray out, the safety shield serves to reduce the effect of the system line pressure and route the leak along the pipe rather than directly at you or your colleagues.

Safety Shields can therefore act as a key part of a risk reduction programme for use with equipment conveying hazardous materials, be they chemicals, high temperature fluids or flammable products.

They can assist in achieving the safety requirement of the Pressure Equipment Directive.

Their application can be plant wide if there is a high level of risk across a site, or specific to lines handling dangerous substances or lines in potentially hazardous locations such as above or alongside walkways.

### Flange Shields

Flange shields are available as standard for ASME and DIN flanges for all popular nominal bores and can be manufactured for sizes up to 40 inches (DN 1000).

The most universal and popular product comprises two layers of woven PTFE coated fibreglass cloth for the side pieces and a high temperature FEP viewing window. The draw cords and sewing threads are manufactured from Nomex® the flame resistant meta-aramid. The viewing strip enables complete visual inspection and the product is fire, tear and UV resistant with a continuous operating temperature of 200°C, and near universal chemical resistance.

A product option is to have a PTFE drain attached. This can route any leak to site containment using PTFE tubing as a push fit. This is popular in high traffic areas or where sensitive electronic equipment is in the vicinity. Alternatively it can act as a drain for leaks, a vent for rainwater or moisture or as an emissions test port. It is also possible to fit pH indicator paper to indicate the presence of acids or alkalis.

Flange Shield

Flange Shield with PTFE Drain



# Safety Shields
## Bellows,Valve & High Temperature Shields

### Bellows Shields

The shield style for bellows is a double layer PTFE coated woven fibreglass cloth, with a clear high temperature FEP viewing window. The special FEP provides nearly universal chemical and UV light resistance and a 200°C upper performance. As standard these are available for 2-5 convolution bellows with ASME or DIN flanges in all nominal bores up to 40 inches (DN 1000).

As non-metallic bellows generally only have a single layer of PTFE or rubber between the media and the outside world and as by definition they are subject to flexible movement throughout their lives, we strongly recommend safety shields on bellows applications. These shields are suitable for PTFE, rubber and metallic bellows and are of course designed to function with the range of movements expected in the bellows.

### Valve Shields

As a universal choice for valve shields we recommend the PTFE woven glass cloth shield with a clear high temperature FEP viewing window. Valve shields are available for all types of valve including ball, check, butterfly, gate, plug, diaphragm, control and globe with bonnet shields available for gate and globe valves to enable operation. Shields are also available for covering instrumentation, actuators and electronics to protect them from local atmospheric conditions. Because valve dimensions vary from manufacturer to manufacturer even on the same style of valve it is necessary to provide information on the specific valve types.

### High Temperature and Pressure Flange Shields

For 1100°C and 200 Bar performance there is a 316 stainless steel shield available.

The stainless steel band securely clamps around the flange (different widths are available). A layer of stainless steel netting around the inside diameter of the shield dissipates any pressurised spray by directing it around the flange circumference. This shield is again designed for fitting without tools, has smooth corners to avoid sharp edges and is designed for the flange bolting to remain visible when fitted.

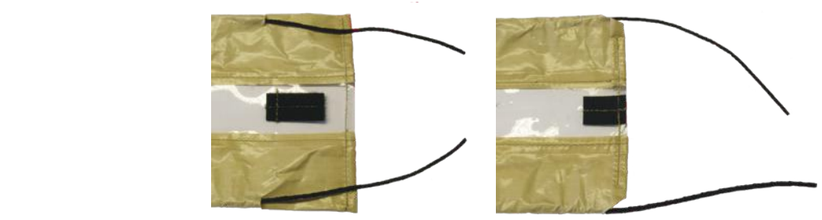
3 Convolution Bellows Shield

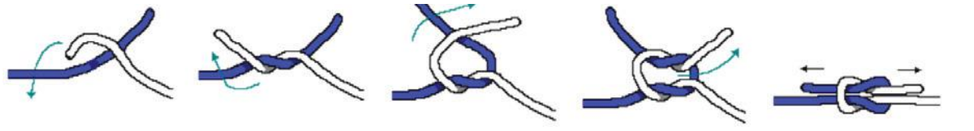
PTFE coated Valve Shield for a Ball Valve

Stainless Steel High Temperature and Pressure Flange Shield

## Construction

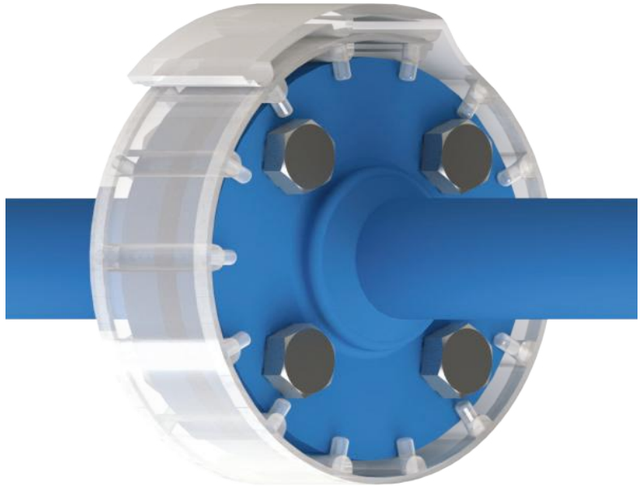
All of the fabric shields come with Velcro fastenings securely sewn onto the shield fabric. This enables one person to wrap the shield around the flange connection and complete the fastening in a short time. Well retained drawcords give an easy means of closing the shield. Once wrapped around the components the safety shield can be securely tied using the drawcords and a simple reef knot enabling installation by one person in less than a minute.

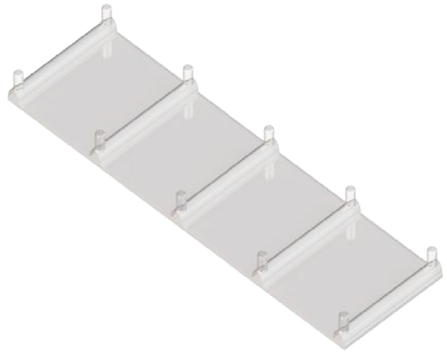








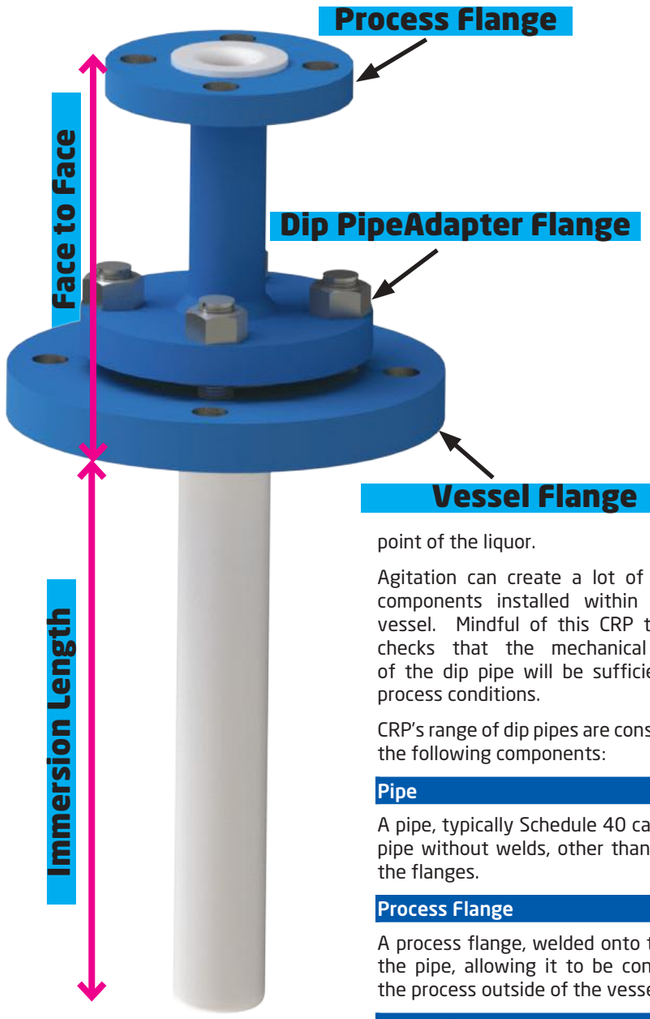


Flange protection tape is used to protect personnel from uncontrolled spray out from a failing flange joint. They should always be considered when installing any piping system carrying toxic or corrosive chemicals. By controlling the leak and protecting personnel and surrounding plant from chemical contact they can save both money and can be a key part of any risk mitigation for personnel.

The flange tape is supplied in a roll, making it ideal as a maintenance stores item, each width covering a range of flange to flange sizes. The correct length is simply cut from the roll, wrapped around the flange joint and secured with a small stainless steel self-tapping screw.

The basic function is one of deflecting the spray out from the joint, significantly reducing the chance of a pressurised spray hitting personnel. The spray shield is suitable for piping at temperatures from -40° to 110°C and manufactured in polypropylene it will withstand a broad range of exposure to chemical environments. Available in 50 metre rolls – or smaller lengths if required there are five widths in the range, but three of the sizes cover the bulk of sizes. Of course this is not just a lined piping product and can be used successfully with many piping materials involving flanged joints.

| Flange Protection Tape | | | | | | |
|---|---|---|---|---|---|---|
| Nominal Bore | | Required Length | Tape Width | | | Weight Per Metre |
| | | | F/F | F/R | R/R | |
| Inches | mm | mm | mm | mm | mm | gm |
| ½ | 15 | 360 | 50 | 50 | 70 | 70 |
| ¾ | 20 | 390 | 50 | 50 | 70 | 70 |
| 1 | 25 | 400 | 50 | 50 | 70 | 70 |
| 1½ | 40 | 460 | 50 | 70 | 70 | 70 |
| 2 | 50 | 540 | 50 | 70 | 100 | 100 |
| 3 | 80 | 660 | 70 | 70 | 100 | 100 |
| 4 | 100 | 780 | 70 | 100 | 100 | 100 |
| 6 | 150 | 940 | 70 | 100 | 100 | 100 |
| 8 | 200 | 1140 | 70 | 100 | 140 | 140 |
| 10 | 250 | 1340 | 70 | 100 | 140 | 140 |
| 12 | 300 | 1580 | 100 | 100 | 140 | 140 |
| 14 | 350 | 1740 | 100 | 140 | 140 | 140 |
| 16 | 400 | 1940 | 100 | 140 | 140 | 140 |
| 18 | 450 | 2060 | 100 | 140 | 140 | 140 |
| 20 | 500 | 2260 | 100 | 140 | 180 | 180 |
| 24 | 600 | 2620 | 140 | 140 | 180 | 180 |




Dip pipes have a wide array of uses. Typically they are used to charge a reactor below the liquid level, to extract samples from the reactor as part of one of our sampling systems, or to extract liquid from a vessel without the need of a side or bottom outlet.

CRP dip pipes are manufactured from a carbon steel fabricated construction with a continuously lined paste extrusion PTFE liner referred to as an CLDP. One piece of PTFE liner covers and protects both the inside and outside of the dip pipe. Our advanced manufacturing techniques enable us to produce a dip without any pinched or welded ends eliminating a potential source of failure.

Dip pipes can be supplied straight or curved to precisely position the discharge point of the liquor.

Agitation can create a lot of stress on components installed within a reactor vessel. Mindful of this CRP thoroughly checks that the mechanical strength of the dip pipe will be sufficient in the process conditions.

CRP's range of dip pipes are constructed of the following components:

### Pipe

A pipe, typically Schedule 40 carbon steel pipe without welds, other than to attach the flanges.

### Process Flange

A process flange, welded onto the end of the pipe, allowing it to be connected to the process outside of the vessel.

### Vessel Flange

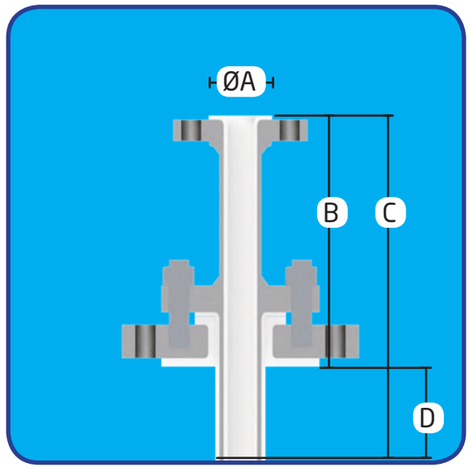
The vessel "flange". This flange is attached part way along the dip pipe to allow it to be connected onto a port in the top of the vessel. With a CLDP it is usually necessary to make the vessel flange from two parts.

(i) a flange welded to the dip pipe itself and shows as welded above

(ii) an adapter flange, bolted to the flange on the dip pipe.

### Adapter Flange

This adapter flange is much the same as a reducing flange, except that its bore is larger than on an equivalent reducing flange, since it has to allow the lined dip pipe through it rather than be the same as the lined bore of the smaller nominal bore size of the reducing flange. Also, they are parallel bore – a tapered bore would be of no benefit. The reason for needing an adapter flange is simply because it is impossible to flare the PTFE on the dip pipe out to the raised face diameter of the vessel nozzle.




A Unique Lining Approach

### Liner

The liner – a single piece of PTFE covering all of the wetted surfaces of the dip pipe itself. The PTFE is manipulated to bend it back on itself to allow this to be done. The main advantage is that there are no welds in the PTFE to act as a weak point in the construction. Please note that the adapter flange is usually PFA moulded.

### General Design

Dip pipes are available in the size range 1" – 6" nominal bore.

They are rated from -29°C to +200°C at full ASME150 line pressure (i.e. same range as for spools).

All dip pipes are full vacuum rated. For 3", 4" and 6" nominal bore an inner vacuum liner is fitted to ensure that the liner doesn't collapse under vacuum at high temperature. We can supply vacuum liners for the smaller dip pipes too, although they are not necessary.

Dip pipes have a single vent hole in the steel pipe, typically equispaced between the vessel and process flanges.

We can offer dip pipes made of stainless steel, and also manufactured from Schedule 80 pipe.

Typically the face-to-face length of a dip pipe is 150mm, although we can make this longer and also somewhat shorter.

The process flange can be fixed (usual) or rotating.

The maximum total length of dip pipe that can be manufacture is about 3000mm.

For lined vessels, the vessel flange usually needs to be two sizes larger than the nominal bore of the dip pipe, although sometimes a dip pipe will fit down a nozzle only one size larger than the dip pipe. (Typically a nozzle is made of Schedule 40 pipe, with approximatly 4mm per side of glass lining. CRP dip pipes are made of Schedule 40 pipe with 3mm per side (approximately) of lining up the outside, and with something of a bull nose at the tip. Usually a one pipe size difference between nozzle and dip pipe is insufficient to cope with these two layers of linings).

