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User Manual

A guide to the specification, storage, installation, operation and maintenance of CRP's range of lined pipes, fittings and ancillary piping products. Sections 1-3 contain practical information for those involved in storage and installation, whilst section 4 is more relevant to those involved in specifying product. Each section starts with generic information relevant to all products. This is followed by product specific information. An EC declaration of conformity is included in the guide.

If you have questions not answered by this guide, CRP will be pleased to help; our contact details can be found above.

1. Introduction

This document is intended to provide information to aid in the specification, storage, installation, operation and maintenance of CRP's range of lined pipes, fittings and ancillary piping products. While the information contained here is based upon many years of experience, test results and design calculations, it is for general guidance only and is given without guarantee, warranty or liability. In the case of uncertainty on the part of the user, please contact the manufacturer for advice on any of the contents of this document.

PTFE, PFA and FEP lined products cannot be treated in the same way as unlined steel products, and personnel responsible for all aspects of them should be competent to undertake such work.

2. Storage

2.1 Generic Instructions

Lined products should ideally be stored indoors in cool dry conditions. This is because neither the end boards nor the primer paint with which they are painted, are intended for prolonged outdoor exposure.

PTFE and PFA are relatively soft materials. Therefore to protect the lined surfaces they are supplied with end boards. These boards should only be removed immediately prior to installation. If they are removed for inspection purposes they should be replaced immediately or irrevocable damage and distortion may occur. During removal of the end boards care should be taken to avoid damaging the flare faces of the products, since this will likely result in leakage once the item has been installed.

During transport, lined products should not be moved by having anything placed inside the bore as an aid to moving, such as the forks of a fork lift truck, since this may well damage the liner, resulting in failure of the lined item.

2.2 Product Specific Instructions

2.2.1 LGSG Level Gauges

The LGSG is lined with a PFA liner and is packed in such a way as to protect this liner during transport and storage. This packaging should not be removed until installation as the liner can easily be damaged through the level gauge viewing slots.

2.2.2 Sight Glasses

By their very nature, sight glasses contain glass, which is brittle. Care must be taken to avoid impacts with all glass parts of these products during transport and storage.

2.2.3 Dip Legs/Dip Pipes

Since these products have an external lining of PTFE, extra care must be taken when storing, handling and transporting them, since, due to their mass, fairly minor drops, knocks, or scrapes can result in the liner being damaged or broken.

2.2.4 Bellows

The PTFE convolutions of bellows are not protected by any metalwork. Therefore during storage and handling, particular care must be taken not to damage them. Also the packaging that they are supplied in should be kept in place until immediately prior to installation.

3. Installation Operation & Maintenance

3.1 Generic Instructions

3.1.1 Overview

PTFE & PFA lined products cannot be treated in the same way as unlined steel products. In order to ensure trouble free operation the following instructions should be followed carefully.

Note: Welding, brazing, soldering or flame cutting must not be performed on lined products. These processes may damage the liner and toxic gasses may also be produced.

3.1.2 Flare Faces

The flare face on any lined piping component forms the sealing face of the component to the next item in the line. Therefore, it is vital that this face is not damaged at any stage. Particular care should be taken to ensure the following:

- End boards must be kept in place until immediately prior to installation.
- Flare faces must be protected during preparation for painting and during painting.
- When the end boards of an item are removed, the flare faces should be visually inspected. If there is any surface contamination, this should be removed using a soft clean cloth.

3.1.3 System Pressure Testing

In deciding upon the appropriate line test pressure, this should be calculated to be 1.5 times the rated pressure of the lowest rated lined piping component in the system, unless some other constraint from another item in the system requires a lower test pressure to be used.

In undertaking a pressure test, care should be taken to ensure that pressure is applied from the upstream side of all non-return valves, and is released from the downstream side of all such valves to ensure (a) a pressure test of the complete system and (b) all of the test pressure has been removed from the system at the end of the test.

3.1.4 Gaskets

Gaskets are not normally required where PTFE lined items are being connected to similar products. Where components are connecting to dissimilar materials such as glass, ceramic or exotic metal then the use of a PTFE envelope gasket or similar device is recommended.

3.1.5 Vent Holes

The majority of lined products contain vent holes (typically 5mm diameter). These holes fulfil two critical purposes:

1. In some circumstances depending on temperature, pressure and the chemistry of the contained media, a small amount of material may permeate through the liner. As it reaches the outside of the PTFE, it can form a pocket of trapped gas and if this permeant is not allowed to escape through the vent holes, it can lead to the collapse of the liner in the lined component.

2. They provide an early indication of liner failure. Rather than a liner failure occur catastrophically, the vent holes can indicate a problem possibly before it becomes serious.

Where vent holes exist, the user is responsible for setting up a system to regularly check them. If any product is leaking from the vent holes, the item in question should be removed from service without delay, since catastrophic failure is likely to occur if no action is taken. It is therefore important not to block the vent holes with paint or any other substance. This requirement applies equally to systems where vent extensions/plugs are utilised.

3.1.6 Bolting Materials

Bolting materials should be of good quality, clean and well lubricated. The use of washers is recommended to ensure correct even torque. Bolts should be tightened by use of a torque wrench in strict sequence of diagonally opposite pairs. This, and all subsequent torqueing, of bolts should be undertaken at ambient temperature.

It is strongly recommended that all bolts are re-torqued a minimum of 24 hours after commissioning or following the initial full process cycle. The torque of all bolted joints should then be rechecked at least annually thereafter.

The following table gives recommended torque levels for flange to flange connections.

Torque and Bolting Details

Nominal Bore		ASME 150				PN10			PN16		
Imp	Metric	Quantity	Bolts/Studs UNC	Bolts/Studs Metric	Torque Nm	Quantity	Bolts/Studs Metric	Torque Nm	Quantity	Bolts/Studs Metric	Torque Nm
½”	15	4	1/2"	M12	7	4	M12	16	4	M12	16
¾”	20	4	1/2"	M12	15	4	M12	32	4	M12	32
1"	25	4	1/2"	M12	19	4	M12	40	4	M12	40
1.¼”	32	4	1/2"	M12	24	4	M16	55	4	M16	55
1.½"	40	4	1/2"	M12	27	4	M16	60	4	M16	60
2"	50	4	5/8"	M16	47	4	M16	66	4	M16	66
2.½”	65	4	5/8"	M16	53	8	M16	45	8	M16	45
3"	80	4	5/8"	M16	73	8	M16	50	8	M16	50
4"	100	8	5/8"	M16	54	8	M16	55	8	M16	55
5”	125	8	3/4"	M20	83	8	M16	74	8	M16	74
6"	150	8	3/4"	M20	108	8	M20	103	8	M20	103
8"	200	8	3/4"	M20	136	8	M20	137	12	M20	91
10"	250	12	7/8"	M24	127	12	M20	99	12	M24	118
12"	300	12	7/8"	M24	145	12	M20	104	12	M24	148
14”	350	12	1”	M27	182	16	M20	142	16	M24	191
16”	400	16	1”	M27	173	16	M24	197	16	M27	247
18”	450	16	1.1/8”	M30	262	20	M24	173	20	M27	245
20”	500	20	1.1/8”	M30	231	20	M24	197	20	M30	332
24”	600	20	1.1/4”	M30	331	20	M27	257	20	M33	494
28”	700	40	3/4"	M20	70*	24	M27	295	24	M33	337
30”	750	44	3/4”	M20	51*	Not applicable					
32”	800	48	3/4"	M20	66*	24	M30	385	24	M36	435
36”	900	44	7/8”	M24	77*	28	M30	365	28	M36	415

* Note that for 28” and 32” ASME 150 torque for Series B flanges are quoted.

