User Guide

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. 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 at the back of this leaflet.

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 board's 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 at 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.

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 3mm 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 trapped gas andIf 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) To 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 torquing, of bolts should be undertaken at ambient temperature.

It is recommended that all bolts are retorqued 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.

Nominal Bore		Torque		Bolts/Studs		
Imp	Metric	Ft Ibs	Nm	Qty	Size (Metric)	Size (UNC)
1"	25	14	19	4	M12	1/2"
1.1/2"	40	20	27	4	M12	1/2"
2"	50	35	47	4	M16	5/8"
3"	80	54	73	4	M16	5/8"
4"	100	40	54	8	M16	5/8"
6"	150	80	108	8	M20	3/4"
8"	200	100	136	8	M20	3/4"
10"	250	94	127	12	M24	7/8"
12"	300	107	145	12	M24	7/8"

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℃ 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	Component	Flange Thickness	Steel Flare/Stub End Thickness	Liner Thickness/ Upstand	Half Joint Total Thickness
1"	Vanstone Spool	15.0	3.0	2.5	20.5
1 1/2"	Vanstone Spool	18.0	3.0	2.5	23.5
2"	Vanstone Spool	20.0	3.0	2.5	25.5
3"	Vanstone Spool	24.0	3.0	2.5	29.5
4"	Vanstone Spool	24.0	5.0	4.0	33.0
1"	Standard Spool Fixed Flange	15.0		2.5	17.5
1 1/2"	Standard Spool Fixed Flange	18.0		2.5	20.5
2"	Standard Spool Fixed Flange	19.0		2.5	21.5
3"	Standard Spool Fixed Flange	24.0		2.5	26.5
4"	Standard Spool Fixed Flange	24.0		4.0	28.0
6"	Standard Spool Fixed Flange	26.0		5.0	31.0
8"	Standard Duty Spool Fixed Flange	29.0		4.0	33.0
10"	Standard Duty Spool Fixed Flange	31.0		4.0	35.0
12"	Standard Duty Spool Fixed Flange	32.0		5.0	37.0
8"	Heavy Duty Spool Fixed Flange	29.0		6.0	35.0
10"	Heavy Duty Spool Fixed Flange	31.0		7.0	38.0
12"	Heavy Duty Spool Fixed Flange	32.0		8.0	40.0
1"	Standard Spool Rotating Flange	15.0	12.0	2.5	29.5
1 1/2"	Standard Spool Rotating Flange	18.0	12.0	2.5	32.5
2"	Standard Spool Rotating Flange	19.0	14.0	2.5	35.5
3"	Standard Spool Rotating Flange	24.0	16.0	2.5	42.5
4"	Standard Spool Rotating Flange	24.0	16.0	4.0	44.0
6"	Standard Spool Rotating Flange	26.0	18.0	5.0	49.0
8"	Standard Duty Spool Rotating Flange	29.0	20.0	4.0	53.0
10"	Standard Duty Spool Rotating Flange	31.0	22.0	4.0	57.0
12"	Standard Duty Spool Rotating Flange	32.0	22.0	5.0	59.0
8"	Heavy Duty Spool Rotating Flange	29.0	20.0	6.0	55.0
10"	Heavy Duty Spool Rotating Flange	31.0	22.0	7.0	60.0
12"	Heavy Duty Spool Rotating Flange	32.0	22.0	8.0	62.0
1"	Fitting Fixed Flange	15.0		4.5	19.5
1 1/2"	Fitting Fixed Flange	18.0		5.0	23.0
2"	Fitting Fixed Flange	19.0		5.5	24.5
3"	Fitting Fixed Flange	24.0		6.0	30.0
4"	Fitting Fixed Flange	24.0		7.0	31.0
6"	Fitting Fixed Flange	26.0		7.5	33.5
8"	Fitting Fixed Flange	29.0		9.5	38.5
10"	Fitting Fixed Flange	31.0		11.0	42.0
12"	Fitting Fixed Flange	32.0		11.0	43.0
1"	Fitting Rotating Flange	15.0	12.0	4.5	31.5
1 1/2"	Fitting Rotating Flange	18.0	12.0	5.0	35.0
2"	Fitting Rotating Flange	19.0	14.0	5.5	38.5
3"	Fitting Rotating Flange	24.0	16.0	6.0	46.0
4"	Fitting Rotating Flange	24.0	16.0	7.0	47.0
6"	Fitting Rotating Flange	26.0	18.0	7.5	51.5
1"	45 degree Elbow Fixed Flanges(1)	15.0		2.5	17.5
1 1/2"	45 degree Elbow Fixed Flanges	18.0		2.5	20.5
2"	45 degree Elbow Fixed Flanges	19.0		2.5	21.5
3"	45 degree Elbow Fixed Flanges	24.0		2.5	26.5
4"	45 degree Elbow Fixed Flanges	24.0		4.0	28.0
6"	45 degree Elbow Fixed Flanges	26.0		5.0	31.0
8"	45 degree Elbow Fixed Flanges	29.0		9.5	38.5
10"	45 degree Elbow Fixed Flanges	31.0		11.0	42.0
12"	45 degree Elbow Fixed Flanges	32.0		11.0	43.0
1"	45 degree Elbow Rotating/Fixed	15.0	6.0	2.5	23.5
1 1/2"	45 degree Elbow Rotating/Fixed	18.0	12.0	2.5	32.5
2"	45 degree Elbow Rotating/Fixed	19.0	14.0	2.5	35.5
3"	45 degree Elbow Rotating/Fixed	24.0	16.0	2.5	42.5
4"	45 degree Elbow Rotating/Fixed	24.0	16.0	4.0	44.0
6"	45 degree Elbow Rotating/Fixed	26.0	18.0	5.0	49.0
1"	45 degree Elbow Rotating Flanges(1)	15.0	6.0	2.5	23.5
1 1/2"	45 degree Elbow Rotating Flanges(1)	18.0	7.0	2.5	27.5
2"	45 degree Elbow Rotating Flanges(2)	19.0	7.0	2.5	28.5
3"	45 degree Elbow Rotating Flanges(2)	24.0	8.0	2.5	34.5
4"	45 degree Elbow Rotating Flanges	24.0	16.0	4.0	44.0
6"	45 degree Elbow Rotating Flanges	26.0	18.0	5.0	49.0