Curved dip pipes can be produced (not in 4" or 6" NB), but the curve has to be very gentle (500mm minimum bend radius), and not with a long straight before the start of the curve.

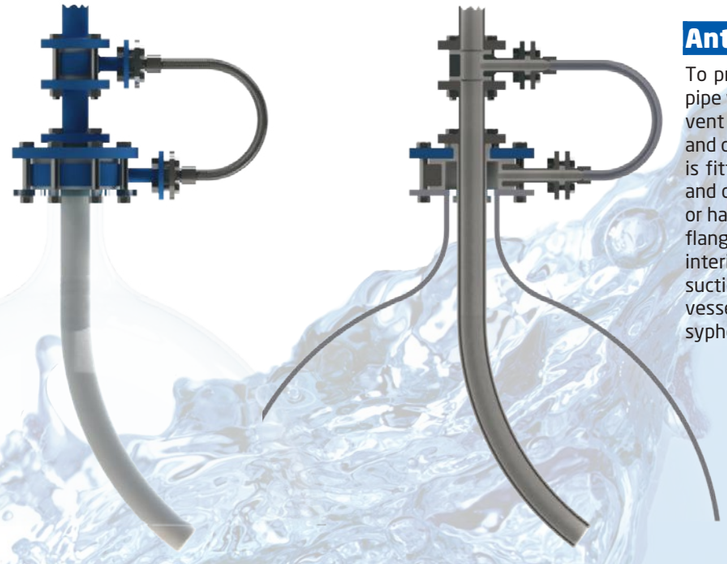
Screwed and pinned construction solid PTFE dip legs are available, enabling the production of a sharp bend or if a spray ball is required.

CRP has stress calculation model for straight dip pipes in agitated vessels.

To assist in determining a specification for a particular dip pipe a questionnaire is available to download from our website.

| Dip Pipe | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Nominal Bore | | Process Flanges Size | Maximum Vessel Flange Size | Process Flange Raised Face | Face to Face Standard | Maximum Total Length | Maximum Immersion Length | |
| Inches | mm | inch | inch | mm | mm | mm | mm | Construction |
| ¾ | 20 | ¾ | 24 | 43 | 150 | 1000 | 850 | FT |
| 1 | 25 | 1 | 24 | 51 | 150 | 3000 | 2850 | FT |
| 1½ | 40 | 1½ | 24 | 73 | 150 | 3000 | 2850 | FT |
| 2 | 50 | 2 | 24 | 92 | 150 | 3000 | 2850 | FT |
| 3 | 80 | 3 | 24 | 127 | 150 | 3000 | 2850 | FT |
| 4 | 100 | 4 | 24 | 157 | 150 | 3000 | 2650 | FT |
| 6 | 150 | 6 | 24 | 216 | 150 | 2000 | 1850 | FT |

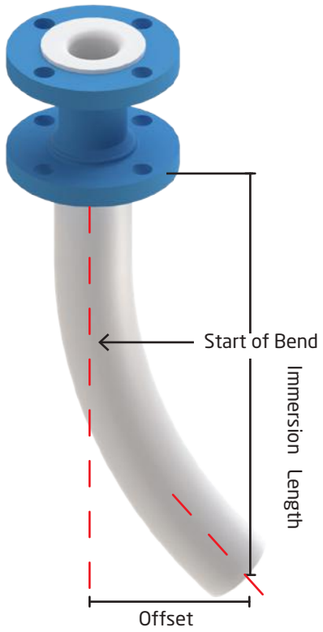
| Construction Codes | | |
|---|---|---|
| Code | Steelwork | Lining |
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

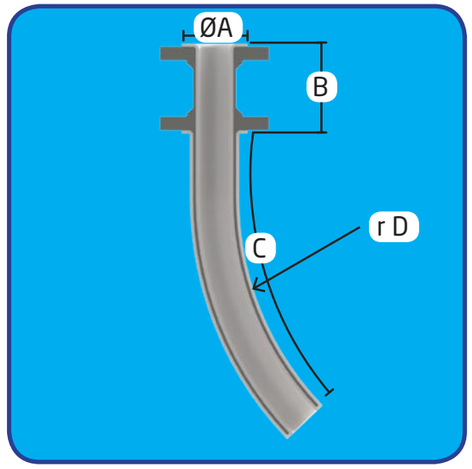


### Anti-syphon System

To prevent liquor being drawn up the dip pipe we can supply anti-siphon systems to vent the dip pipe safely within the reactor and create an air break. An instrument tee is fitted on the top of the process flange and connected to another via a PTFE hose or hard piping to another below the vessel flange and having access to the vessel interior. Under any condition inducing suction gases are drawn from within the vessel rather than the contents being syphoned out.

# Curved CLDP




Curved dip pipes have a variety of uses. They can be used to introduce liquor into a vessel directing it to the side of the vessel wall to lessen the gas bubbles created if directed directly onto the liquid level surface reducing the froth that may be created encouraging a gentler introduction of the media into the vessel. They can also be used to position the discharge close to an agitator blade to provide a very effective mixing of the liquid into the vessel. Where vessels have multiple dip pipes the dip pipe discharges can be positioned to direct flow away from each other to mix effectively with the vessel contents.

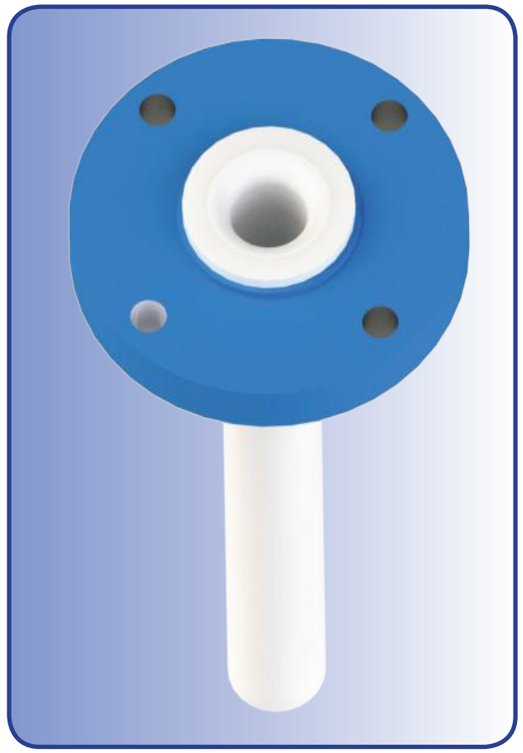
As we are lining curved dip pipes with straight liners we are not able to produce dip pipes with tight radii, we need a gradual curve so that we do not cause deformations and ripples on the inside of the bend. Also consideration has to be taken that that the curved dip pipe will actually fit through the nozzle of the vessel. If the vessel nozzle is not much larger diameter than the dip pipe then the curve will prevent this being inserted through, here again a gradual curve helps in these situations. Please consult us to determine what can be achieved.

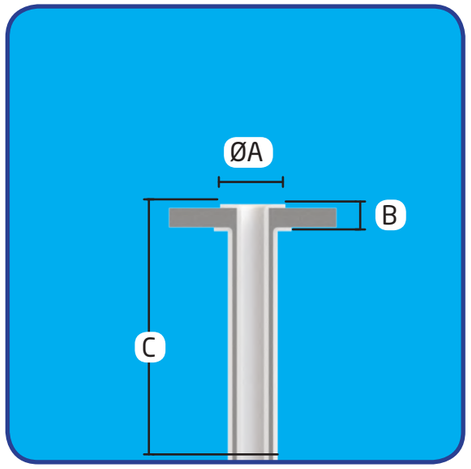
**Curved Dip Pipe**

| Nominal Bore | | Process Flange Size | Maximum Vessel Flange Size | Process Flange Raised Face | Face to Face Standard | Maximum Curve Length | Minimum Bend Radius | |
|---|---|---|---|---|---|---|---|---|
| | | | | Ø A | B | C | r D | |
| Inches | mm | inch | inch | mm | mm | mm | mm | Construction |
| ¾ | 20 | ¾ | 24 | 43 | 150 | 950 | 500 | FT |
| 1 | 25 | 1 | 24 | 51 | 150 | 2900 | 500 | FT |
| 1½ | 40 | 1½ | 24 | 73 | 150 | 2900 | 500 | FT |
| 2 | 50 | 2 | 24 | 92 | 150 | 2900 | 500 | FT |
| 3 | 80 | 3 | 24 | 127 | 150 | 2900 | 500 | FT |
| 4 | 100 | 4 | 24 | 157 | 150 | 2900 | 500 | FT |
| 6 | 150 | 6 | 24 | 216 | 150 | 1900 | 800 | FT |



# Dip Leg






A dip leg is simply a dip pipe without an upstand, this does allow some space saving around a reactor head, If bolting to a reactor vessel flange they typically will have an adaptor flange too as the connection needs to have a large enough bore to allow the lined dip leg to pass through. Dip legs can also be bolted directly to a pipe discharge straight into a tank or vessel without the need for support from a vessel lid etc.

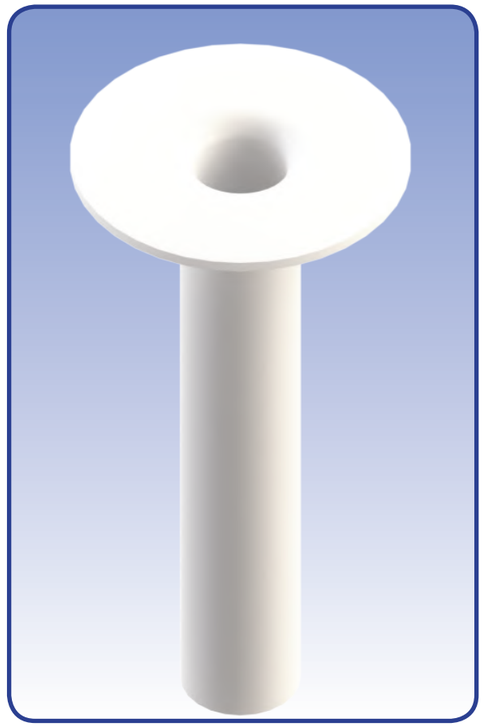
**Dip Leg**

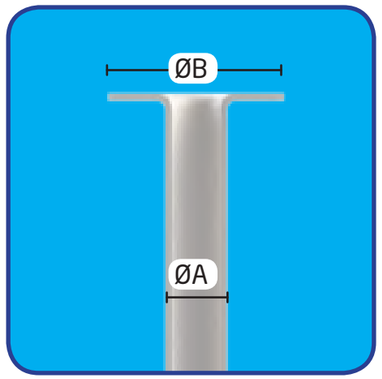
| NB | | Raised Face | Face to Face Standard | Maximum Length | |
|---|---|---|---|---|---|
| | | Ø A | B | C | |
| Inches | mm | mm | mm | mm | Construction |
| ¾ | 20 | 43 | 17 | 1000 | FT |
| 1 | 25 | 51 | 20 | 3000 | FT |
| 1½ | 40 | 73 | 24 | 3000 | FT |
| 2 | 50 | 92 | 25 | 3000 | FT |
| 3 | 80 | 127 | 30 | 3000 | FT |
| 4 | 100 | 157 | 29 | 3000 | FT |
| 6 | 150 | 216 | 34 | 2000 | FT |

Construction Codes

| Code | Steelwork | Lining |
|---|---|---|
| CP | Cast Steel | PFA |
| CT | Cast Steel | PTFE |
| FP | Fabricated Steel | PFA |
| FT | Fabricated Steel | PTFE |

# Entry Pipe






Where there is little need for mechanical strength offered by CRPs lined steel dip pipes, CRP's Entry pipes can be an ideal low cost solution to introduce liquor into a storage vessel etc.. They are manufactured from paste extruded PTFE flared one end to raised face dimensions to connect between suitable mating flanges. They can be supplied in any length up to 6000mm long and generally available in sizes from 1" to 6"NB. Entry pipes are often used to protect the bores of glass lined vessels from mechanical damage, being a sacrificial sleeve. We can supply custom sized liners to ensure correct fit in existing nozzles etc.

| Entry Pipe | | | | | |
|---|---|---|---|---|---|
| NB | | Pipe OD Ø A | Raised Face Ø B | Maximum Length | |
| inches | mm | mm | mm | mm | Material |
| ½ | 15 | 16 | 35 | 6000 | PTFE |
| ¾ | 20 | 21 | 43 | 6000 | PTFE |
| 1 | 25 | 27 | 51 | 6000 | PTFE |
| 1½ | 40 | 41 | 73 | 6000 | PTFE |
| 2 | 50 | 53 | 92 | 6000 | PTFE |
| 3 | 80 | 78 | 127 | 6000 | PTFE |
| 4 | 100 | 102 | 157 | 6000 | PTFE |
| 6 | 150 | 154 | 216 | 6000 | PTFE |
| 8 | 200 | 203 | 270 | 3000 | PTFE |
| 10 | 250 | 254 | 324 | 3000 | PTFE |
| 12 | 300 | 303 | 381 | 3000 | PTFE |
| 14 | 350 | 333 | 413 | 3000 | PTFE |
| 16 | 400 | 381 | 470 | 500 | PTFE |
| 18 | 450 | 429 | 533 | 500 | PTFE |
| 20 | 500 | 478 | 584 | 500 | PTFE |
| 24 | 600 | 575 | 692 | 500 | PTFE |



# Lined Equipment Basics

## A Guide For Those New to Lined Piping

Lined piping is a term generally associated with PTFE and PFA piping systems in which a lining is either fitted or moulded into a metal housing. It should not be confused with line pipe – a term used for steel piping to be used in pipelines and one should also be aware that lined pipe can have other plastic materials acting as the lining.

Lined piping comprises an assembly of individual components, generally connected by bolting flanges together in the field. This is because unlike all metal or plastic systems, the technologies and materials involved does not allow it to be site manufactured. This is not universally true as there are some components designed specifically for field fabrication, but these are used for local convenience and it would be unusual to build a plant from these products.

Each individual component comprises an outer housing – usually of carbon or stainless steel. The purpose of this is to provide the mechanical strength element of the piping system and give a means of connection of adjacent components. It is fair to say that these elements in following international design standards created for standalone steel systems are significantly overspecified in terms of pressure, temperature and vacuum capability. There is no disadvantage in this, however, one does not need to focus on aspects of steelwork integrity such as weld porosity which are not relevant in a lined system. It is much more important to consider the lining itself and therefore obtain an understanding of these materials and processes.

### Lining

Components are then lined in either paste extruded PTFE or PFA. PTFE is generally used for straight lengths of piping (pipe spools) and PFA for pipe fittings – elbows, tees, etcetera. PFA has all of the performance characteristics of PTFE and some more and is suitable for the more complex fittings components, which have branches or require great dimensional precision. Some fittings are lined in paste extruded PTFE where their geometry is simple, especially when Static-Dissipating materials are selected and commercial considerations enable the use of Static-Dissipating PTFE over Static-Dissipating PFA.