The torque values given above are a guide; they may be exceeded by a value of 50% to effect a seal. If once this torque level has been reached a seal has not been achieved, it is likely that some other source of failure, such as scratched flare faces, is operating.

Note: When bolting together dissimilar materials, always tighten to the lowest recommended torque of the components in the joint. Using higher torques may result in damage to the softer material in the joint.

3.1.7 Disassembly

The bolts on lined systems must not be loosened while the system temperature is above 60°C otherwise flare distortion or irrevocable damage may occur. Always secure end covers on to the flanges of lined components which have been removed from a system, this will prevent damage, the ingress of dirt and allow trouble free re-assembly.

3.1.8 Stud/Bolt Length Calculator

In order to calculate the length of stud/bolt required for any joint, it is necessary to calculate the half joint length for the two flanges that make up the joint, and then add them together. In addition, allowance must be made for any wafer pattern item, such as an instrument tee, that is included in the joint. The information below provides the data necessary to allow these calculations to be made.

3.1.8.1 *Lined Item Data*

Size Imp	Size Metric	Component	Half Joint Total Thickness
1"	25	Vanstone Spool	20.5
1.½"	40	Vanstone Spool	23.5
2"	50	Vanstone Spool	25.5
3"	80	Vanstone Spool	29.5
4"	100	Vanstone Spool	33.0
6"	150	Vanstone Spool	36.5
8"	200	Vanstone Spool (Heavy Duty liner)	42.0
8"	200	Vanstone Spool (Standard Duty liner)	41.0
½"	15	Heavy Duty Spool Fixed Flange	13.5
¾"	20	Heavy Duty Spool Fixed Flange	14.5
1"	25	Heavy Duty Spool Fixed Flange	17.5
1.½"	40	Heavy Duty Spool Fixed Flange	20.5
2"	50	Heavy Duty Spool Fixed Flange	21.5
3"	80	Heavy Duty Spool Fixed Flange	26.5
4"	100	Heavy Duty Spool Fixed Flange	28.0
6"	150	Heavy Duty Spool Fixed Flange	31.0
8"	200	Standard Duty Spool Fixed Flange	34.0
10"	250	Standard Duty Spool Fixed Flange	35.0
12"	300	Standard Duty Spool Fixed Flange	36.5
14"	350	Standard Duty Spool Fixed Flange	41.5
8"	200	Heavy Duty Spool Fixed Flange	35.0
10"	250	Heavy Duty Spool Fixed Flange	38.0
12"	300	Heavy Duty Spool Fixed Flange	40.0
½"	15	Heavy Duty Spool Rotating Flange	23.5
¾"	20	Heavy Duty Spool Rotating Flange	26.5
1"	25	Heavy Duty Spool Rotating Flange	29.5
1.½"	40	Heavy Duty Spool Rotating Flange	32.5
2"	50	Heavy Duty Spool Rotating Flange	35.5
3"	80	Heavy Duty Spool Rotating Flange	42.5
4"	100	Heavy Duty Spool Rotating Flange	44.0
6"	150	Heavy Duty Spool Rotating Flange	49.0
8"	200	Standard Duty Spool Rotating Flange	54.0
10"	250	Standard Duty Spool Rotating Flange	57.0
12"	300	Standard Duty Spool Rotating Flange	58.5
14"	350	Standard Duty Spool Rotating Flange	65.5
8"	200	Heavy Duty Spool Rotating Flange	55.0
10"	250	Heavy Duty Spool Rotating Flange	60.0
12"	300	Heavy Duty Spool Rotating Flange	62.0

Size Imp	Size Metric	Component	Half Joint Total Thickness
½"	15	Fitting Fixed Flange	12.5
¾"	20	Fitting Fixed Flange	15.0
1"	25	Fitting Fixed Flange	17.0
1.½"	40	Fitting Fixed Flange	21.0
2"	50	Fitting Fixed Flange	23.0
3"	80	Fitting Fixed Flange	28.5
4"	100	Fitting Fixed Flange	29.5
6"	150	Fitting Fixed Flange	31.5
8"	200	Fitting Fixed Flange	36.5
10"	250	Fitting Fixed Flange	39.5
12"	300	Fitting Fixed Flange	41.0
14"	350	Fitting Fixed Flange	43.5
½"	15	Fitting Rotating Flange	22.5
¾"	20	Fitting Rotating Flange	27.0
1"	25	Fitting Rotating Flange	29.0
1.½"	40	Fitting Rotating Flange	33.0
2"	50	Fitting Rotating Flange	37.0
3"	80	Fitting Rotating Flange	44.5
4"	100	Fitting Rotating Flange	45.5
6"	150	Fitting Rotating Flange	49.5
8"	200	Fitting Rotating Flange	56.5
10"	250	Fitting Rotating Flange	61.5
12"	300	Fitting Rotating Flange	63.0
14"	350	Fitting Rotating Flange	67.5
½"	15	CTSG/DTSG	34.0
1"	25	CTSG/DTSG	38.0
1.½"	40	CTSG/DTSG	38.0
2"	50	CTSG/DTSG	38.0
3"	80	CTSG/DTSG	43.0
4"	100	CTSG/DTSG	46.0
6"	150	CTSG/DTSG	46.0
8"	200	CTSG/DTSG	45.0
10"	250	CTSG/DTSG	49.0
12"	300	CTSG/DTSG	52.0
1"	25	45 degree Elbow Fixed Flange (1)	14.5
1"	25	45 degree Elbow Rotating Flange (1)	23.5
1.½"	40	45 degree Elbow Rotating Flange (1)	27.5
2"	50	45 degree Elbow Rotating Flange (2)	28.5
3"	80	45 degree Elbow Rotating Flange (2)	34.5

Notes
(1) Bolt holes threaded ½" UNC
(2) Bolt holes threaded ⅝" UNC

3.1.8.2 *Wafer Pattern Product Data*

Size Imp	Size Metric	Component	Component Thickness
½" Branch	15	Instrument Tee	51.0
¾" Branch	20	Instrument Tee	51.0
1" Branch	25	Instrument Tee	51.0
1.½" Branch	40	Instrument Tee	76.0
2" Branch	50	Instrument Tee	89.0
3" Branch	80	Instrument Tee	150.0
½"	15	WPCV	30.0
1"	25	WPCV	35.0
1.½"	40	WPCV	45.0
2"	50	WPCV	56.0
3"	80	WPCV	71.0
4"	100	WPCV	80.0
4"	100	STCV	52.0
6"	150	STCV	56.0
8"	200	STCV	60.0
10"	250	STCV	68.0
12"	300	STCV	78.0

3.1.8.3 Bellows Data

Nominal Bore		Half Joint Total Thickness
Imp	Metric	
1"	25	14.5
1.¼"	32	14.5
1.½"	40	18.5
2"	50	18.5
2.½	65	18.5
3"	80	18.5
4"	100	20
5"	125	24
6"	150	25
8"	200	27.5
10"	250	26
12"	300	26
14"	350	28.5
16"	400	27
18"	450	29.5
20"	500	33
24"	600	33.5
28"	700	36.5
30"	750	40.5
32"	800	40.5
36"	900	40.5

Nb. As standard, bellows are supplied with threaded flange holes.