### Finishing

The final element is the external finish, which can be a simple primer/finish coat capable of providing some durability in more benign environments, through to high build multi-coat paint systems for the most corrosive environments in coastal chemical plants.

### Configuration

The essential design aspect of lined piping is that the straight spools provide the variable element as it is relatively easy to manufacture these at different lengths, whilst the fittings are manufactured to standard dimensions, which all remain the same within a bore size. This allows interchangeability without complete system redesign and provides the easiest and cheapest way of applying a product that has a complex manufacturing cycle and is unsuited to site running. Changes of direction are most cost-effectively accommodated by having rotating flanges on the pipe spools and fixed flanges on fittings.

## Fluoropolymers

Fluoropolymers are ideal for bulk chemical, agro-chemical, fine and speciality chemical, pharmaceutical and biopharmaceutical processing equipment because they have excellent chemical and thermal resistance. Their molecules have continuous non-reactive surfaces and are compatible with virtually all chemicals and solvents. They are far more resistant to chemical attack than conventional chlorinated and hydrocarbon polymers, and have far higher service temperatures.

There are a number of materials in the Fluoropolymer family. PTFE (Polytetrafluoroethylene) is the original Fluoropolymer, discovered by DuPont in 1938. From this original development there have been a number of other materials developed – trying to improve on the difficult processing characteristics of PTFE. These have been more or less successful, having to trade properties of PTFE in order to attain other characteristics. The principal materials used in the industries that we serve are:

- PTFE
- PFA
- FEP
- PVDF
- ETFE

### PTFE

PTFE is not melt-processable and therefore usually needs to be formed into the required shape prior to sintering.

PTFE comprises both carbon and fluorine atoms, as a straight chain molecule, the carbon backbone being protected by a helix of the fluorine atoms wrapped around it. This carbon fluorine bond is one of the strongest chemical bonds and gives the material its properties of corrosion resistance and non-stick.

### Key Properties of PTFE

#### Chemically Inert

PTFE resists the most aggressive organic and inorganic chemicals and solvents over a broad temperature range. This includes:

- Strong mineral acids
- Inorganic bases
- Inorganic oxidising agents
- Salt solutions
- Aldehydes
- Chlorocarbons
- Organic Acids
- Anhydrides
- Aromatics
- Alcohols
- Ketones
- Esters
- Fluorocarbons
- and Others

#### Electrical Properties

The ability to resist an electrical charge is measured by surface and volume resistivity. In the case of PTFE these figures are colossal. Depending upon how the test work is performed, values in excess of $10^{17}\Omega cm$ are considered minimum. In the case of equipment lined for the chemical and pharmaceutical industry this property can be a nuisance as PTFE lined equipment may build up electrostatic charges and be unable

to dissipate them. This is considered elsewhere in relation to static-dissipating materials.

### Low Friction

PTFE has a very low coefficient of friction and for all calculation purposes it can be considered hydraulically smooth,

### Thermal Stability

PTFE retains useful properties (i.e. not more than 15% loss of chemical resistance) at up to 200°C and sometimes beyond depending upon the application. In fact it has the highest retention of its chemical properties of any known plastic like material. (Please be wary of materials performance data stating that PTFE has an upper service limit of 260°C. This is true in a laboratory situation, but in service most material properties such as mechanical strength will have been lost preventing it from performing a useful duty.)

### PTFE Paste Extrusion

CRP uses the most expensive grades of PTFE to produce the uniquely manufactured HiPerFlon. These are coagulated dispersions, often referred to as fine powders. These have a very close process control of grain size range and are uniquely capable of being sheared by lubricated paste extrusion into a coherent fibrous matrix with useful structural integrity. Pipe liners for the chemical and pharmaceutical industry are almost universally manufactured from HiPerFlon. The paste extrusion process provides the highest level of surface finish, the highest resistance to permeation and the closest dimensional control of all of the methods of lining in PTFE. This serves to differentiate what we manufacture from processing technologies using lower quality and priced materials – being ram extrusion, mandrel wrapping and isostatic moulding.

Paste extrusion however is only suitable for making straight lengths of PTFE tubing colloquially known as pipe liners in our industry. It can be subsequently manipulated into bends and other simple forms, but is not capable of lining complex shapes without joints.

### PFA

PFA (Perfluoroalkoxy) was developed in order to achieve a true melt-processable fluoropolymer. Its characteristics are such that in service it can be considered as interchangeable with PTFE in terms of its chemical service and temperature and pressure duty. It has the highest permeation resistance of the fluoropolymers, exceeding that even of paste extruded PTFE. It also provides the smoothest and least wettable finish of all of the Fluoropolymers. Unfortunately the trade-off is cost, the material being more expensive than PTFE. CRP uses PFA in the production of most of its lined fittings and the Flowserve range of Atomac and Durco valves are available lined in PFA.

### FEP

Standard FEP (Fluorinated Ethylene Propylene) is another melt-processable Fluoropolymer. It does not have the almost universal chemical resistance of PTFE and PFA and its maximum operating temperature in service is 150°C. CRP uses the material occasionally for the manufacture of "sheet lined products". This is essentially a lining made up of sheet and tube elements of FEP welded together in situ. Sheet lining allows one to line complex articles without the use of expensive moulding tools, to cope with the inevitable tolerance errors of welded fabricated steelwork and with the use of bonded linings to provide a degree of vacuum performance. Where the chemical performance and temperature duty are not an issue, the material provides a less expensive alternative to PFA, however it is not used in lined pipe and fittings.

### PVDF

PVDF (Polyvinylidene difluoride) is an engineering fluoropolymer and has a more limited range of chemicals performance and an upper temperature limit of 120°C. It has been replaced in many applications by the improved performance of PTFE resins and is not well supported in the market.

### Materials Suppliers

It is worth stating that CRP only use fluoropolymers from well respected global producers. This provides confidence in the raw materials in terms of their standards, both quality and consistency of materials and product traceability.





## Pressure

The pressure rating of CRP's Class 150 lined piping system is generally driven by the pressure rating of the flanges used. These pressure ratings are detailed in the US standard ASME B16.5, and specifically Class 150 flanges. Within this standard, the pressure rating of flanges is also dependent upon the material of construction, and the operating temperature. Typically, at ambient temperature, the pressure rating of a carbon steel flange is 19.6 bar(g), with stainless steel flanges having a slightly lower pressure rating, the exact values depending upon the grade used. In all cases the pressure rating of flanges also reduces with increasing temperature. Please refer to the pressure temperature curves below for more detail.

### ASME B16.5 Class 300

In reality many chemical processes are much more benign running at only a few bars of pressure. However, if a higher rated pressure system is required, CRP can offer a Class 300 flanged piping system, although the pressure rating in this case is driven by the joint integrity of the PTFE to PTFE flare faces between the flanges, rather than the pressure rating of the flanges themselves. Please consult CRP for more details.

### Exceptions

There are three exceptions to this general rule:

### Blanking Spades

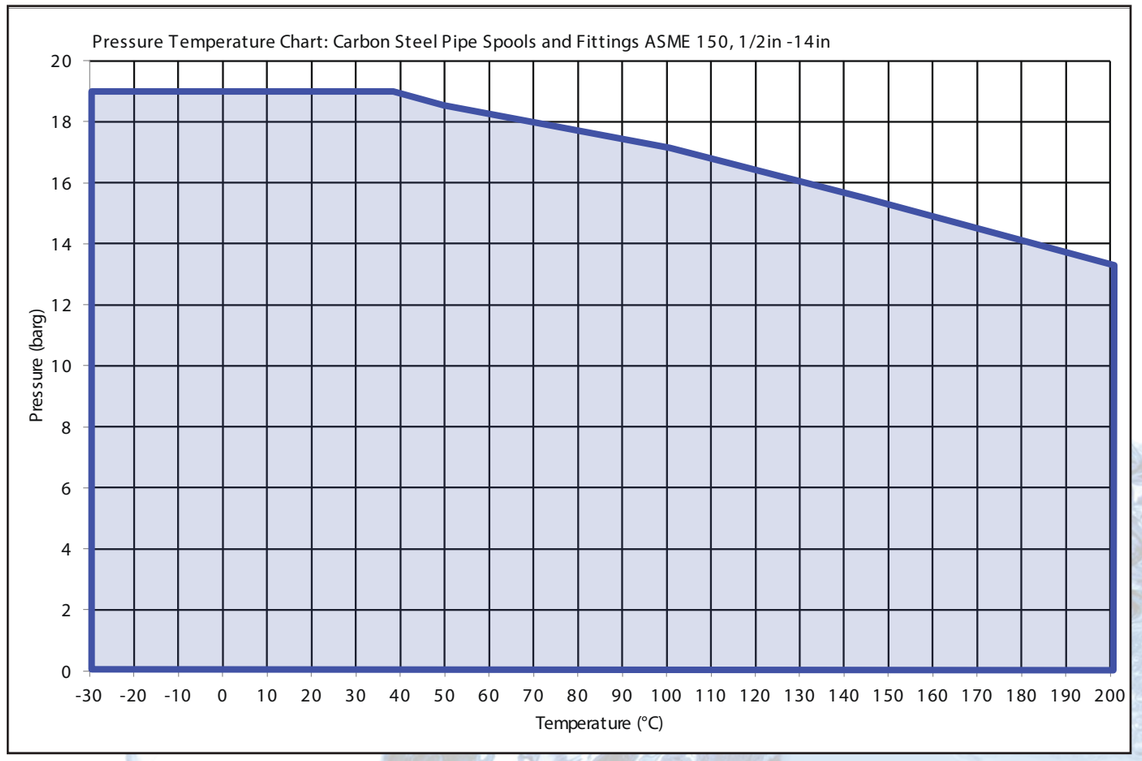
Here the pressure rating is limited due to the necessity to keep the spade thin enough to be fitted between two flanges. Particularly at larger sizes, this significantly limits the allowable pressure.

### Solid PTFE Sliding Blinds

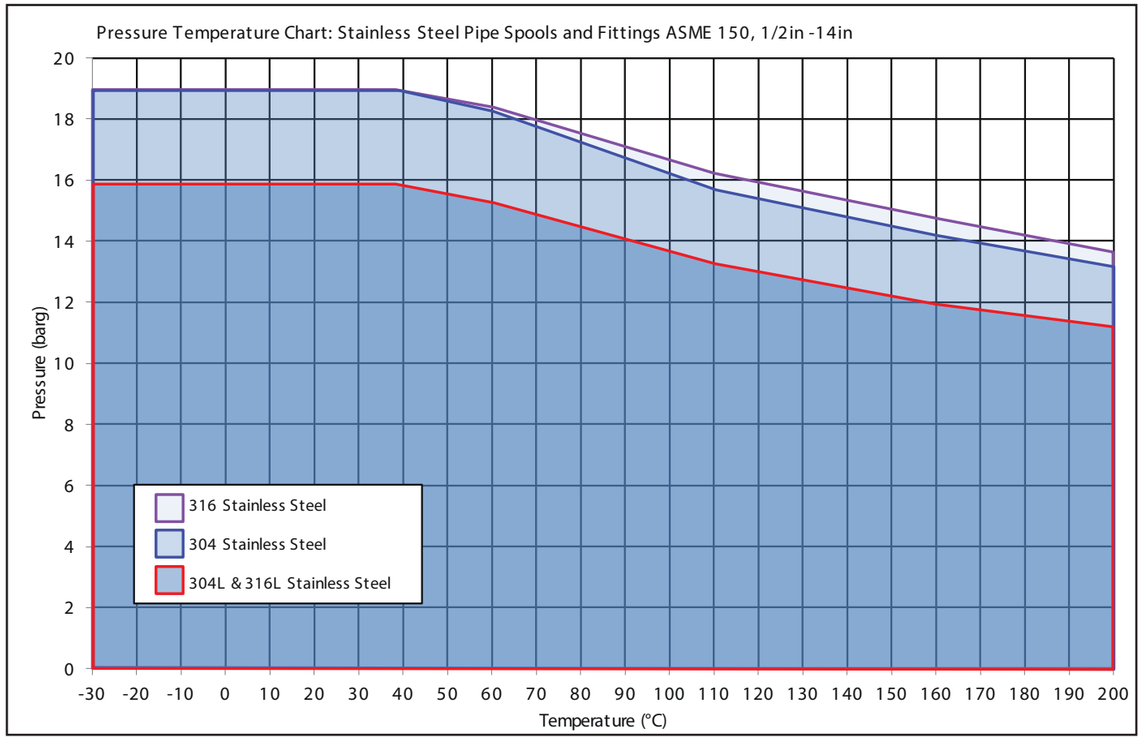
Here the pressure rating is limited by the fact that the strength of these components comes only from PTFE, there is no steel to provide mechanical strength. Once again, particularly at larger sizes, this imposes significant limits on the pressure rating of these components.

### Hose Adapters

In this case the pressure rating is driven by the pressure rating of the hose connection end of the component, which is usually lower than the flange pressure rating.



# Pressure & Temperature




## Temperature

### Lower Temperature Limit

For CRP's standard range of carbon steel lined piping, the lower temperature limit is set by the lower operating temperature of the steel housings, -30°C, as detailed in ASME B31.3. PTFE and PFA are both capable of operating down to cryogenic temperatures, and therefore, if operating temperatures below -30°C are required, CRP can offer lined piping systems manufactured using either low temperature carbon steel housings or, more commonly, using stainless steel housings, which are typically rated to -195°C.

### Upper Temperature Limit

This is determined by the mechanical strength of the PTFE/PFA linings used by CRP. While in laboratory conditions, PTFE and PFA retain excellent corrosion resistant properties up to 260°C, as with all polymers, their mechanical properties reduce with increasing temperature, and their thermal expansion rates far exceed those of steel. The consequence of these two factors is that at temperatures over 200°C, the integrity of the joints between individual lined items becomes questionable, as does their vacuum performance.

When specifying a lined piping system, consideration should also be given to any situations of thermal shock, and the potential for upset conditions (both pressure and temperature).



# Vacuum & Temperature

## Vacuum

Vacuum is the most often ignored aspect of lined piping systems and consequently one of the more common causes of failure.

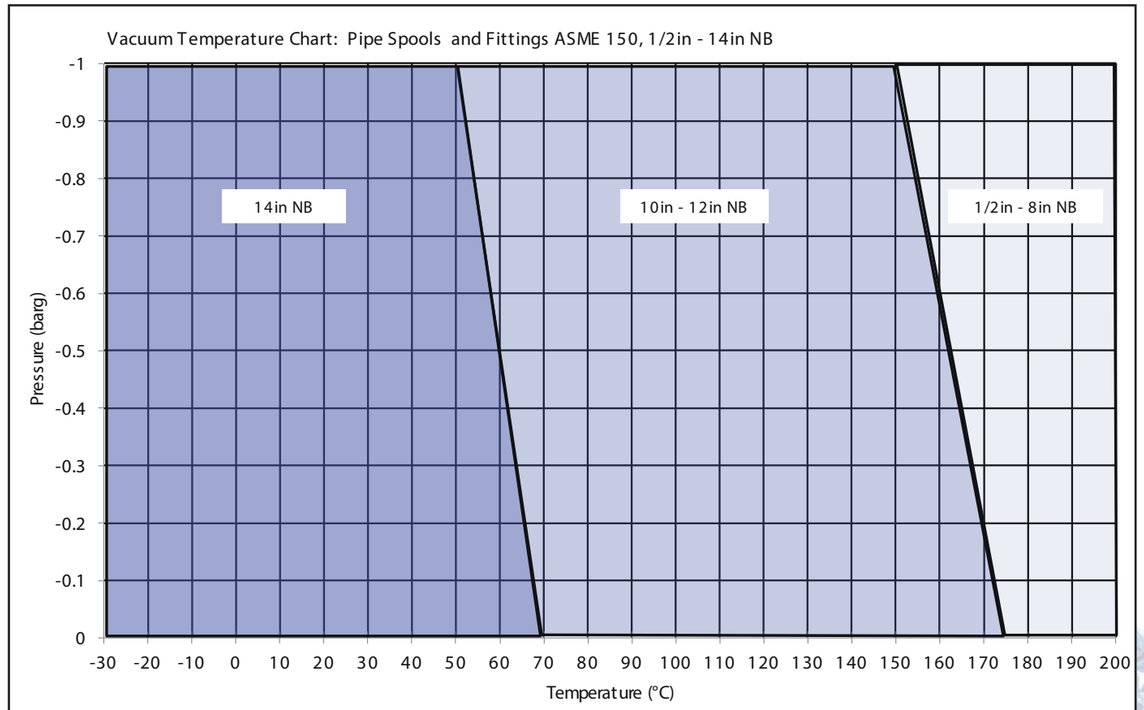
The vacuum performance of a lined piping system is unrelated to the positive pressure rating of the system. Rather it is driven by a combination of: the liner thickness; the degree of interference between the liner and the steel housing; whether the liner is mechanically keyed onto the housing; and operating temperature. In essence, thicker liners provide more hoop strength to the liner and so resist vacuum better.

Secondly, liners that are tight in the bore of the housing have a higher vacuum performance than loose liners. This is because, for a tight liner, the steel housing helps prevent the liner from deforming and collapsing under vacuum.

Thirdly, if a liner is mechanically keyed onto the steel housing (only possible for PFA lined components), this provides additional support for the liner and thus improved vacuum performance.

Fourthly, at higher temperatures, liners have less mechanical strength, and thus a reduced vacuum performance.

By adjusting each of the above factors, CRP's range of lined pipe have the vacuum performance detailed elsewhere in this catalogue.



# Product Materials of Construction

## Materials of Construction

| Product | Item → | Cast/Fabricated | Specification → | Liner | | | | | | Carbon Steel | | | | | | | | Stainless Steel | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Fabrication | | | | | | | Cast | Fabrication | | | | | | | | Cast |
| | | | | Virgin PTFE | Static-dissipating PTFE | Virgin PTFE | Static-dissipating PTFE | Virgin PFA | Static-dissipating PFA | Pipe | Flange | Stub End | Vent Boss | Vent Extension[5] | Body | Wrought Fitting | Profile | Casting | Pipe | Flange | Stub End | Vent Boss | Vent Extension[5] | Body | Wrought Fitting | Profile | Reinforcement | Casting |
| | | | | ASTM D4895 Type I | ASTM D4895 Type I + Carbon | ASTM D4894 | ASTM D4894 + Carbon | ASTM D3307 Type II | ASTM D3307 Type II + Carbon | API 5L Grade B/ASTM A106 Grade B | ASTM A105 | ASTM A516 Grade 60 | Free machining Carbon Steel | Free machining Carbon Steel | ASTM A516 Grade 60 | ASTM A234 Grade WPB | ASTM A516 Grade 60/ ASTM A105 | ASTM A216 Grade WCB | ASTM A312 Grades: 304/304L/316/316L | ASTM A182 Grades:F304/F304L/F316/F316L | ASTM A240 Grades: 304L/316L | ASTM A276 Grades: 304L/316L | ASTM A312 Grades: 304/304L/316/316L | ASTM A403 Grades: 304L/316L | ASTM A240 Grades: 304/304L/316/316L | ASTM A240 Grade 304 | ASTM A351 Grade CF8/CF8M |
| Pipe Spool Van Stone | | F | | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | ✓ | | | | | |
| Welded Construction Fixed/Rotating Pipe Spool | | F | | ✓ | ✓ | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | |
| Welded Construction Fixed/Fixed Pipe Spool | | F | | ✓ | ✓ | | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | ✓ | ✓ | ✓ | ✓ | ✓ | | | | | |
| Field Flare | | F | | | | | | | | | | | | | | | | | | | | | | | | | |
| Spacer Type 1 | | - | | | | ✓ | ✓ | | | | | | | | | | | | | | | | | | | | |
| Spacer Type 2 | | - | | ✓ | ✓ | | | | | | | | | | | ✓ | | | | | | | ✓ | | | | |
| Spacer Type 3 | | - | | ✓ | ✓ | | | | | ✓ | | ✓ | | | | | | ✓ | | ✓ | | | | | | | |
| 90° Elbow | | C | | | ✓ | | | ✓ | | | | | | ✓ | | | | ✓ | | | ✓ | | | | | | ✓ |
| 90° Elbow | | F | | ✓ | ✓ | | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | ✓ | | | |
| 90° Elbow 3D | | F | | ✓ | ✓ | | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | ✓ | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | ✓ | | | |
| 90° Elbow 5D | | F | | ✓ | ✓ | | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | | |
| 45° Elbow | | C | | ✓ | ✓ | | | | | | | | | ✓ | | | | ✓ | | | | ✓ | | | | | ✓ |
| 45° Elbow | | F | | ✓ | ✓ | | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | | |
| Equal Tee | | C | | | | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | ✓ | | | | | ✓ |
| Equal Tee | | F | | | | | | ✓ | ✓ | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | | |
| Reducing Tee | | C | | | | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | ✓ | | | | | ✓ |
| Reducing Tee | | F | | | | | | ✓ | ✓ | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | | |
| Short Stack Tee | | C | | | | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | ✓ | | | | | |
| Short Stack Tee | | F | | | | | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | ✓ | ✓ | | ✓ | ✓ | | | | | |
| Strainer Tee | | C | | | | ✓[1] | ✓[1] | ✓ | ✓ | | | | ✓ | ✓ | | | | ✓ | | | | ✓ | | | | | ✓ |
| Equal Lateral Tee | | C | | | | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | | | | | | |
| Equal Lateral Tee | | F | | | | | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ | | | | |
| Reducing Lateral Tee | | C | | | | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | | | | | | |
| Reducing Lateral Tee | | F | | | | | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ | | | | |
| Instrument Tee | | C | | | | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | | | | | | ✓ |
| Instrument Tee | | F | | | | | | ✓ | ✓ | ✓ | ✓ | ✓[4] | | ✓ | ✓ | | | | ✓ | ✓ | ✓[4] | | ✓ | ✓ | | | |
| Double Branch Instrument Tee | | F | | | | | | ✓ | ✓ | ✓ | ✓ | ✓[4] | | ✓ | ✓ | | | | ✓ | ✓ | ✓[4] | | ✓ | ✓ | | | |
| Equal Cross | | C | | | | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | | | | | | |
| Equal Cross | | F | | | | | | ✓ | ✓ | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | |
| Reducing Cross | | F | | | | | | ✓ | ✓ | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | |
| Short Stack Cross | | F | | | | | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | | | | ✓ | ✓ | | ✓ | ✓ | | | | |
| Concentric Reducer | | C | | ✓[2] | ✓[2] | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | ✓ | | | | | ✓ |
| Concentric Reducer | | F | | ✓ | ✓ | | | ✓[3] | ✓[3] | ✓ | ✓ | ✓[4] | ✓ | ✓ | | ✓ | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | ✓ | | | |
| Reducing Flange Taper Bore | | F | | ✓[2] | ✓[2] | | | ✓ | ✓ | | | | | ✓ | | ✓ | | | | | | | ✓ | | | ✓ | |
| Reducing Flange Parallel Bore | | F | | ✓ | ✓ | | | ✓[3] | ✓[3] | | | | | ✓ | | ✓ | | | | | | | ✓ | | | ✓ | |
| Eccentric Reducer | | C | | ✓[2] | ✓[2] | | | ✓ | ✓ | | | | | ✓ | | | | ✓ | | | | | | | | | |
| Eccentric Reducer | | F | | ✓ | ✓ | | | ✓[3] | ✓[3] | ✓ | ✓ | ✓[4] | ✓ | ✓ | | | | | ✓ | ✓ | ✓[4] | ✓ | ✓ | | ✓ | | |
| Blank Flange | | - | | | ✓ | ✓ | | | | | ✓ | | | | | | | | | ✓ | | | | | | | |
| Blanking Spade | | - | | | ✓ | ✓ | | | | | | | | | | | | | | | | | | | | ✓ | |
| Orifice Plate | | - | | | ✓ | ✓ | ✓[5] | ✓[5] | | | | | | | | | ✓[5] | | | | | | | | | ✓[5] | |
| Sliding Blind | | - | | | ✓ | ✓ | | | | | | | | | | | | | | | | | | | | | |
| Spectacle Blind | | - | | ✓ | ✓ | ✓ | ✓ | ✓[5] | ✓[5] | | | | | | | | ✓ | | | | | | | | | ✓ | |
| Toughgask | | - | | | | ✓ | | | | | | | | | | | | | | | | | | | | | ✓ |

1 - Strainer Plate
2 - Certain reductions may be PTFE Lined
3 - Certain reductions may be PFA Lined
4 - For fabricated fittings stub ends are only used with rotating flanges
5 - Optional component



# PTFE and PFA Material Properties

## PTFE and PFA Material Properties

| | Units | Virgin PTFE (paste extruded) [ASTM D4895 Type I] (Grades A or B) | Static Dissipating PTFE (paste extruded) [ASTM D4895 Type I] (Grades A or B) | Virgin UHP PTFE (paste extruded) [ASTM D4895 Type I] (Grades A or B) | Virgin PFA [ASTM D3307 Type II] | Static Dissipating PFA |
|---|---|---|---|---|---|---|
| **Mechanical** | | | | | | |
| Minimum Tensile Strength | MPa | 20.7 | 20.7 | 20.7 | 26.2 | 26.2 |
| Minimum Elongation at Break | % | 250 | 250 | 250 | 300 | 300 |
| Hardness | Shore D | 55-60 | 55-60 | 55-61 | 55 | 55 |
| **Physical** | | | | | | |
| Specific Gravity | | 2.16-2.19 | 2.16-2.19 | 2.16-2.19 | 2,12-2,17 | 2,12-2,17 |
| Melt Flow Rate when tested to ASTM D3307 at 372°C | g/10 min | n/a | n/a | n/a | 2 | 1.8-2.5 |
| Liner Colour | | White | Black | White | Translucent | Black |
| Water Absorption | % | < 0.01 | < 0.01 | < 0.02 | <0.03 | <0.03 |
| FDA Compliant | | Yes | Yes | Yes | Yes | No |
| **Thermal** | | | | | | |
| Thermal Conductivity | W/(m·k) | 0.25 | 0.25 | 0.25 | 0.19 | 0.19 |
| **Coefficient of Linear Thermal Expansion** | | | | | | |
| 25°C to 100°C | mm/mm.K | $124x10^{-6}$ | $124x10^{-6}$ | $109x10^{-6}$ | | |
| 25°C to 150°C | mm/mm.K | $135x10^{-6}$ | $135x10^{-6}$ | $141x10^{-6}$ | | |
| 25°C to 200°C | mm/mm.K | $151x10^{-6}$ | $151x10^{-6}$ | $141x10^{-6}$ | | |
| 21°C to 100°C | mm/mm.K | | | | $140x10^{-6}$ | $140x10^{-6}$ |
| 100°C to 150°C | mm/mm.K | | | | $180x10^{-6}$ | $180x10^{-6}$ |
| 150°C to 208°C | mm/mm.K | | | | $220x10^{-6}$ | $220x10^{-6}$ |
| Flammability | | Non Flammable | | | | |
| **Electrical** | | | | | | |
| Volume Resistivity | Ω.m | $>10^{16}$ | - | $10^{18}$ | $10^{16}$ | 0,15-0,25 |
| Surface Resistivity | Ω/£ | $10^{17}$ | $<10^{9}$ | $10^{17}$ | $10^{17}$ | Unavailable |

# PTFE Liner Dimensions

| PTFE Liner Dimensions | | | | | | | |
|---|---|---|---|---|---|---|---|
| Nominal Bore | | | Outside Diameter[2] | | Wall Thickness | | Weight |
| Inches | mm | Liner Type | Nominal mm | Tolerance +/-mm | Nominal mm | Tolerance +/-mm | Per metre kg |
| ½[1] | 15 | Heavy Duty Virgin & Static Dissipating | 25 | 1.0 | 2.3 | 0.2 | 0.5 |
| ¾ | 20 | | 25 | 1.0 | 2.3 | 0.2 | 0.5 |
| 1 | 25 | | 29 | 1.0 | 3.2 | 0.2 | 0.6 |
| 1½ | 40 | | 44 | 1.0 | 3.2 | 0.2 | 0.9 |
| 2 | 50 | | 55 | 1.5 | 3.2 | 0.2 | 1.2 |
| 3 | 80 | | 82 | 1.5 | 3.2 | 0.2 | 1.0 |
| 4 | 100 | | 107 | 3.0 | 4.5 | 0.2 | 3.5 |
| 6 | 150 | | 159 | 3.0 | 5.5 | 0.2 | 6.8 |
| 8 | 200 | | 208 | 3.0 | 8.5 | 0.2 | 13.1 |
| 10 | 250 | | 259 | 4.0 | 9.1 | 0.2 | 15.9 |
| 12 | 300 | | 319 | 5.0 | 10.4 | 0.4 | 23.4 |
| 14 | 350 | | 343 | 5.0 | 8.3 | 0.2 | 21.6 |
| ½[1] | 15 | UltraHiPerFlon® Superweight Virgin UHP | 25 | 1.0 | 2.3 | 0.2 | 0.5 |
| ¾ | 20 | | 25 | 1.0 | 2.3 | 0.2 | 0.5 |
| 1 | 25 | | 29 | 1.0 | 4.5 | 0.2 | 0.8 |
| 1½ | 40 | | 43 | 1.0 | 4.5 | 0.2 | 1.3 |
| 2 | 50 | | 54 | 1.0 | 4.5 | 0.2 | 1.7 |
| 3 | 80 | | 81 | 1.5 | 4.8 | 0.2 | 2.5 |
| 4 | 100 | | 107 | 1.5 | 5.0 | 0.2 | 3.5 |
| 6 | 150 | | 159 | 1.5 | 6.0 | 0.2 | 6.8 |
| 8 | 200 | UltraHiPerFlon® Heavy Duty UHP | 208 | 3.0 | 8.5 | 0.2 | 13.1 |
| 10 | 250 | | 259 | 4.0 | 9.1 | 0.2 | 15.9 |
| 12 | 300 | | 319 | 5.0 | 10.4 | 0.4 | 23.4 |
| 14 | 350 | | 343 | 5.0 | 8.3 | 0.2 | 21.6 |

1 - 1/2in liners are too small, so a 3/4in size is used.
2 - When supplied as a separate pipe liner, NB when fitted into a steel pipe the liner will take on the id of the pipe.