3.1.8.2 Nut/Stud Data

UNC Thread	Thread Pitch (mm)	Nut Thickness* (mm)	
		Ordinary	Heavy
½"	2	11	13
⅝"	2.3	14	16
¾"	2.5	17	19
⅞"	2.8	19	23
1"	3	22	26
1.⅛"	3.6	25	29
1.¼"	3.6	28	32
1.½"	4.2	33	38

Metric Thread	Thread Pitch (mm)	Nut Thickness (mm)
M12	1.75	10
M16	2	13
M20	2.5	16
M24	3	19
M27	3	22
M33	3.5	26
M36	4	29

* Assuming nuts are faced on one side

Example

To work out the length of a stud for a joint add together the total length for each half of the joint. e.g. a 1.1/2" fitting to a 1.1/2" rotating flange spool = 21mm + 32.5mm = 53.5mm. To this value add on two off nut thicknesses + clear threads if using studs or one nut thickness + clear threads if using bolts.

If using an item with threaded holes, no nuts are required. If the threaded holes are blind, no clear threads need to be added for that side of the joint. If the threaded holes are through holes, clear threads may also be added if required.

3.2 Product Specific Instructions

If there is no mention of a particular product in this section, there are no additional product specific instructions to follow.

3.2.1 CTSG/DTSG/BFSG Tubular Sight Glass

Following installation the tie rod torques must be checked. This is achieved in the following manner:

Release the backing nuts at both ends of the sight glass.

Check the torques on the outer tie rod nuts with a torque wrench in pairs diagonally opposite – see the table below for recommended torques. Nb. This is a safety critical step. Failure to retighten the tie rods may lead to leakage between the end flanges and the glass.

Retighten all of the backing nuts. NB. This is a safety critical step. Failure to retighten these nuts may lead to excessive compressive or torsional loads being applied to the glass, resulting in damage to, or failure of, the glass.

The following table gives recommended torque levels for tie rod nuts.

Nominal Bore		Torque
Imp	Metric	Nm
1"	25	10
1.1/2"	40	15
2"	50	20
3"	80	30
4"	100	37
6"	150	44
8"	200	44
10”	250	44
12”	300	44

It is strongly recommended that tie rod torques are checked at least 24 hours after commissioning or following the initial full process cycle, and at least annually thereafter.

3.2.2 LGSG Level Gauge

The LGSG is lined with a PFA liner and is adequately protected in transit. This packing must not be removed until installation as the liner can easily be damaged through the level gauge viewing slots.

3.2.3 WPCV & FPCV Wafer & Flanged Poppet Check Valve

In addition to the generic installation instructions for lined pipe products;

- Check that the direction of flow arrow on the valve body points in the right direction.
- Ensure that the mounting flanges are parallel.
- Position the valve centrally between flange faces.
- Ensure that there is sufficient contact between the flange faces and the sealing area of the check valve.

3.2.4 SPCV Sight Glass Poppet Check Valve

Follow generic installation instructions for lined pipe products and the additional instructions above for CTSG/DTSG/BFSG products. Also, particular care must be taken to ensure the product is installed the correct way up vis-à-vis flow direction.

3.2.5 Dip Legs & Dip Pipes

The Dip Pipe is internally and externally lined in PTFE and great care must be taken when handling this product to ensure that the liner is not damaged during transport, storage or installation.

3.2.6 Tee Piece & Bulls Eye Sight Glasses

Following installation the tie rod torques must be checked with a torque wrench in pairs diagonally opposite. The following table gives recommended torque levels for tie rod nuts.

Nominal Bore		No. of Tie Rods	Torque	
Imp	Metric		Ft lbs	Nm
1"	25	4	11	15
1.1/2"	40	4	18	24
2"	50	4	31	42
3"	80	4	44	59
4"	100	6	51	69
6"	150	8	39	53

It is strongly recommended that tie rod torques are checked at least 24 hours after commissioning or following the initial full process cycle, and at least annually thereafter.

3.2.7 STCV Swing Check Valve

The valve can be universally mounted in both horizontal and vertical pipelines and some angled pipelines. The angled sealing face is particularly beneficial in horizontal lines in providing a positive shutoff, as even when the disc is closed against the seat; gravity still exerts a noticeable closing force on the disc. In horizontal lines the valve must be mounted correctly with the hinge part of the valve uppermost within the pipeline.

In vertical or angled lines the flow must be upward through the valve allowing gravity to provide a valve closing force. The valve body has a clear flow direction arrow cast into the side. The valve must be fitted into the pipeline with the direction of this arrow pointing downstream.

The 8in (DN200) and above sized valves have a threaded hole in the top of the body to allow a lifting eye to be fitted to allow easy handling and installation. The valve is manufactured to self-centre between the boltholes. Typically for instance in a horizontal line, the two adjacent bottom bolts would be fitted first and the swing check valve rested on these bolts. Then the remaining bolts can be fitted and all bolts correctly tightened to the specified torque.

There are no user serviceable items in the product; although it is recommended that for critical services the valve should be inspected for wear at an interval to be determined by the user according to the severity of the duty.

3.2.8 Bellows

3.2.8.1 Bolt Holes

Bellows are supplied with threaded bolt holes as standard. These should not be drilled out to create clearance holes due to the possibility of nuts/studs hitting the PTFE convolutions, leading to bellows failure or damage to the bellows during the drilling process. In some circumstances there is no danger of nuts/studs hitting the convolutions, and so bellows flanges with clearance holes can be supplied. Consult the factory if clearance holes are required.

When installed, no more than 2 threads of the connecting studs should protrude beyond the back face of the bellows flanges

3.2.8.2 Initial Inspection

Upon receipt from the manufacturer, a bellows should be thoroughly inspected to ensure that it has not been damaged during transit from the factory. If at all possible, this inspection should be carried out in a clean, dry, covered area to avoid any potential damage during the inspection process. The specification of the bellows supplied should be checked against that ordered both in terms of its physical attributes (size, flange type, number of convolutions etc.) and also any special elements such as root ring material. The flare faces should be examined to ensure that they are free from scratches or other damage that would allow the joint to leak. Also, the convolutions should be examined to look for any abrasion, nicks in the PTFE, or any other damage. Once the bellows have been examined, the end caps and other protection should be refitted until the bellows is due to be installed.

3.2.8.3 Installation

Lifting

If a bellows is to be lifted by crane or other mechanical lifting device, it should be slung from one or more of the tie rods, but ensuring that the sling does not press against the convolutions. Never lift by slinging around or through the PTFE convolutions themselves.

End Caps

All bellows are supplied with end caps covering both flare faces. These should be kept in place until immediately prior to installation of the bellows. After installation, it is good practice to keep the end caps so that if the bellows are removed from service during maintenance or similar, the end caps can be refitted to protect the flare faces.

Tie Rods

Tie rods are supplied set to limit the axial extension of the bellows to the maximum allowable length. These should never be increased, although if it is desired to limit the axial extension of the bellows they can be shortened. The tie rods should never be removed. It should be noted that the tie rods are not designed to be sufficiently strong to resist all possible axial loads that could be applied by a piping system. Rather they are designed to resist any loads generated by pressure inside the bellows themselves.

Limit Sleeves

The limit sleeves are supplied set to prevent the bellows from being over compressed. These should never be removed.

Movement Range Setting

Ideally a bellows should be fitted such that the movements it experiences results in the bellows being as near its neutral length as much as possible, since this will ensure its life is maximised. It may therefore be appropriate to install the bellows extended or compressed compared to its neutral length so that at its operating temperature it has returned to approximately its neutral length.

In a similar vein, if a bellows is to cope with a movement say of 20 mm axially, it would be better to arrange the adjacent pipework such that the movement is +/-10mm about the neutral length rather than the neutral length +20/-0mm.

Post Installation Inspection

After installation, and again after the first process cycle, the bellows should be re-inspected particularly to detect any increased misalignment compared to the design amounts. If any increase has occurred appropriate action should be taken to remedy the situation.

Welding

Weld spatter hitting the PTFE convolutions will cause bellows to fail prematurely. It is therefore vital that welding is not allowed in the vicinity of bellows at any time.

Safety Shields

For all PTFE bellows, excluding those with a metallic outer, there is only one layer of PTFE between the contained fluid and the outside world. Therefore, CRP recommends the use of safety shields on bellows for hazardous duties.

Pipe Supports

Bellows should not be fitted and the system pressure tested until all of the supports on the adjacent pipework have been installed. Failure to do this could lead to the bellows being forced to move beyond their allowable limits, causing premature failure.

Almost all pipework systems are subject to a variety of forces, such as thermal expansion, vibration, internal pressure etc. which can give rise to unwanted pipework movements. To ensure the longevity of the pipework system it is critical that these movements are considered and suitable measures, including pipework supports are taken to accommodate them. PTFE bellows can provide one part of the solution in accommodating such movements. It is beyond the scope of this document to define suitable pipe supports, however with regard to bellows the designer must take account of the following:

Pipework adjacent to bellows must be suitably supported to prevent inappropriate loads being transferred to the bellows. E.g. A vertically mounted bellows must not be relied upon to support the weight of the pipework mounted above or below it.

Bellows have significant spring rates, and can exert significant loads on adjacent pipework as they are expanded or compressed.

As bellows are pressurised, this creates end loads on the adjacent pipework.

Nb. For the above reasons vertically mounted bellows should not be attached directly to vessels on load cells.

3.2.8.4 Maintenance and Routine Inspection

Bellows are largely maintenance free items. However, regular inspections are required of them. The following items should be checked on a regular basis:

Metallic Components

Tie rods, flanges and root rings. These items should be inspected on a regular basis to look for any signs of damage or corrosion. If any significant damage or corrosion is detected, the bellows should be removed from service. In addition, it should be checked that the tie rods can move freely within the holes in the bellows flanges.

Leakage

If any leakage around the bellows is detected, or if any significant damage or discolouration of the PTFE convolutions is detected, this should be investigated and appropriate action taken. Appropriate precautions must be taken not to endanger personnel during any such investigations.

Movement

When the pipework system was initially installed, the movements that the bellows had to accommodate should have been within the allowable ranges. However, in time, if the process changes, or there is any subsequent movement in the pipework, this may result in the movements required of the bellows falling outside the acceptable limits. If this is found to be the case, steps should be taken immediately to remedy the situation.

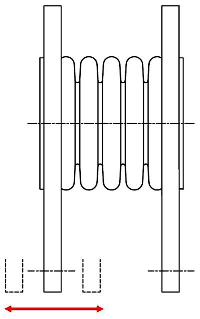
PTFE Convolutions

The PTFE convolutions of a bellows should be inspected regularly for signs of external and internal damage. If any significant damage is found the bellows should be immediately removed from service.

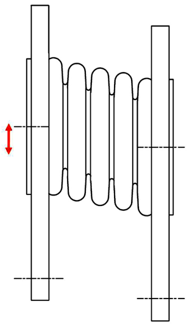
3.2.8.5 Allowable Bellows Movements

Bellows are designed to allow axial, lateral and angular movements, and combinations of these movements.

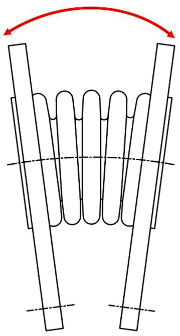
Axial Movement



Lateral Movement



Angular Movement



It is not allowable to have the maximum amount of any one movement combined with any amount of the other possible movements. The following is a useful rule of thumb in trying to assess situations where a combination of movements is required:

Let:

Dx = axial movement
Dy = lateral movement
Da = angular movement

$$\frac{Dx}{Dx_{max}} + \frac{Dy}{Dy_{max}} + \frac{Da}{Da_{max}} \leq 1$$

Nb.

Bellows are not designed to allow torsional (rotation around their axis) movements. If torsional movements occur this will compromise the integrity of the bellows and lead to immediate or premature failure.

3.2.8.6 General Comments

Due to the nature of PTFE bellows, extra care must be taken when handling, installing and using these products. In particular the following issues must be addressed to ensure satisfactory operation of the bellows:

Bellows are not designed to accommodate incorrect pipework installation. In fact they should be fitted with as much care as a pump and similar equipment.

In assessing the required movements from a bellows, likely construction tolerances should be taken into account.

Do not use abrasives such as steel wool, wire brushes or emery paper to clean bellows. These can cause scratches on the PTFE leading to premature failure of the bellows.

If there is a possibility of temperature or pressure surges, beyond the operating range of the bellows, systems must be put in place to prevent such surges from occurring.

If a bellows is to be used with abrasive slurries or solids, a smooth bore internal sleeve should be used to ensure smooth flow through the bellows and to minimise the risk to the PTFE convolutions from abrasion by the contained fluid.

3.2.9 Atomac and Durco Valve Products

Please refer to the appropriate Installation, Operation and Maintenance Manuals on the website.