# PFA Lining Dimensions

The nature of PFA mouldings are such that the lining thickness is very dependent upon the internal diameter of the steelwork, whose standards give rise to large tolerances, therefore these are expressed as minimums.

| PFA Lining Dimensions | | | |
|---|---|---|---|
| Nominal Bore | | Wall Thickness | |
| Inches | mm | Nominal mm | Minimum mm |
| ½ | 15 | 3.5 | 1.8 |
| ¾ | 20 | 3.5 | 1.8 |
| 1 | 25 | 3.5 | 2.4 |
| 1½ | 40 | 4.0 | 2.8 |
| 2 | 50 | 4.3 | 3.2 |
| 3 | 80 | 6.0 | 4.8 |
| 4 | 100 | 8.2 | 6.8 |
| 6 | 150 | 8.6 | 6.9 |
| 8 | 200 | 9.5 | 7.6 |
| 10 | 250 | 10.2 | 8.0 |
| 12 | 300 | 10.1 | 7.6 |
| 14 | 350 | 9.8 | 7.0 |

# Spool & Fitting Bores

Please note that because of the method of manufacture and tolerances on steel materials these are a guide. Please consult if you require a precise dimension for instrument, mixer or other insertion or a calibrated volume.

| Spool and Fitting Bores | | | | |
|---|---|---|---|---|
| | | Nominal Lined Bore Diameters | | |
| | | Pipe Spool/PTFE Lined Fitting | | Lined Fitting |
| Nominal Bore | | Heavy Duty | Superweight | PFA |
| Inches | mm | mm | mm | mm |
| ½ | 15 | 16 | 16 | 12 |
| ¾ | 20 | 16 | 16 | 12 |
| 1 | 25 | 20 | 18 | 20 |
| 1½ | 40 | 34 | 32 | 33 |
| 2 | 50 | 46 | 44 | 44 |
| 3 | 80 | 70 | 68 | 66 |
| 4 | 100 | 93 | 91 | 86 |
| 6 | 150 | 143 | 142 | 137 |
| 8 | 200 | 188 | - | 186 |
| 10 | 250 | 247 | - | 237 |
| 12 | 300 | 286 | - | 287 |
| 14 | 350 | 319 | - | 317 |

# Materials Contact Compliance

## Virgin PTFE and PFA Resins

CRP only uses virgin Polytetrafluoroethylene (PTFE) and Perfluoroalkoxy (PFA) resins that have the following status relative to food contact regulations.

### European Union

Compliance with European Regulation EU No.10/2011 as amended. We can confirm that the raw materials and the subsequent products manufactured have been produced according to a quality management system which complies with the requirements of European Regulation EC No.2023/2006 on good manufacturing practice for materials and articles intended to come into contact with food.

### United States of America

Compliance with U.S. FDA 21 CFR 177.1550 (a)(2) and (b) Perfluorocarbon resins.

## Static-Dissipating PTFE Resin

CRP also declares that the high purity furnace black used in the manufacture of static dissipating PTFE products has the following status relative to food contact regulations.

### European Union

Compliance with European Regulation EU No.10/2011 as amended. We can confirm that the raw materials and the subsequent products manufactured have been produced according to a quality management system which complies with the requirements of European Regulation EC No.2023/2006 on good manufacturing practice for materials and articles intended to come into contact with food.

### United States of America

Compliance with U.S. FDA 21 CFR 178.3297 Colorants for polymers. We can confirm that the formulated carbon black levels do not exceed 2.5% by weight.

## Static-Dissipating PFA

The carbon used in creating the static-dissipating properties of this PFA is not FDA compliant and nor does the amount used fall under the minimum percentage for compliance. At present there is no FDA compliant material available.

# Static-Dissipating PTFE Performance

An independent inspection company and a specialist technical consultancy conducted the following tests with results.

### Resistance Test

Measure BS2050 A4.5 modifed for PTFE

Result- Measured resistance $2x10^{6}\Omega$

### Resistivity Tests

#### Surface Resistivity

This is the resistance to leakage of a charge across a square area of surface.

Tested at ambient temperature and 50% relative humidity

Result - Measured value (inside liner) $1.8x10^{4}\Omega m$

#### Volume Resistivty

This is the internal resistance of an insulating material to current flow. High volume resistivity guarantees that the material acts as an insulator and low volume resistivity demonstrates that the material is a conductor.

Tested at ambient temperature and 50% relative humidity.

Result - Measured value $2.1 \times 10^{4}\Omega m$

### Classification

The materials are classified as static-dissipative or anti-static and far exceed the minimum requirements. CRP's static disspating materials exceed the requirements of the specification EDS. PIP.53.04A June 1989.

# PTFE & PFA Material Standards

### ASTM D4895 Type I: Standard Specification for Polytetrafluoroethylene : PTFE : Resin Produced From Dispersion

This is the most common global raw material specification for PTFE polymers which are produced by the controlled coagulation of dispersions. These PTFE's are called "Coagulated Dispersions, Fine Powders or Paste Polymers" and are much more precisely controlled than the coarse granular materials. These types of PTFE are almost always mixed with a volatile processing aid and are used to make high quality extrusions. Type I grades are suitable for extruding the thick walled liners suitable for lining steel pipes.

### ASTM D4894:Standard Specification for Polytetrafluoroethylene : PTFE: Granular Molding and Ram Extrusion Materials

This is the most common global raw material specification for PTFE polymers used to make isostatically moulded PTFE lined pipework, ram extruded PTFE items and billets of PTFE which are machined to produce finished components. This is not a preferred material for lined piping components other than those machined from soild.



# Materials Standards

### ASTM D3307 Type II:Standard Specification for Perfluoroalkoxy :PFA:-Fluorocarbon Resin Molding and Extrusion Materials

This is the most common global raw material specification for the various types of PFA polymers giving full details of the physical and mechanical attributes of the PFA both as supplied by the manufacturer and after processing. The specification also contains details of test methods to be used for PFA polymers.

### Type II

In common with most ASTM Standard Specifications for materials ASTM D3307 is divided into many grades or in this case 13 types each destined for a different application. A type reference determines the mechanical and thermal properties of a particular grade or type. Whilst the mechanical properties are important it is the thermal properties which have the most significance when PFA is used as a corrosion resistant lining material. Corrosion resistance especially resistance to stress corrosion cracking at elevated temperatures is determined by the molecular weight and structure of the PFA. The best lining materials have high molecular weights and are renowned for their extraordinarily high viscosity even when they are fully melted. It is a measure of the viscosity when melted referred to as melt flow index which is the principal method of determining a 'type' of PFA. The lower the melt flow index the greater the melt viscosity and performance in highly aggressive situations. CRP only uses PFA classified to type II which has the lowest melt flow index of all the PFA grades.

# Steelwork Material Standards

### API 5L Grade B:Specification for Lined Pipe

Material specification and some dimensional standards and tolerances for steel pipe. This is the most common standard for steel pipe and is readily recognised throughout the Petrochemical industry. This specification is widely used in the Grade B form as the standard pipe material for Lined Pipe and Fittings manufacture. It is now quite common to see steel pipes dual certified to this specification and to ASTM A106 Grade B.

### ASTM A106 Grade B:Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

Material specification often seen as a combined specification with API 5L Grade B. Grade B is the most widely used of the three grades steel pipe referred to in ASTM A106. The term grade B determines the chemical composition and mechanical performance of the steel used to make the pipe.

### ASTM A105: Carbon Steel Forgings for Piping Applications

Material specification for forgings - in our case flanges.

### ASTM A182 Grades: F304/F304L/ F316/F316L/ Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service

Material specification for stainless flanges.

### ASTM A216 Grade WCB: Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

A material specification covering both performance and composition. Grade WCB is used by CRP in their investment castings for the majority of their PFA lined fittings.

### ASTM A234 Grade WPB: Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service

Material specification. This standard covers wrought carbon steel fittings which are manufactured to the dimensional specifications of ASME B16.9 used in the fabrication of our flanged pipe fittings.

Grade WPB is the grade usually used for lined pipe and fittings.

### ASTM A240 Grades: 304/304L/316/316L: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

Material specification. Stainless steel to this specification is used where plate materials are required in the manufacture of pipe spool stub ends, reducing flanges and bespoke flanges - anywhere plate may be used.

### ASTM A276 Grades: 304L/316L: Standard Specification for Stainless Steel Bars and Shapes

A material specification used for machined components.

### ASTM A312 Grades: 304/304L/316/316L: Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes

### /Specification for Castings, Austenitic, for Pressure-Containing Parts

### ASTM A403 Grades:304L/316L/ Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

Material specification for stainless fittings used in fabricating pipe fittings.

### ASTM A516 Grade 60: Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service

A material specification. Steel to this specification is used where plate materials are required in the manufacture of pipe spool stub ends, reducing flanges and bespoke flanges - anywhere plate may be used. There are four grades specified in the standard with different composition and mechanical properties. Grade 60 is the most widely used for CRP's products.

### BS970 Grade 080M40(Free Machining Carbon Steel): Specification for wrought steels for mechanical and allied engineering purposes. General inspection and testing procedures and specific requirements for carbon, carbon manganese, alloy and stainless steels

A material specification used for machined components.

# Steelwork Dimensional Standards

### ASME B36.10 Welded and Seamless Wrought Steel Pipe

Dimensional standard for carbon steel pipe. This covers the outside diameter of pipes, as well as the various standard wall thicknesses, described as the pipe schedules.

### ASME B16.9: Factory-Made Wrought Buttwelding Fittings

Dimensional standard for the wrought fittings used in the fabrication of our flanged pipe fittings.

| Carbon Steel Pipe Dimensions to ASME B36.10 | | | | | |
|---|---|---|---|---|---|
| Nominal Bore | | Pipe Schedule[1] | Outside Diameter[2] | Wall Thickness[2] | Inside Diameter[2] |
| Inches | mm | | mm | mm | mm |
| ½[3] | 15 | 40 | 26.7 | 2.9 | 20.9 |
| ¾ | 20 | 40 | 26.7 | 2.9 | 20.9 |
| 1 | 25 | 40 | 33.4 | 3.4 | 26.6 |
| 1½ | 40 | 40 | 48.3 | 3.7 | 40.9 |
| 2 | 50 | 40 | 60.3 | 3.9 | 52.5 |
| 3 | 80 | 40 | 88.9 | 5.5 | 77.9 |
| 4 | 100 | 40 | 114.3 | 6.0 | 102.3 |
| 6 | 150 | 40 | 168.3 | 7.1 | 154.1 |
| 8 | 200 | 30 | 219.1 | 7.0 | 205.1 |
| 10 | 250 | 30 | 273.0 | 7.8 | 257.4 |
| 12 | 300 | 30 | 323.9 | 8.4 | 307.1 |
| 14 | 350 | 30 | 355.6 | 9.5 | 336.6 |
| 16 | 400 | Std | 406.4 | 9.5 | 387.4 |
| 18 | 450 | Std | 457.2 | 9.5 | 438.2 |
| 20 | 500 | Std | 508.0 | 9.5 | 489.0 |
| 24 | 600 | Std | 609.6 | 9.5 | 590.6 |

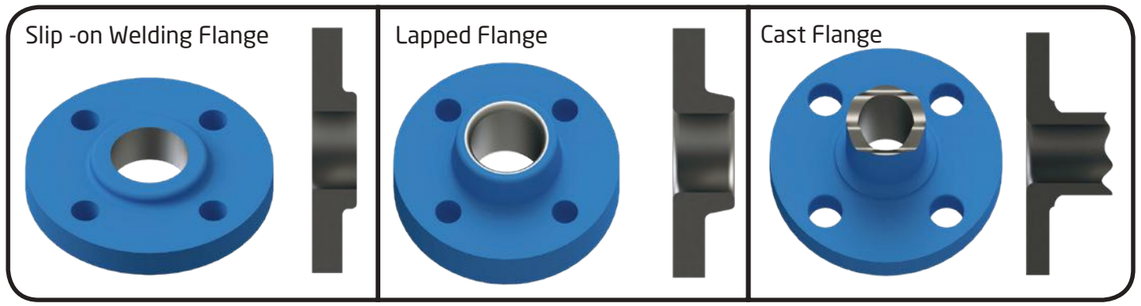
1 - All carbon steel spools and fabricated fittings use the same pipe schedule.
2 - All dimensions are nominal.
3 - For 1/2 inch NB lined pipe and fittings 3/4 inch NB pipe is used.

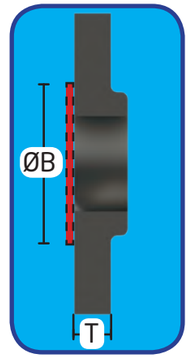
| Stainless Steel Pipe Dimensions to ASME B36.19 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Spools | | | Fittings | | |
| Nominal Bore | | Outside Diameter[1] | Pipe Schedule[2] | Wall Thickness[1] | Inside Diameter[1] | Pipe Schedule[2] | Wall Thickness[1] | Inside Diameter[1] |
| Inches | mm | mm | | mm | mm | | mm | mm |
| ½[3] | 15 | 26.7 | 10 | 2.2 | 22.3 | 40 | 2.8 | 21.1 |
| ¾ | 20 | 26.7 | 10 | 2.2 | 22.3 | 40 | 2.9 | 20.9 |
| 1 | 25 | 33.4 | 10 | 2.8 | 27.9 | 40 | 3.4 | 26.6 |
| 1½ | 40 | 48.3 | 10 | 2.8 | 42.7 | 40 | 3.7 | 40.9 |
| 2 | 50 | 60.3 | 10 | 2.8 | 54.8 | 40 | 3.9 | 52.5 |
| 3 | 80 | 88.9 | 10 | 3.1 | 82.8 | 40 | 5.5 | 77.9 |
| 4 | 100 | 114.3 | 10 | 3.1 | 108.2 | 40 | 6.0 | 102.3 |
| 6 | 150 | 168.3 | 10 | 3.4 | 161.5 | 40 | 7.1 | 154.1 |
| 8 | 200 | 219.1 | 10 | 3.8 | 211.6 | 30 | 7.0 | 205.1 |
| 10 | 250 | 273.0 | 10 | 4.2 | 264.6 | 30 | 7.8 | 257.4 |
| 12 | 300 | 323.9 | 10 | 4.6 | 314.8 | 30 | 8.4 | 307.1 |
| 14 | 350 | 355.6 | 10 | 4.8 | 346.0 | 30 | 9.5 | 336.6 |

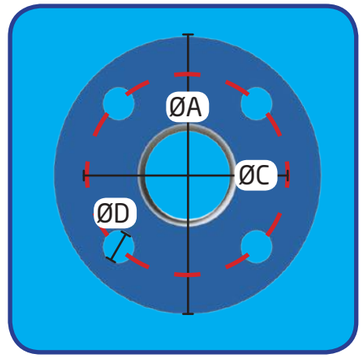
1 - All dimensions nominal.
2 - Pipe schedule varies between spools and fabricated fittings as detailed.
3 - For 1/2 inch NB lined pipe and fittings 3/4 inch NB pipe is used.





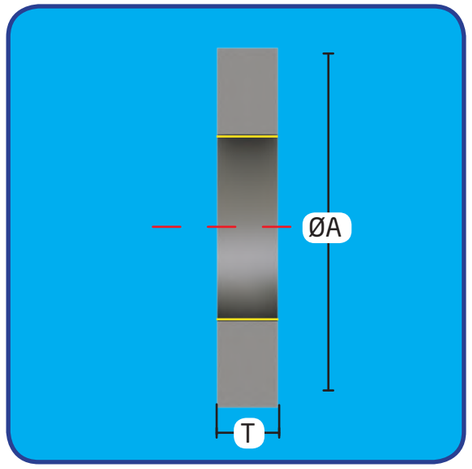



| Steel Flange Dimensions[1] ASME B16.5 Class 150 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Flange Thickness (Min) | | | | | | | |
| Nominal Bore | | Flange | Raised Face[2] | Slip-on Welding Flange[3] | Lapped Flange | Cast Flange | Pitch Circle | Bolt Holes | Bolt Hole | UNC Bolt Size | Metric Equivalent Bolt |
| | | Ø A | Ø B | T | | | Ø C | | Ø D | | |
| Inches | mm | mm | mm | mm | | | mm | Qty | mm | Inches | M Size |
| ½ | 15 | 90 | 34.9 | 9.60 | 11.2 | 8.0 | 60.3 | 4 | 15.9 | ½ | M12/M14[4] |
| ¾ | 20 | 100 | 42.9 | 11.20 | 12.7 | 8.9 | 69.9 | 4 | 15.9 | ½ | M12/M14[4] |
| 1 | 25 | 110 | 50.8 | 12.70 | 14.3 | 9.6 | 79.4 | 4 | 15.9 | ½ | M12/M14[4] |
| 1½ | 40 | 125 | 73.0 | 15.90 | 17.5 | 12.7 | 98.4 | 4 | 15.9 | ½ | M12/M14[4] |
| 2 | 50 | 150 | 92.1 | 17.50 | 19.1 | 14.3 | 120.7 | 4 | 19.1 | ⅝ | M16 |
| 3 | 80 | 190 | 127.0 | 22.30 | 23.9 | 17.5 | 152.4 | 4 | 19.1 | ⅝ | M16 |
| 4 | 100 | 230 | 157.2 | 22.30 | 23.9 | 22.3 | 190.5 | 8 | 19.1 | ⅝ | M16 |
| 6 | 150 | 280 | 215.9 | 23.90 | 25.4 | 23.9 | 241.3 | 8 | 22.2 | ¾ | M20 |
| 8 | 200 | 345 | 269.9 | 27.00 | 28.6 | 27.0 | 298.5 | 8 | 22.2 | ¾ | M20 |
| 10 | 250 | 405 | 323.8 | 28.60 | 30.2 | 28.6 | 362.0 | 12 | 25.4 | ⅞ | M24 |
| 12 | 300 | 485 | 381.0 | 30.20 | 31.8 | 30.2 | 431.8 | 12 | 25.4 | ⅞ | M24 |
| 14 | 350 | 535 | 412.8 | 33.40 | 35.0 | 33.4 | 476.3 | 12 | 28.6 | 1 | M27 |
| 16 | 400 | 595 | 469.9 | 35.00 | 36.6 | 35.0 | 539.8 | 16 | 28.6 | 1 | M27 |
| 18 | 450 | 635 | 533.4 | 38.10 | 39.7 | 38.1 | 577.9 | 16 | 31.8 | 1⅛ | M30 |
| 20 | 500 | 700 | 584.2 | 41.30 | 42.9 | 41.3 | 635.0 | 20 | 31.8 | 1⅛ | M30 |
| 24 | 600 | 815 | 692.2 | 46.10 | 47.7 | 46.1 | 749.3 | 20 | 34.9 | 1¼ | M30 |

1 - All dimensions exclude liner thicknesses.
2 - Steel raised faces are not usually relevant in lined piping as it is the PTFE or PFA raised face that is critical. Steel raised faces may be retained or may be machined from proprietary flanges to suit production methods. Face to face and centreline to face dimensions will take account of this.
3 - Flange thickness excluding raised face.
4 - As standard CRP would assume M12 bolting, but M14 can be accomodated if required.




| Stub End Dimensions | | | | |
|---|---|---|---|---|
| Nominal Bore | | Stub End[1] | Stub End Thickness[2] | |
| | | ØA | T | Weight |
| Inches | mm | mm | mm | kg |
| ½ | 15 | 44 | 10 | 0.1 |
| ¾ | 20 | 54 | 12 | 0.2 |
| 1 | 25 | 64 | 12 | 0.3 |
| 1½ | 40 | 83 | 12 | 0.4 |
| 2 | 50 | 102 | 14 | 0.7 |
| 2½ | 65 | 121 | 14 | 0.8 |
| 3 | 80 | 133 | 16 | 1.2 |
| 4 | 100 | 171 | 16 | 1.9 |
| 5 | 125 | 186 | 18 | 2.1 |
| 6 | 150 | 216 | 18 | 2.6 |
| 8 | 200 | 270 | 20 | 3.9 |
| 10 | 250 | 324 | 22 | 5.4 |
| 12 | 300 | 381 | 22 | 7.1 |
| 14 | 350 | 413 | 24 | 8.7 |
| 16 | 400 | 470 | 24 | 10.8 |
| 18 | 450 | 533 | 24 | 14.4 |
| 20 | 500 | 584 | 24 | 16.4 |
| 24 | 600 | 692 | 24 | 21.5 |

1 - Diameter is to flange inner bolt circle, up to and including 10 in, after that it is the raised face diameter.
2 - Thickness to EN1092-1., until 14in then it stays at the same thickness.





| Cast Fittings Carbon & Stainless Steel Dimensions to ASME B16.5 | | | | |
|---|---|---|---|---|
| Nominal Bore | | Outside Diameter[1] | Wall Thickness[1] | Inside Diameter[1] |
| Inches | mm | mm | mm | mm |
| 1 | 25 | 33 | 4.0 | 25 |
| 1½ | 40 | 48 | 4.8 | 38 |
| 2 | 50 | 62 | 5.6 | 51 |
| 3 | 80 | 87 | 5.6 | 76 |
| 4 | 100 | 115 | 6.4 | 102 |
| 6 | 150 | 166 | 7.1 | 152 |
| 8 | 200 | 219 | 7.9 | 203 |
| 10 | 250 | 271 | 8.7 | 254 |
| 12 | 300 | 324 | 9.5 | 305 |
| 14 | 350 | 358 | 10.3 | 337 |

1 - All dimensions nominal.

# Key Product Tolerances

| Tolerances | |
|---|---|
| Element | Tolerance |
| Pipe Length | ± 3.2mm |
| Fixed flange bolt hole alignment | ± 1.6mm |
| Flange perpendicularity (with pipe centreline) | 7.8 mm/m of diameter |
| Flange Dimensions: | In accordance with ASME B 16.5 |
| Fitting Dimensions: | In accordance with ASME B 16.5 |
| PTFE Liner Thickness: | |
| 1/2" to 10" | ± 0.2mm |
| 12" to 14" | ± 0.4mm |
| PFA Liner Thickness: | Not possible to define because of fabricated steelwork or casting tolerance, however nominals in catalogue are a good guide. |

# Design

CRP's products are all manufactured and tested to national and international standards where applicable, with fundamental design qualification having been undertaken via the approval process required to comply with the Pressure Equipment Directive 2014/68/EU. The primary design standards used by CRP are:

### ASME B31.3:Process Piping

This contains requirements for piping typically found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants; and related processing plants and terminals. It covers materials and components, design, fabrication, assembly, erection, examination, inspection, and testing of piping. This represents the core of the design part of a lined piping system.

### ASME B16.5: Pipe Flanges and Flanged Fittings: NPS 1:2 through NPS 24

The standard covers pressure-temperature ratings, materials, dimensions, tolerances, marking, testing, and methods of designating openings for pipe flanges and flanged fittings. Key aspects are the design of flanges and the face to face dimensions of flanged fittings. There are a number of pressure classes detailed in the standard.

### Class 150

The pressure classification and therefore dimensional specification that the majority of lined piping is manufactured to is 150 pound (150lb) or in metric terms 10 bar. Therefore this specification is often referred to and is called ASME B16.5 Class 150, or abbreviated to ASME150.

It is possible to manufacture lined piping for Class 300 (300lb), but although this can be achieved dimensionally, it will not achieve the performance levels of Class 300 due to the creep effect on PTFE and PFA. Please note however that the pressure/temperature rating for a Class 150 flange depends on which raw materials you choose to make the flange from. In the case of CRP's ASTM A105 flanges the pressure rating at ambient is 19.6 bar.

### ASTM F1545:Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges

This is the latest version of ASTM lined pipe specifications, setting out the materials to be used, methods of fabrication and testing both as type tests and production tests. It covers several plastic materials including PTFE.

It has over the years been used as the bench mark quality standard for the manufacture of PTFE Lined pipe and fittings throughout most of the world with only central Europe preferring the DIN equivalent.

ASTM F423 is the original lined piping specification which had a little more detail and only referred to PTFE. It is still referred to in some user specifications although withdrawn in 2002. CRP refers to it, in that our product type testing was mainly done against this specification.

### ASME Boiler & Pressure Vessel Code Section IX. Welding, Brazing, and Fusing Procedures: Welders: Brazers: and Welding, Brazing and Fusing Operators

The title is self-explanatory and applies to welding activities principally on spools and fittings.

### BS EN ISO 9606-1: Qualification testing of welders -- Fusion welding -- Part 1:Steels

This standard applies to the approvals held by CRP's welding operators.

### BS EN ISO 15641-1: Specification And Qualification Of Welding Procedures For Metallic Materials - Welding Procedure Test - Part 1:Arc And Gas Welding Of Steels And Arc Welding Of Nickel And Nickel Alloys

This applies to weld procedure qualificaiton.

# Quality

### ISO 9001:2015

CRP is an ISO 9001:2015 approved company. Originally accredited to BS5750 Part 1 in 1992, CRP maintains this accreditation through a process of continuous third party surveillance with, six monthly, annual and triennial audits taking place. All of the company's manufacturing and test procedures fall within this regime.

### Pressure Equipment Directive

CRP's products are all manufactured and tested to national and international standards where applicable, with fundamental design qualification having been undertaken via the approval process required to comply with the Pressure Equipment Directive 2014/68/EU.

### TSG

CRP has Chinese TSG (Manufacturing License of Special Equipment of The Peoples Republic of China) licence approval from the GuangZhou Special Pressure Equipment Inspection and Research Institute, for many of its products, including its range of PTFE/PFA lined pipe and fittings. This is often referred to as a China Stamp.


Alcumus
Certificate of Registration


Quality System Registration





# Welding

### Standard

For CRP's range of products with welded construction steel housings, the company employs coded welders (to ASME IX and/or ISO 9606-1) following procedures in compliance with the requirements of the PED, and either ASME IX or EN15614-1.

### Options

If required, welding can be carried out by welding sub-contractors compliant with the requirements of ISO 3834-2.

Welded fabrications can be supplied with individual weld maps.

Appropriate types and levels of NDT can be offered, including radiography, magnetic particle inspection, dye penetrant, etc.

# Product Finishing

CRP's standard paint finish is a two component low VOC, high solids fast curing epoxy primer/finish containing zinc phosphate anti-corrosive pigmentation. The standard colour is RAL 5015 - Blue Semi-Gloss, with a typical application thickness of 60 microns.

This paint system is intended as a primer coat and would not be considered as falling within any of the environmental/durability classifications of ISO 12944 Parts 1 and 2. However as a primer it should provide sufficient durability for site installation and subsequent over coating. It will perform as a primer coat for the majority of paint systems applied.

CRP can also apply multi-coat wet paint systems in ISO 12944 compliant paint systems based on selecting the corrosive environment and durability requirement. Typically customers require protection for the C4, C5I and C5M environments and Medium or High durability. CRP are able to provide such finishes or apply customer specified paint systems.

Because of the health hazards associated with paints containing free isocyanate CRP are not able to apply these, but can offer alternatives.

Steel components are abrasive blast cleaned using non-ferrous media to Sa 2½ ISO 8501-1 – "very thorough blast cleaning". A surface profile Medium (G) ISO 8503-1 is achieved.

# Product Testing

All virgin PTFE/PFA lined products are subject to an electrostatic spark test at 25kV. All pipe spools and certain fittings are also subject to Hydrotest at 29 bar(g) for three minutes, followed by a relaxation dwell to atmospheric pressure and a repeat.

All spools and fittings lined in static dissipating PTFE/PFA are subject to Hydrotest at 29 bar(g) for three minutes, followed by a relaxation dwell to atmospheric pressure and a repeat.

Ultrasonic testing is conducted on large diameter PFA lined fittings to determine the liner thickness.

All spools and fittings are visually examined, particularly the flare faces, to ensure that there are no defects that would prevent the item sealing against adjacent items.

The mechanical properties and the specific gravity of representative samples of PTFE liner, selected from each sinter batch, are tested to confirm that they comply with the PTFE specification detailed elsewhere in this document.

# Permanent Product Marking

CRP is proud of what we manufacture and wherever possible the product is identified as having been manufactured by us. This is as permanent as practicable - in contrast to much other product on the market which is anonymous. Castings have the CRP logo, together with the web address, our notifed body number (CE mark), the product class (ASME 150), the material standard e.g. A216 WCB and the product size e.g. 40 x 25 (11/2" x 1").