4. User Instructions

4.1 Generic User Instructions

It is the responsibility of the user to ensure that the products are suitable for conveying the intended chemical(s) and for the intended operating conditions. Specifically, consideration must be given to the effects of corrosion, erosion/wear, including potential effects from turbulence and vortices etc. It should be noted that while PTFE/PFA/FEP have outstanding corrosion resistance, they have limited erosion resistance, and contained fluid velocities should be kept below 15m/s. In addition, these products are not approved for conveying unstable fluids.

Solids or slurry handling can create erosion in addition to corrosion. The following list provides general guidance on the handling of slurries. However the degree of erosion is dependent on the nature of the solids being handled, and therefore in cases of doubt, it is recommended that testing be carried out to prove the suitability of lined piping.

The contained fluid and solids should be chemically compatible with the lining.

Ideally, the flow velocity should be kept at 0.6 to 1.2 m/sec but in any case should not be more than 2.1 m/sec. Consideration must be given to components where the flow path is convoluted, since this may give rise to local flow velocities in excess of the general flow velocity.

To minimize erosion, particle sizes should be less than 60 microns. Particle sizes greater than 150 microns will likely result in unacceptable levels of erosion. Intermediate particle sizes will likely result in acceptable levels of erosion.

Long radius elbows should be used.

Regular inspections of the insides of the lined piping system should be conducted to ensure that no excessive erosion has occurred.

In designing the support structure the user must take into account the following factors in both operating and test conditions, and the possibility of more than one of these loads occurring simultaneously:

- Internal pressure from the contained fluid.
- The mass of the contained fluid.
- Traffic, wind and earthquake loading.
- The potential to overstress the flanges.
- Vibration.
- Reaction forces and moments which result from the supports, attachments, thermal movement, other piping etc.
- Fatigue etc.

In earthquake conditions, CRP is unable to guarantee the integrity of its products, and the user must take suitable precautions to guard against potential product failure and its consequences in these circumstances.

It is the responsibility of the user to ensure that suitable pressure relief and other appropriate safety devices have been included in the design of the entire pressure system, and that discharges from such equipment have been considered, including draining facilities to prevent liquid build up in gas lines which may give rise to water hammer.

If the products are to reach temperatures during operation or test which would be harmful to individuals should they come in contact with the products in these conditions, it is the user's responsibility to overcome this hazard.

The user is responsible for ensuring that suitable provision is made to allow for any necessary draining and venting of the system.

The user is responsible for ensuring that suitable provision is made to allow for isolation of take off pipes if these are of a size to present a significant risk. In addition, the risk of inadvertent discharge must be minimised, and the take off points must be clearly marked on the permanent side, indicating the fluid contained.

While CRP applies a corrosion resistant undercoat/paint to products, or other customer specific paint, prior to despatch, unless specifically instructed not to do so by the customer, or it is unnecessary due to the materials of construction, the user is responsible for the maintenance of the exterior of the products to prevent corrosive attack.

Where, under reasonably foreseeable conditions, the allowable pressure limits of the products could be exceeded, the user is responsible for the fitting of suitable protective devices, and, if appropriate adequate monitoring devices.

By their nature, PTFE/PFA/FEP lined products are not fire proof (the PTFE/PFA/FEP lining will melt under extremes of heat). Also, the integrity of the glass elements of sight glasses cannot be guaranteed under such conditions. Therefore, if appropriate, the user must consider how to meet any damage limitation requirements in the event of a fire.

If lined pipes or other products are to be placed underground, it is recommended that, as a minimum, their position and route be recorded in the technical documentation to facilitate safe maintenance, inspection and repair.

If lined equipment is to be used to for wet chlorine duty, the maximum temperature must not exceed 150°C. Above this temperature, any chlorine that permeates the liner may react with the steel shell, and cause a fire.

4.2 Product Specific User Instructions

4.2.1 ½"NB – 14"NB Spools & Lined Fittings

4.2.1.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

These are determined by the lowest of the allowable limits for the items comprising the spools/fittings. In most cases the flanges are the limiting factor (see tables below). Nb. Pressures are shown in bar(g).

For pressure ratings at intermediate temperatures in the tables below, linear interpolation can be used to calculate allowable pressures.

Flange Class	Temp (°C)	1	2	3	4	5
ASME B16.5, Class 150	-29 to 38	19.6	19.0	19.0	15.9	16.3
	50	19.2	18.3	18.4	15.3	16.0
	100	17.7	15.7	16.2	13.3	14.9
	150	15.8	14.2	14.8	12.0	14.4
	200	13.8	13.2	13.7	11.2	13.8
ASME B16.5, Class 300	-29 to 50	31.0	31.0	31.0	31.0	31.0
	100	27.8	27.8	27.8	27.8	27.8
	150	23.7	23.7	23.7	23.7	23.7
	200	20.0	20.0	20.0	20.0	20.0

Flange Material Types

1. ASTM A105, ASTM A350 Grade LF2, ASTM A216 Grade WCB
2. ASTM A182 Grade F304
3. ASTM Grade F316
4. ASTM A182 Grades F304L and F316L
5. BS1501-161 Grade 430A,

Flange Class	Temp (°C)	Flange Materials									
		A	B	C	D	E	F	G	H	J	K
BS EN 1092-1 PN10	-10 to +50	10.0	10.0	9.1	9.1	7.6	9.1	8.9	9.3	9.1	8.4
	100	8.0	10.0	7.5	7.8	6.3	8.3	6.9	6.9	7.8	7.3
	150	7.5	9.7	6.8	7.1	5.7	8.1	6.2	6.2	7.0	6.7
	200	6.9	9.4	6.3	6.6	5.3	7.9	5.6	5.6	6.4	6.1
BS EN 1092-1 PN16	-10 to +50	16.0	16.0	14.7	14.7	12.3	14.7	14.2	14.9	14.6	13.5
	100	12.8	16.0	12.1	12.5	10.2	13.4	11.0	11.0	12.4	11.7
	150	11.9	15.6	11.0	11.4	9.2	13.0	10.0	10.0	11.2	10.7
	200	11.0	15.1	10.2	10.6	8.5	12.6	9.0	9.0	10.3	9.7

Flange Materials:

A: DIN 17100 R.St 37.2 (EN10025 S235 JRG2, Werkstoff No. 1.0038, C22.8)
B: ASTM A105, ASTM A350 Gr. LF2, ASTM A216 Gr. WCB.
C: ASTM A182 Gr. F304
D: ASTM A182 Gr. F316
E: ASTM A182 Gr. F304L, 316L
F: BS1501-161-430A, ASTM A516 Gr. 60, EN10028-2 P265GH
G: EN10222-5 Grade X5CrNi18-10, EN10213-4 Grade GX5CrNi19-10, and EN10028-7 Grade X5CrNi18-10 (304)
H: EN10222-5 Grade X2CrNi18-9, EN10213-4 Grade GX2CrNi19-11, and EN10028-7 Grade X2CrNi19-11 (304L)
J: EN10222-5 Grade X5CrNiMo17-12-2, EN10213-4 Grade GX5CrNiMo19-11-2, and EN10028-7 Grade X5CrNiMo17-12-2 (316)
K: EN10222-5 Grade X2CrNiMo17-12-2, EN10213-4 Grade GX2CrNiMo19-11-2, and EN10028-7 Grade X2CrNiMo17-12-2 (316L)

Flange Class	Temp (°C)	Minimum Pressure	Maximum Pressure
BS10 Table D	-17.8 - 200		6.9
BS10 Table E	-17.8 - 200		13.8
ISO1609	-29 - 200	-1	1.5

However, in a few cases, the pipe can be the limiting factor. The tables below show the situations where this may be the case. If the pipe doesn't appear, then this means that it can never be the pressure limiting factor for the spool/fitting.