Those products subject to PED compliance which are not castings have a high temperature cable tie added with the notifed body number and company details.

Some products have a stainless steel data plate riveted containing basic product data, serial numbers and in some cases basic performance limits.

# Shipment Product Marking

To enable easy identification of product on delivery - particularly when delivering a mixed collection of product for a project, CRP has developed some simple systems which enable items to be matched to delivery documentation. As standard pipe spools are identified with their nominal bore and length in indelible marker pen. Timber end boards are identified with the customer name, CRP order number, order line item number and which one of the item it is - in the case of multiple identical items on the same line of the order e.g. 1 of 20.

On consultation with the customer, information such as the isometric drawing number or plant item tag can be added both the item and the delivery paperwork, making it easier to select items.

# Product Traceability

All CRP manufactured Lined Pipe and Fittings are backwards traceable from the finished component to the manufacturing tests, processes and lining materials.

## Pipe Spools

Each spool has one flange stamped with the reference of the liner batch used in its construction. This provides traceability back to the liner manufacture, the tests undertaken and the materials certification of the polymer.


## PFA Moulded Fittings

PFA moulded items likewise are stamped with a mould reference which again provide traceability back to the manufacturing and test activities and the material certification of the polymers used.


Type 2.2. material certification can be provided as routine. Type 3.1 certification can be provided on request.

# Installation

CRP has a comprehenisve User Manual which gives extensive guidance on the installation of lined piping systems. Please ensure that those charged with installing the product read this guide and familiarise themselves with the special requirements of lined piping. There is nothing particularly complicated, but there are a few basic rules that must be followed in order to havea successful installation. CRP can also provide comprehensive training in the installation of lined equipment and our field sales team are trained in providing practical support. Copies of the User Guide are shipped with all product and it is also available to downlload from the website.




# Non-Destructive Testing

Non-destructive testing is also referred to by the acronym NDT or in the USA as non-destructive examination (NDE). It is the process by which materials – usually metals are examined without destroying them. Usually this is for searching for defects. In the case of CRP it would principally be specified for the examination of welds.

## CRP Experience

It is worth commenting that in the history of CRP, no product has ever failed because of a lack of weld integrity. In CRP's product the welds are not in contact with the process fluid and therefore do not need to retain the liquid or gas, they are serving to hold the housing together and to support the lining. As routine, all PFA lined fittings are subject to at least 70 Bar and 370°C as part of the moulding process.

Appropriate Non-Destructive Testing

| Weld Type | Material | Radiography | Ultrasonic | Magnetic Particle Inspection | Liquid (Dye) Penetrant |
|---|---|---|---|---|---|
| Butt Weld | Carbon Steel | ✓ | ✓ | ✓ | ✓ |
| Butt Weld | Stainless Steel | ✓ | ✓ | × | ✓ |
| Fillet Weld | Carbon Steel | × | × | ✓ | ✓ Not preferred |
| Fillet Weld | Stainless Steel | × | × | × | ✓ |

# Training

CRP offer customers and their nominated contractor's comprehensive training in three specific areas:

## Installation Training

Because of the niche position of PTFE and PFA lined equipment, it is not unusual for installation contractors to be unfamiliar with the installation of lined equipment. This can lead to installation mistakes, expensive rework and a delayed project implementation. Through the provision of some simple training CRP can assist in ensuring a good piping installation that does the equipment justice and gives the client confidence in its application.

## Product Training

CRP is keen to help customers choose the correct lined equipment for the job and get the best out of it. With the health, safety and environmental duties that come to bear on many of our customers and the need to keep the general technical level of understanding up of an ever changing workforce, CRP has developed training to assist design, project and plant engineers to understand the world of lined equipment. The objective is to provide a comprehensive overview of PTFE lined piping systems, including an understanding of why such materials are selected and how they are used. This could be to meet training obligations - either for continuous professional development, or to fulfil health and safety requirements.

## Field Flare Training

Field Flare piping is a useful addition to the toolbox of any serious user of lined equipment. It provides a simple self-help system, enabling the local fabrication of spools for emergency use or for the odd small modification or maintenance task. Occasionally because of historic site development or convenience some customers manufacture all of their spool requirements locally and CRP can support such users. Through the provision of training CRP can "approve" nominated staff of the end user or their contractor in the use and installation of field flare spools.

## Method

Usually this is provided via a classroom based training session, site based or at CRP's facility; making use of audio-visual presentations and classroom media. The training session would typically last two hours and a class size of around 10 is ideal. The training is provided by our technical, manufacturing and commercial staff as appropriate. Field flare training is usually provided via a practical training session at CRP's factory. This enables the candidates not only to undertake hands on training on the activity of field flaring, but also to understand all of the other issues that surround the use of fluoropolymer lined equipment.

A short multiple choice question paper is set to both help fix and confirm understanding. As part of the presentation, CRP will put together a small exhibition of products to aid understanding and a question and answer session concludes the training.

## Course Materials

We plan to provide course materials for each attendee, which will include notes relating to the presentation and other reference materials for subsequent reference. We will also provide immediately after the visit, certificates confirming the individual's attendance and understanding of the training.

## Caveat and Costs

It is important to comment that we are not acting as paid consultants. We are not insured for such a role. However, we believe that we can bring a wealth of both theoretical and practical experience that is not available from other sources, which should give your team and others a good background in working with these materials.

We see the provision of such training as part of the added value that a supply chain relationship with CRP can bring. To this end we offer such training to our supply contract customers and their agents and sub-contractors. Costs are usually on the basis of meeting our expenses.

# Template Lined Piping Specification - Carbon Steel

| | | | |
|---|---|---|---|
| **Performance** | **Temperature Range** | | -29°C to +200°C Class 150 |
| | **Pressure Range** | | Temperature (°C) / Max Pressure (bar g) Class 150:<br>-29 to +38: 19.6<br>50: 19.2<br>100: 17.7<br>150: 15.8<br>200: 13.8<br>Nb. It is acceptable to linearly interpolate to intermediate temperatures. |
| | **Vacuum Range** | | 1" – 8" NB: Full vacuum at all temperatures.<br>10" – 12" NB: Full vacuum at temperatures up to 150°C. |
| **Design Standards** | **Metalwork** | | ASME B31.3, ASME B16.5, PER/PED |
| | **Lined Items** | | ASTM F1545 – ASME B16.5 Class 150 |
| **Materials** | **Virgin PTFE Liners** | Standards | PTFE to ASTM D4895 Type I, Grade 1, Class A or B<br>Method of manufacture: Fine powder paste extrusion. |
| | | Mechanical properties | Minimum Tensile Requirements:<br>Longitudinal Tensile Strength at Break: 20.7 MPa (when tested to ASTM D4895)<br>Transverse Tensile Strength at Break: 19.0 MPa (when tested to ASTM D4895)<br>Longitudinal Elongation at Break: 250% (when tested to ASTM D4895)<br>Transverse Elongation at Break: 200% (when tested to ASTM D4895)<br>Specific Gravity: 2.14-2.17 (when tested to ASTM D792) |
| | | Minimum Wall Thicknesses | NB / Min Wall (mm) / NB / Min Wall (mm):<br>½" 2.0 — 4" 4.5<br>¾" 2.0 — 6" 6.0<br>1" 3.0 — 8" 8.0<br>1.1/2" 3.0 — 10" 9.0<br>2" 3.0 — 12" 9.5<br>3" 3.0 — 14" 8.3<br>Nb. All blind flanges are supplied with bonded on, 2mm thick PTFE liner. |
| | | Products lined in PTFE | • All spools<br>• All type 2 and type 3 spacers<br>• Concentric and eccentric reducers with one size reduction<br>• Some reducing flanges<br>• Elbows with angles other than 90 degrees, and/or with non-standard centreline to face dimensions.<br>• Isostatically moulded PTFE liners shall not be used except by specific concession. |
| | | Notes | • Spool liners to be a sliding or interference fit.<br>• Linings shall show no evidence of pinholes, porosity or cracks.<br>• Any bulges or other obvious indication of poor contact with the housing shall be cause for rejection.<br>• The gasket-sealing surface of the linings shall be free of surface defects that could impair sealing effectiveness.<br>• Scratches, dents, nicks or tool marks on the sealing surface shall be not deeper than 0.15 mm. Any radial defect shall be cause for rejection.<br>• Additives and colourants in liners are not permitted.<br>• Linings shall be made from virgin material.<br>• Reworked material is not permitted.<br>• Linings on flange/collar faces shall be uniform thickness, and not less than 80% of the wall thickness in the bore, unless otherwise agreed. |
| | **Static-Dissipating PTFE Liners** | Standards | PTFE to ASTM D4895 Type I, Grade 1, Class A<br>Fluffy Form Speciality Carbon Black meeting the requirements of F1545 for fillers<br>Method of manufacture: Fine powder paste extrusion. |
| | | Mechanical properties | Minimum Tensile Requirements:<br>Longitudinal Tensile Strength at Break: 20.7 MPa (when tested to ASTM D4895)<br>Transverse Tensile Strength at Break: 19.0 MPa (when tested to ASTM D4895)<br>Longitudinal Elongation at Break: 250% (when tested to ASTM D4895)<br>Transverse Elongation at Break: 200% (when tested to ASTM D4895)<br>Specific Gravity: 2.14-2.17 (when tested to ASTM D792)<br>Resistance: < 1 MΩ thereby meeting the requirements of DIN 2874 Section 3.7 and EDS.PIP.53.04.A Section 16.3.2 |



# Template Lined Piping Specification - Carbon Steel

| | | | |
|---|---|---|---|
| **Materials** | **Static Dissipating PTFE Liners** | Minimum Wall Thicknesses | NB / Min Wall (mm) / NB / Min Wall (mm):<br>½" 2.0 — 4" 4.5<br>¾" 2.0 — 6" 6.0<br>1" 3.0 — 8" 8.0<br>1.1/2" 3.0 — 10" 9.0<br>2" 3.0 — 12" 9.5<br>3" 3.0 — 14" 8.3<br>Nb. All blind flanges are supplied with bonded on, 2mm thick PTFE liner. |
| | | Products lined in PTFE | • All spools<br>• All type 2 and type 3 spacers<br>• Concentric and eccentric reducers with one size reduction<br>• Some reducing flanges<br>• Elbows with angles other than 90 degrees, and/or with non-standard centreline to face dimensions.<br>• Isostatically moulded PTFE liners shall not be used except by specific concession. |
| | | Notes | • Spool liners to be a sliding or interference fit.<br>• Linings shall show no evidence of pinholes, porosity or cracks.<br>• Any bulges or other obvious indication of poor contact with the housing shall be cause for rejection.<br>• The gasket-sealing surface of the linings shall be free of surface defects that could impair sealing effectiveness.<br>• Scratches, dents, nicks or tool marks on the sealing surface shall be not deeper than 0.15 mm. Any radial defect shall be cause for rejection.<br>• Reworked material is not permitted.<br>• Linings on flange/collar faces shall be uniform thickness, and not less than 80% of the wall thickness in the bore, unless otherwise agreed. |
| | **Virgin PFA Linings** | Standards | PFA to ASTM D3307 type II<br>Note PFA is the preferred lining material for fittings, with paste extruded PTFE liners also acceptable. |
| | | Mechanical properties | Minimum Tensile Requirements:<br>Tensile Strength at Break: 26.2 MPa (when tested to ASTM D3307 or ISO 12086)<br>Elongation at Break: 300% (when tested to ASTM D3307 or ISO 12086)<br>Minimum Melting Temperature: 300°C (when tested to ASTM D4591)<br>Specific Gravity: 2.12-2.17 (when tested to ASTM D792)<br>Melt Flow Rate: 1-3g/10mins (when tested to ASTM D3307 or ISO 12086) |
| | | Minimum Wall Thicknesses | NB / Min Wall (mm) / NB / Min Wall (mm):<br>1" 3 — 6" 5<br>1.1/2" 3 — 8" 6.5<br>2" 3 — 10" 7.5<br>3" 3 — 12" 8.5<br>4" 4 — 14" 8.5 |
| | | Products lined in PFA | • Class 150 90 degree elbows with standard centreline to face dimensions<br>• Equal and reducing tees<br>• Instrument tees<br>• Equal and reducing: crosses; short stack tees; lateral tees<br>• Concentric and eccentric reducers with more than one size reduction<br>• Some reducing flanges<br>• Isostatically moulded PTFE liners shall not be used except by specific concession. |
| | | Notes | • Linings shall show no evidence of pinholes, porosity or cracks.<br>• The gasket-sealing surface of the linings shall be free of surface defects that could impair sealing effectiveness.<br>• Scratches, dents, nicks or tool marks on the sealing surface shall be not deeper than 0.15 mm. Any radial defect shall be cause for rejection.<br>• Additives and colourants in liners are not permitted.<br>• Linings on flange/collar faces shall be uniform thickness, and not less than 80% of the wall thickness in the bore, unless otherwise agreed. |
| | **Static Dissipating PFA Linings** | Standards | Not applicable, not covered by ASTM D3307 |
| | | Mechanical properties | Minimum Tensile Requirements:<br>Tensile Strength at Break: 26.2 MPa (when tested to ASTM D3307 or ISO 12086)<br>Elongation at Break: 300% (when tested to ASTM D3307 or ISO 12086)<br>Typical Melting Temperature: 284°C (when tested to ASTM D4591)<br>Specific Gravity: 2.12-2.17 (when tested to ASTM D792)<br>Melt Flow Rate: 1-3g/10mins (when tested to ASTM D3307 or ISO 12086)<br>Volume Resistivity: 0.10 Ωm (when tested to ISO 3915) |