	OD	Wall		Max Allowable Pressure (bar(g)) at:				
DN	(mm)	(mm)	Material	RT*	50C	100C	150C	200C
250	273	2.9	L	N/a	N/a	27.5	N/a	N/a
			M	N/a	28.9	26	23.2	N/a
300	323.9	3.2	L	30.9	29.3	25.5	22.8	N/a
			M	28.9	26.9	24.2	21.5	19.5
			N	N/a	30.9	N/a	N/a	N/a
			P	30.2	29.2	26.9	N/a	N/a
		3.6	M	N/a	30.3	27.3	N/a	N/a
350	355.6	3.6	L	N/a	30	26.2	23.4	N/a
			M	29.6	27.6	24.8	22	20
			P	N/a	29.9	27.6	N/a	N/a
		4	M	N/a	30.7	27.6	N/a	N/a

Pipe Materials:

L: EN10216-5 Seamless & EN10217-7 Welded Grade X5CrNi18-10 (304).
M: EN10216-5 Seamless & En10217-7 Welded Grade X2CrNi19-11 (304L).
N: EN10216-5 Seamless & En10217-7 Welded Grade X5CrNiMo17-12-2 (316).
P: EN10216-5 Seamless & EN10217-7 Welded Grade X2CrNiMo17-12-2 (316L).

* RT = Room Temperature

			Max Allowable Pressure (bar(g)) at:	
Pipe NB	Pipe Schedule	Material	-29 to 149C	150 to 200C
6	10	R	27.7	N/a
		S	24.9	23.5
		T	29.7	N/a
8	10	R	25.3	23.6
		S	21.1	19.9
		T	25.3	N/a
		U	21.1	19.5
10	10	R	22.6	21.1
		S	18.9	17.9
		T	22.6	21.8
		U	18.9	17.5
12	10	R	20.7	19.4
		S	17.3	16.4

			Max Allowable Pressure (bar(g)) at:	
Pipe NB	Pipe Schedule	Material	-29 to 149C	150 to 200C
12	10	T	20.7	20.1
		U	17.3	16.1
	20	R	28.9	N/a
		S	24.1	22.8
		T	28.9	N/a
		U	24.1	22.3
		V	30.7	30.7
14	10	R	26.3	N/a
		S	21.9	20.7
		T	26.3	N/a
		U	21.9	20.3
	20	S	27.4	25.9
		U	27.4	N/a

Pipe Materials:

R: ASTM A312 TP304.
S: ASTM A312 TP304L.
T: ASTM A312 TP316
U: ASTM A312 TP316L
V: ASTM A333 Gr.6

The vacuum performance of spools and fittings are as detailed below:

Product	Size Range	Rating	Temperature Range
Spools	1/2" – 8" NB	full vacuum	-29°C to +200°C
Spools	10" & 12" NB (heavy duty liner)	full vacuum	-29°C to +150°C
Spools	14" NB (standard duty liners)	full vacuum	-29°C to +50°C
Fittings	1/2" – 6" NB	full vacuum	-29°C to +200°C
Fittings	8" – 14" NB	consult factory	

4.2.2 Spacers – Types 1, 2, & 3

4.2.2.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

These are determined by the lowest of the allowable limits for the adjacent components. (See tables below).

Flange Class	Temp (°C)	Maximum Pressure
ASME B16.5, Class 150 & Class 300	-29 to 38	19.6
	50	19.2
	100	17.7
	150	15.8
	200	13.8
BS EN 1092-1 PN10	-10 to +50	10.0
	100	10.0
	150	9.7
	200	9.4
BS EN 1092-1 PN16	-10 to +50	16.0
	100	16.0
	150	15.6
	200	15.1
BS10 Table D	-17.8 to 200	6.9
BS10 Table E	-17.8 to 200	13.8
ISO1609	-29 – 200	1.5

NB.

1. Type 1 spacers are unsuitable for pressures greater than those of ASME B16.5 Class 150.
2. Pressures are shown in bar(g).

4.2.3 CTSG, DTSG and BFSG Tubular Sight Glasses

In assessing the suitability of a CTSG/DTSG/BFSG for a particular service duty, it should be noted that the tubular elements of these sight glasses are made from borosilicate glass 3.3 to ISO 3585, and the user must confirm the fitness of this glass for conveying the intended chemicals. Further, if an unlined tubular sight glass is being used, the user must ensure the compatibility of the contained fluid with the flange material.

These products are unsuitable for resisting torsional loads and the support system should ensure that these are not applied.

4.2.3.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

In all cases, these products can withstand full vacuum across their entire operating temperature range. The one exception to this is if a PFA/FEP liner has been added to the inside of the glass, in which case the sight glass is not suitable for vacuum duties. The maximum allowable operating pressures are determined by the lowest of the allowable limits for the items comprising the sight glasses. In most cases the glass is the limiting factor (see the table below – data is for all temperatures from –29°C to +150°C. Pressures are shown in bar(g).

Glass Tube NB	Maximum Pressure
½”	10
¾”	10
1”	10
1½”	10
2”	10
2½”	10
3”	10
4”	10
5”	10
6”	6
8”	5
10”	3
12”	3

However, in a few cases, the flanges can be the limiting factor. The tables below show the situations where this may be the case. If the flange doesn’t appear, then this means that it can never be the pressure limiting factor for the sight glass. NB The pressures shown here (given in bar(g)) are applicable across the entire operating temperature range.

Flange Class	Temp (°C)	Flange Material Type				
		1	2	3	4	5
BS EN 1092-1 PN10	-10 to 50	10.0	9.1	9.1	7.6	10.0
	100	10.0	7.5	7.8	6.3	9.3
	150	9.7	6.8	7.1	5.7	8.7
		Maximum Pressure				
BS10 Table D	-17.8 to 200	6.9				

Flange Material Types

1. BS1501-161-430A
2. ASTM A216 Grade WCB
3. ASTM A240 Gr. 304, BS970:1991 Gr. 304S15, 230M07, 070M20
4. ASTM A240 Gr. 316, BS970:1991 Gr. 316S31
5. ASTM A240 Gr. 304L, 316L, BS970:1991 Gr. 304S11, 316S11