# Template Lined Piping Specification - Carbon Steel

# Template Lined Piping Specification - Carbon Steel

| | | | |
|---|---|---|---|
| **Materials** | **Static Dissipating PFA Linings** | Minimum Wall Thicknesses | NB / Min Wall (mm) / NB / Min Wall (mm)<br>1" 3.0 6" 5.0<br>1.1/2" 3.0 8" 6.5<br>2" 3.0 10" 7.5<br>3" 3.0 12" 8.5<br>4" 4.0 14" 8.5 |
| | | Products lined in PFA | • Class 150 90 degree elbows with standard centreline to face dimensions<br>• Equal and reducing tees<br>• Instrument tees<br>• Equal and reducing: crosses; short stack tees; lateral tees<br>• Concentric and eccentric reducers with more than one size reduction<br>• Some reducing flanges<br>• Isostatically moulded PTFE liners shall not be used except by specific concession. |
| | | Notes | • Linings shall show no evidence of pinholes, porosity or cracks.<br>• The gasket-sealing surface of the linings shall be free of surface defects that could impair sealing effectiveness.<br>• Scratches, dents, nicks or tool marks on the sealing surface shall be not deeper than 0.15 mm. Any radial defect shall be cause for rejection.<br>• Linings on flange/collar faces shall be uniform thickness, and not less than 80% of the wall thickness in the bore, unless otherwise agreed. |
| | **Metalwork** | Spools | Flanges: ASTM A105N<br>Pipe: ASTM A106 Grade B/API 5L Grade B<br>Stub Ends: BS1501-161-430A |
| | | Cast Fittings | Cast Steel: ASTM A216 Grade WCB<br>Ductile Iron: ASTM A395 Grade 60-40-18 |
| | | Fabricated Fittings | Flanges: ASTM A105N<br>Pipe: ASTM A106 Grade B/API 5L Grade B<br>Forged Bends: ASTM A234 Grade WPB<br>Stub Ends: BS1501-161-430A<br>Plate: BS1501-161-430A |
| | | NDE | Not required |
| | | Heat Treatment | Not required |
| | **Venting** | Bosses | Castings: As per parent metal<br>Fabrications: Drawn mild steel bar |
| | | Plugs | Virgin PTFE |
| **Dimensions** | **Spools** | NB & Length | Van Stone Class 150<br>NB / Min (mm) / Max (mm)<br>½" 250 6000<br>¾" 250 6000<br>1" 250 6000<br>1.1/2" 250 6000<br>2" 250 6000<br>3" 250 6000<br>4" 250 6000<br>6" 500 6000<br>8" 500 3000<br><br>Welded Fixed/Rotating Class 150<br>NB / Min (mm) / Max (mm)<br>½" 90 6000<br>¾" 90 6000<br>1" 90 6000<br>1.1/2" 95 6000<br>2" 110 6000<br>3" 120 6000<br>4" 125 6000<br>6" 140 6000<br>8" 150 3000<br>10" 165 3000<br>12" 170 3000<br>14" 190 3000 |
| | | Flange Arrangement | 1" to 8" Van Stone construction flanged pipe with 2 rotating flanges.<br>10" to 14" Welded construction 1 flange fixed, 1 flange rotating. |
| | | Stub End Sizes for welded construction | NB / OD (mm) / Thickness (mm) / NB / OD (mm) / Thickness (mm)<br>½" 44 10 4" 171 16<br>¾" 54 12 6" 216 18<br>1" 64 12 8" 270 20<br>1.1/2" 83 12 10" 324 22<br>2" 102 14 12" 381 22<br>3" 133 16 14" 413 24 |
| | | Pipe & Flange Specs | Pipe: ½" – 6" NB: Sch.40; 8" – 14": Sch.30<br>Flanges: ASME B16.5 Class 150 |

| | | | |
|---|---|---|---|
| **Dimensions** | **Fittings** | External Sizes | 90 degree elbows, 45 degree elbows, equal tees, reducing tees, concentric reducers, eccentric reducers: Face to face and centreline to face dimensions as per ASME B16.5 Class 150<br>Instrument tees:<br>Branch / Body Face to face (mm)<br>NB / Class 150 / Class 300<br>1" 51 76<br>1.1/2" 76 76<br>2" 89 89<br>3" 150 N/A<br>Nb.<br>Centreline to face is the same as for an equivalent reducing tee.<br>Not all combinations of body and branch size are possible for instrument tees |
| | | Flange Arrangements | Standard is all fixed off centres. Rotating flanges and on centres flanges can be supplied if required. If rotating flanges are used, collar thicknesses will be the same as for spools, unless dictated by component geometry. |
| | | Pipe & Flange Specs | Pipe: ½" – 6" NB: Sch.40; 8" – 14": Sch.30<br>Flanges: ASME B16.5 Class 150<br>Casting wall thicknesses: As per ASME B16.5 Class 150 |
| | **Spacers** | General | Spacers are a non-preferred item. The use of site closing spools is a better way of making site adjustments. |
| | | Type 1 | These are solid Virgin PTFE thick walled rings.<br>For all nominal bore sizes the minimum thickness is 1mm and the maximum thickness is 25mm. They can be supplied with a small taper angle if required. These spacers should not be used for pressures greater than Class 150. |
| | | Types 2 & 3 | Type 2 (thick walled steel hollow bar), and type 3 (pipe with welded on stub ends) spacers are both permissible.<br>Materials: Steelwork and liners and are the same as for spools.<br>Liner thicknesses: These are the same as for spools of the same nominal bore.<br>The outside diameter of all spacers is to be inner bolt circle diameter.<br>Lengths:<br>NB / Min (mm) / Max (mm) / NB / Min (mm) / Max (mm)<br>½" 26 60 4" 26 150<br>¾" 26 60 6" 26 150<br>1" 26 100 8" 26 200<br>1.1/2" 26 100 10" 26 200<br>2" 26 150 12" 26 200<br>3" 26 150 14" 26 200 |
| | **Venting** | PTFE Lined Items | 5mm vent hole<br>Vent hole locations:<br>Spools:<br>≤ 500mm length 1 vent hole centrally<br>501mm - 6000mm length 2 vent holes 150mm from each flange on same axis.<br>Fittings: 1 vent hole centrally, or as cast. |
| | | | Permeant Service Venting:<br>Vent Boss Description (see Fig 2 below):<br>Vent bosses shall be carbon steel, set on and welded using a full penetration weld. The welding boss shall be threaded BSP parallel. There shall be a minimum of 10mm of full threads. A 5mm vent hole in the pipe shall be drilled and deburred post welding to ensure the welding process does not obscure the vent hole.<br>Vent boss locations:<br>Spools:<br>≤ 500mm length One vent boss centrally<br>501mm - 6000mm length 2 vent bosses 150mm from each flange on same axis.<br>Fittings* One vent boss centrally, or as cast on.<br>* Excludes reducing flanges, instrument tees and type 2 spacers where no vent boss is required - the body is tapped and the vent plug fitted directly into it.<br>Vent Plugs:<br>Vent plugs shall be made from Virgin PTFE, and the design shall be as shown in Fig 1 below. Every spool and fitting shall be supplied with a vent plug fitted into every vent boss/vent hole. |
| | | PFA Lined Items | No specific venting required, with the injection boss acting as a vent. |
| | | | Permeant Service Venting:<br>Vent Boss Description (see fig 3 below):<br>The injection boss on the fitting shall be used for the venting system. The injection boss will be drilled and tapped ½" BSP parallel. The tapping drill hole will extend 2 – 3mm beyond the end of the threads. A flat bottomed drill will be used. A ½" BSP parallel x ¼" BSP parallel reducing bush will be fitted to the injection boss. |

# Template Lined Piping Specification - Carbon Steel

| | | | |
|---|---|---|---|
| **Dimensions** | **Venting** | PFA Lined Items | Vent Plugs:<br>Vent plugs shall be made from Virgin PTFE, and the design shall be as shown in Fig 1 below. Every fitting shall be supplied with a vent plug fitted into the reducing bush in the injection boss. |
| | | Vent Extensions – All items | If vent extensions are required for insulated lines, there shall be a threaded ¼" BSPP half coupling welded over the vent hole and a carbon steel taper threaded pipe fitted over this to create a 70mm tall assembly. For PFA lined fittings a threaded steel reducer is fitted to the injection bosses to take the extension pipe.<br>Permeant Service Venting:<br>The permeant service vent boss is fitted either directly to pipe spools or as part of a reducer in PFA fittings and a 5mm hole extension piece fitted (see Figs 4 & 5 below) |
| | | Notes | Each pipe and fitting including reducing flanges, instrument tees, lined spacers etc. shall be provided with a venting system that will release any gas which, during service, may permeate through the lining and will also indicate any leakage due to failure of the lining.<br>Variable angle outlet PTFE vent plugs (see Fig 6 below) can be retro-fitted to vent plugs if required. |
| **Earthing** | | | Earth continuity shall be achieved by the use of star washers on two of the joint bolts and a CRP spikey washer behind all rotating flanges. |
| **In Process Testing** | | PTFE Liners | Visual<br>Outside Diameter<br>Wall thickness (4 positions)<br>Acceptable sintering profile<br>Longitudinal Tensile Strength<br>Transverse Tensile Strength<br>Longitudinal Elongation at Break<br>Transverse Elongation at Break<br>SG determination of PTFE |
| **Finished Product Testing** | | Class 150 flanged spools & fittings | Hydrostatic Test: Raise pressure to 29 bar g, hold for 3 minutes, and reduce pressure. Repeat cycle.<br>Electrostatic Test: 25kV all over surface of lining. |
| | | | Hydrostatic Test: Any evidence of leakage shall be cause for rejection.<br>Electrostatic Test: Any audible or visible spark through the lining shall be cause for rejection.<br>The electrostatic test shall be carried out after the hydrostatic test. |
| **Paint Finish** | | | As standard all items will be supplied painted with CRP standard two component low VOC, high solids fast curing epoxy primer/finish containing zinc phosphate anti-corrosive pigmentation: Intergard 345, RAL 5015, blue semi-gloss. Typical thickness 60 microns.<br>Other paint colours and systems are available by agreement. |
| **Packing**<br>**PFA lined items** | | **PTFE lined items** | Timber end boards bolted to all flange faces. |
| | | | Push fit plastic end caps to all flange faces. |
| **Certification** | | | Standard certificate of conformity provides details of materials used and details of Electrostatic Test and Hydrostatic Test.<br>All material test certificates if requested at time of order. |
| **Identification**<br>**Fittings** | | **Spools** | NB, size, length, supplier order number, line item number and customer name to be marked on end boards. |
| | | | Supplier order number and line item number to be marked on end caps. |
| **Traceability** | | | All products should be reverse traceable from component through the manufacturing process to original polymer certification. This is provided on fittings via a unique number stamped upon the component flange and on pipe spools via the PTFE run reference stamped upon the component flange. All records relating to the manufacture and test of these items shall be available for scrutiny. |
| **Quality Systems** | | | Certificate 020-QMS-001 for ISO9001:2015 for the development and manufacture of fluoropolymer lined and metallic piping systems, associated pipeline equipment and swampling systems. The stocking and supply of third party valve and actuation products and associated pipeline equipment. Sub-contract fluoropolymer moulding and lining services. |



# Template Lined Piping Specification - Carbon Steel

| | |
|---|---|
| **Quality Systems** | PED compliant, suitable for Group 1 Gases.<br>Registration BES 399303-1/2 in respect of a Quality Management System which has been assessed and found to comply with the requirements of modules D1, E1 and H of Annexe III of the Pressure Equipment Directive 97/23/EC and Schedule 4 of the UK Pressure Equipment Regulations 1999 (SI 2001) for the design and manufacture of fluoropolymer lined and metallic piping systems, associated piping equipment, PTFE bellows and sampling systems. |
| **Qualification Tests** | ASTM F1545<br>BS EN 61340-2-3 third party testing determining that static-dissipating lined pipe and fittings manufactured by CRP have been proven as static-dissipative. |

Diagram of permeant venting arrangements

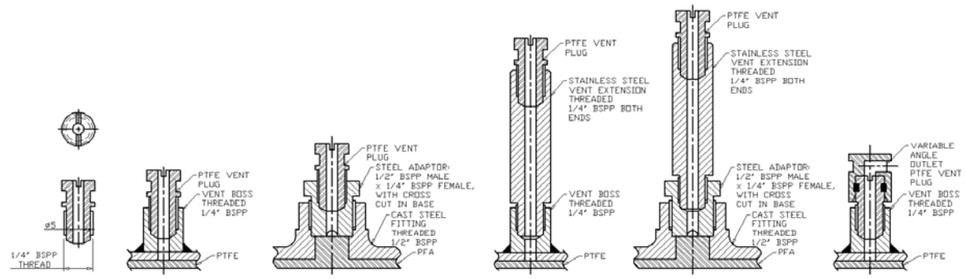
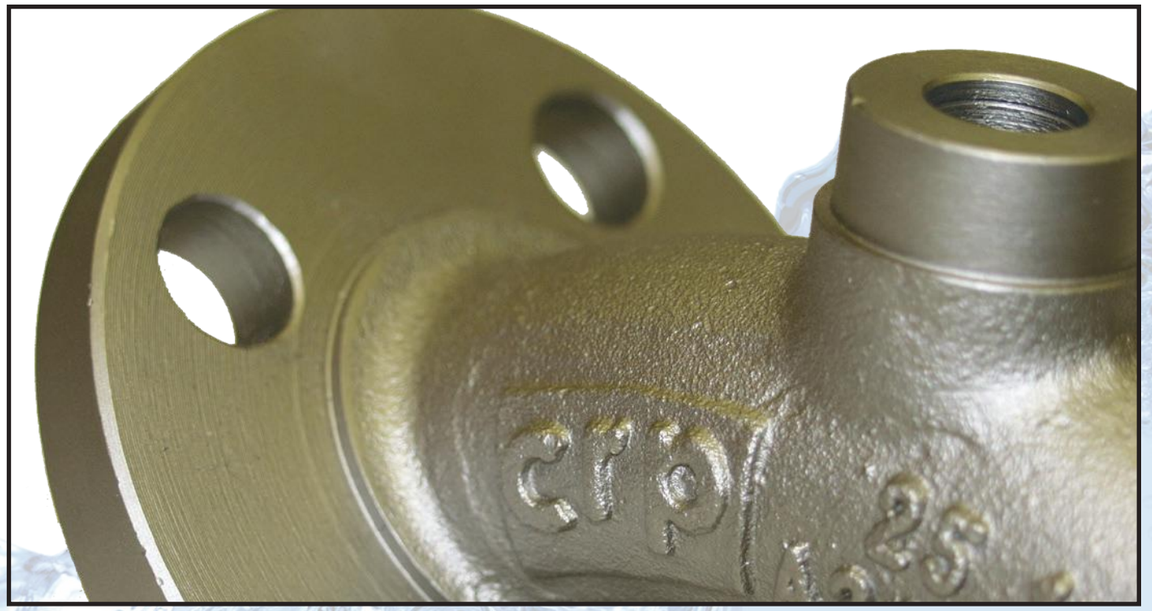



Fig 1 Fig 2 Fig 3 Fig 4 Fig 5 Fig 6

Fig 1 PTFE Vent Plug
Fig 2 Vent Boss & PTFE Vent Plug for PTFE Lined Items
Fig 3 Vent Boss, Threaded Adaptor & PTFE Vent Plug for PFA Lined Items
Fig 4 Vent Boss, Stainless Steel Vent Extension & PTFE Vent Plug for PTFE Lined Items (Insulated Lines)
Fig 5 Vent Boss, Threaded Adaptor, Stainless Steel Vent Extension & PTFE Vent Plug for PFA Lined Items (Insulated Lined)
Fig 6 Optional Variable Angle Outlet PTFE Vent Plug



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