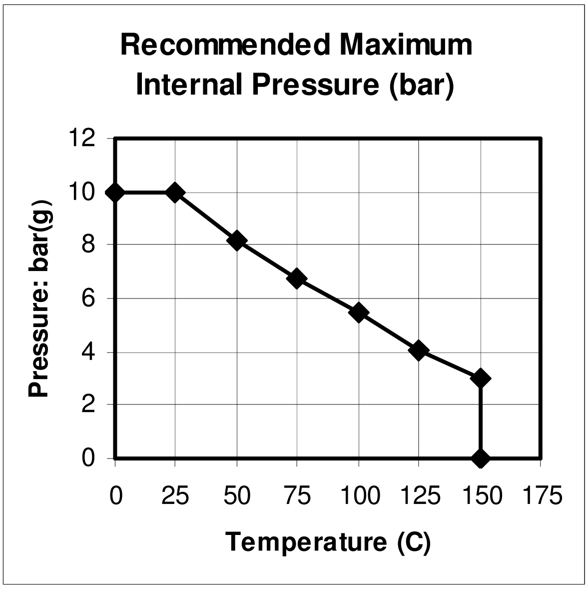
Further with the BFSG Range of products, the floating ball is the limiting pressure factor. For 1” – 2” NB the maximum pressure is 6 bar(g). For the larger sizes the maximum pressure is 4 bar(g). These pressures apply across the entire temperature range.

4.2.4 LGSG Tubular Sight Glasses

These products are unsuitable for resisting torsional loads and the support system should ensure that these are not applied.

4.2.4.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

These are determined by the lowest of the allowable limits for the items comprising the sight glasses. In most cases the PFA lining is the limiting factor (see the graph below).



However, in a few cases, the flanges can be the limiting factor. The tables below show the situations where this may be the case. If the flange doesn’t appear, then this means that it can never be the pressure limiting factor for the sight glass.

Flange Class	Temp (°C)	Flange Material Type						
		1	2	3	4	5	6	7
BS EN 1092-1 PN10	-10 to 50	10.0	10.0	10.0	10.0	9.1	9.1	7.6
	100	10.0	9.3	8.0	9.3	7.5	7.8	6.3
	150	9.7	8.7	7.5	8.7	6.8	7.1	5.7
		Maximum Pressure						
BS10 Table D	-17.8 to 200	6.9						

Flange Material Types

1. ASTM A105, ASTM A350 Gr. LF2, ASTM A216 Gr. WCB
2. BS1501-161-430A
3. DIN 17100 R.St 37.2
4. DIN 2528 C22.8
5. ASTM A182 Gr. F304
6. ASTM A182 Gr. F316
7. ASTM A182 Gr. F304L, F316L

4.2.5 WPCV, FPCV and SPCV Poppet Check Valves

When considering draining and venting of systems containing check valves, consideration must be given to the non-return flow characteristics of the valves.

In assessing the suitability of SPCV valves, for a particular service duty consideration must be given to the corrosion and erosion resistance of the borosilicate glass used in the sight glass element of the valves. These are made from borosilicate glass 3.3 to ISO 3585.

4.2.5.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

In all cases, these products can withstand full vacuum across their entire operating temperature range. Their maximum operating pressures are as detailed below:

WPCV	Temperature range:	-29°C to +200°C.
	Pressure range:	-1 to 19.6 bar(g).
SPCV	Temperature range:	-29°C to +150°C.
	Pressure range:	-1 to 10.0 bar(g).

FPCV: See table below for details of the allowable pressure and temperature ranges for these valves. These are determined by the lowest of the allowable limits for the flanges on the ends of the valves. Nb. Pressures are in bar(g).

Flange Class	Temp (°C)	1	2	3	4	5
ASME B16.5, Class 150	-29 to 38	19.6	19.0	19.0	15.9	16.3
	50	19.2	18.3	18.4	15.3	16.0
	100	17.7	15.7	16.2	13.3	14.9
	150	15.8	14.2	14.8	12.0	14.4
	200	13.8	13.2	13.7	11.2	13.8
BS EN 1092-1 PN10	-10 to 50	10.0	9.1	9.1	7.6	10.0
	100	10.0	7.5	7.8	6.3	9.3
	150	9.7	6.8	7.1	5.7	8.7
	200	9.4	6.3	6.6	5.3	7.8
BS EN 1092- 1 PN16	-10 to 50	16.0	14.7	14.7	12.3	16.0
	100	16.0	12.1	12.5	10.2	14.9
	150	15.6	11.0	11.4	9.2	13.9
	200	15.1	10.2	10.6	8.5	12.4
		Maximum Pressure				
BS10 Table D	-17.8 to 200	6.9				
BS10 Table E	-17.8 to 200	13.8				

Flange Material Types

1. ASTM A105, ASTM A350 Grade LF2, ASTM A216 Grade WCB
2. ASTM A182 Grade F304, ASTM A240 Grade 304
3. ASTM Grade F316, ASTM A240 Grade 316
4. ASTM A182 Grades F304L and F316L, ASTM A240 Grades 304L and 316L
5. BS1501-161 Grade 430A

4.2.6 Dip Legs and Dip Pipes

4.2.6.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

In all cases, these products can withstand full vacuum across their entire operating temperature range. Their maximum operating pressures are determined by the lowest of the allowable limits for the items comprising the dip legs/pipes. In most cases the flanges are the limiting factor (see tables below). NB Pressures are shown in bar(g).

Flange Class	Temp (°C)	Flange Material Type				
		1	2	3	4	5
ASME B16.5, Class 150	-29 to 38	19.7	19.0	19.0	15.9	18.3
	93	17.9	15.9	16.2	13.4	17.2
	149	15.9	14.1	14.8	12.1	15.9
	200	13.8	13.1	13.4	11.0	13.8
ASME B16.5, Class 300	-29 to 38	31.0	31.0	31.0	31.0	31.0
	93	27.8	27.8	27.8	27.8	27.8
	149	23.7	23.7	23.7	23.7	23.7
	200	20.0	20.0	20.0	20.0	20.0
BS EN 1092-1 PN10	-10 to 50	10.0	9.1	9.1	7.6	10.0
	100	10.0	7.5	7.8	6.3	9.3
	150	9.7	6.8	7.1	5.7	8.7
	200	9.4	6.3	6.6	5.3	7.8
BS EN 1092- 1 PN16	-10 to 50	16.0	14.7	14.7	12.3	16.0
	100	16.0	12.1	12.5	10.2	14.9
	150	15.6	11.0	11.4	9.2	13.9
	200	15.1	10.2	10.6	8.5	12.4
		Maximum Pressure				
BS10 Table D	-17.8 to 200	6.9				
BS10 Table E	-17.8 to 200	13.8				

Flange Material Types

1. ASTM A105, ASTM A350 Gr. LF2, ASTM A216 Gr. WCB
2. ASTM A182 Gr. F304
3. ASTM A182 Gr. F316
4. ASTM A182 Gr. F304L, F316L
5. BS1501-161- Grade 430A

Adapter Flanges

Adapter Flange	Max. pressure (bar(g)
400x25	25.0
400x40	25.5
400x50	26.0
400x80	27.0
400x100	29.0

NB While every effort is made to ensure that the products supplied are to specification, the user should note that it is impossible to pressure test dip leg/pipes and, therefore, as part of plant commissioning such a test should be undertaken.

4.2.7 Blanking Spades, Lined Spectacle Blinds and Solid PTFE Spectacle Blinds

4.2.7.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

In all cases, these products can withstand full vacuum across their entire operating temperature range. Their maximum operating pressures are as detailed below:

DN	Maximum Pressures (bar(g))					
	Blanking Spades		PTFE/PFA Lined Steel Spectacle Blinds	Solid PTFE Spectacle Blinds		
	-29°C to 149°C	150°C to 200°C		23°C	100° C	200° C
15	31	31	31.0	31	31	24
20	31	31	31.0	31	31	24
25	31	31	31.0	31	27	15
40	31	31	31.0	25	11	6.4
50	24	22	31.0	31	18	10
80	11	10	31.0	18	8.1	4.5
100	6.3	5.9	30.6	29	13	7.4
150	2.8	2.6	31.0	13	5.9	3.3
200	1.6	1.5	31.0	7.3	3.3	1.8
250	1.0	0.93	31.0	n/a	n/a	n/a
300	0.68	0.64	31.0	n/a	n/a	n/a
350	0.57	0.54	n/a	n/a	n/a	n/a
400	0.43	0.41	n/a	n/a	n/a	n/a

NB For PTFE/PFA lined items, the operating temperature range is –29°C to 200°C. For FEP lined items the range is –29°C to 150°C.

For solid PTFE spectacle blinds the limits are for blinds of the thicknesses detailed below. For other thicknesses contact CRP for details of pressure limits.

All pressures are shown in bar (g)

DN	Thickness	DN	Thickness
15	10	80	16
20	10	100	27
25	10	150	27
40	10	200	27
50	16		

4.2.8 Tee Piece and Bulls Eye Sight Glasses

In assessing the suitability of tee piece and bulls eye sight glasses, for a particular service duty it should be noted that the glass elements of these sight glasses are made from borosilicate glass to DIN 7080, and, if the glass is unlined, the user must confirm the suitability of this glass for conveying the intended chemicals.

4.2.8.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

In all cases, these products can withstand full vacuum across their entire operating temperature range. Their maximum operating pressures are determined by the lowest of the allowable limits for the flanges on the sight glasses and are as detailed below. NB. All pressures are shown in bar (g).

Cast Sight Glasses

Temp (°C)	Operating Pressures (Bar(g))	
	Min	Max
-29 to 38	-1	19.6
50	-1	19.2
100	-1	17.7
150	-1	15.8
200	-1	13.8

Fabricated Sight Glasses

Flange Class	Temp (°C)	Flange Material Type	
		1	2
ASME B16.5, Class 150	-29 to 38	19.6	16.3
	50	19.2	16.0
	100	17.7	14.9
	150	15.8	14.4
	200	13.8	13.8
BS EN 1092-1 PN10	-10 to 50	10.0	9.1
	100	10.0	8.3
	150	9.7	8.1
	200	9.4	7.9
BS EN 1092-1 PN16	-10 to 50	16.0	14.7
	100	16.0	13.4
	150	15.6	13.0
	200	15.1	12.6
		Maximum Pressure	
BS10 Table D	-17.8 to 200	6.9	
BS10 Table E	-17.8 to 200	13.8	

Flange Material Types

1. ASTM A105, ASTM A350 Grade LF2, ASTM A216 Grade WCB
2. BS 1501-16-430A, DIN 2528 C22.8

The glass discs on sight glasses must never be loosened or removed when the internal pressure in the sight glass is other than ambient, nor when there is a contained fluid present whose leakage would be hazardous to personnel or equipment.

4.2.9 STCV Swing Check Valves

When considering draining and venting of systems containing check valves, consideration must be given to the non-return flow characteristics of the valves.

4.2.9.1 Maximum and Minimum Allowable Operating Pressures and Temperatures

For these valves the maximum operating pressure is limited to that of an ASME B16.5 Class 150 flanged component of the same material, as detailed in the table below – pressures are shown in bar (g).

	Valve Material	
Temperature (°C)	ASTM A216 Gr. WCB	ASTM A351 Gr. CF8M
-29 – 38	19.7	19.0
93	17.9	16.2
149	15.9	14.8
200	13.8	13.4

4.2.10 Bellows

4.2.10.1 Maximum and Minimum Allowable Operating Pressure and Temperatures

These are as detailed in the CRP bellows brochure. Under no circumstances should these be exceeded.

EC Declaration of Conformity

I hereby declare that the products listed below, comply with the requirements of the relevant sections of the Pressure Equipment Directive 2014/68/EU.

Manufactured by:

CRP Ltd, Todmorden Road, Littleborough, OL15 9EG, UK.

Authorised Representative:

Gefa Processtechnik GmbH, Germaniastraße 28, 44379 Dortmund, Germany

Assessed by the notified body:

Irish Engineering Services, RSA House, Dundrum Town Centre, Sandyford Rd, Dublin 16, Ireland.
Notified Body No.: 2820
Certificate No.: CAT000530371/PED/v1.0

Assessed against the requirements of the Conformity Assessment Procedure:

Module H

Designed & manufactured to meet the appropriate requirements of the following standards as relevant:

ASME B31.3
ASTM F1545
DIN 2848
DIN 2874

Product Range:

Description	Nominal Bore Size Range
PTFE Lined Pipe Spools:	>DN25 – DN350
CTSG & DTSG Tubular Sight Glasses	>DN25 – DN300
BFSG Tubular Sight Glasses	>DN25 – DN150
PTFE Lined Dip Pipes/Dip Legs	>DN25 – DN100
LGSG Tubular Sight Glasses	>DN25 – DN50
PTFE/PFA Lined Elbows (all angles up to 180°)	>DN25 – DN350
PFA Lined Tees (equal and reducing)	>DN25 – DN350
PFA Lined Lateral Tees (equal and reducing)	>DN25 – DN350
PFA Lined Instrument Tees	>DN25 – DN350
PFA Lined Short Stack Tees	>DN25 – DN350
PFA Lined Crosses (equal and reducing)	>DN25 – DN300
PTFE/PFA Lined Concentric & Eccentric Reducers	>DN25 – DN300 (large flange end)
PTFE/PFA Lined Reducing Flanges	>DN25 – DN600 (large side)
PTFE/PFA Lined Blank Flanges	>DN25 – DN600
WPCV, FPCV, and SPCV PFA Lined Poppet Check Valves	>DN25 – DN100
PTFE Type 1 Spacers	>DN25 – DN300
PTFE Lined Type 2 & 3 Spacers	>DN25 – DN300
PTFE/PFA Lined Blanking Spades	>DN25 – DN350
PTFE/PFA Lined Spectacle Blinds	>DN25 – DN300
Solid PTFE Spectacle Blinds	>DN25 – DN200
Tee Piece Sight Glasses	>DN25 – DN100
Bulls Eye Sight Glasses	>DN25 – DN100
Swing Check Valves	DN100 – DN300
Bellows	>DN25 – DN900

Signed David MacGregor …………………………………… David MacGregor, Engineering Manager