Notes
(1) Bolt holes threaded 1/2" UNC
(2) Bolt holes threaded 5/8" UNC

3.1.8.2 Nut/Stud Data

UNC Thread	Thread Pitch (mm)	Nut Thickness* (mm)	
		Ordinary	Heavy
1/2"	2	11	13
5/8"	2.3	14	16
3/4"	2.5	17	19
7/8"	2.8	19	23

Metric Thread	Thread Pitch (mm)	Nut Thickness (mm)
M12	1.75	10
M16	2	13
M20	2.5	16
M24	3	19

* 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 spool flange = 23mm + 32.5mm = 55.5mm. To this value add on two off nut thicknesses + clear threads if using studs or one nut thickness + clear threads if using bolts.

3.1.8.3 Wafer Pattern Component Data

Size	Component	Component Thickness
1/2" Branch	Instrument Tee	51.0
3/4" Branch	Instrument Tee	51.0
1" Branch	Instrument Tee	51.0
1 1/2" Branch	Instrument Tee	76.0
2" Branch	Instrument Tee	89.0
3" Branch	Instrument Tee	150.0
1/2"	WPCV	30.0
1"	WPCV	35.0
1 1/2"	WPCV	45.0
2"	WPCV	56.0
3"	WPCV	71.0
4"	WPCV	80.0
1/2"	CTSG/DTSG	34.0
1"	CTSG/DTSG	38.0
1.1/2"	CTSG/DTSG	38.0
2"	CTSG/DTSG	38.0
3"	CTSG/DTSG	43.0
4"	CTSG/DTSG	46.0
6"	CTSG/DTSG	46.0
8"	CTSG/DTSG	45.0
10"	CTSG/DTSG	49.0
12"	CTSG/DTSG	52.0
4"	STCV	52.0
6"	STCV	56.0
8"	STCV	60.0
10"	STCV	68.0
12"	STCV	78.0

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

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

- Release the backing nuts at both end 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	Ft lbs	Nm
1"	25	7.5	10
1.1/2"	40	11	15
2"	50	14.5	20
3"	80	22	30
4"	100	28	37
6"	150	32	44
8"	200	32	44
10″	250	32	44
12″	300	32	44

It is 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

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 (Wafer Poppet Check Valve)

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

- 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. However, 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 externally lined 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 & Bullseye 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 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

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

For guidance on the selection, installation and use of bellows, please refer to the CRP publication “Bellows User Instructions & Technical Guide”.

4. User Instructions

4.1 Generic User Instructions

(1) 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.

(2) 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.

(3) 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.

(4) 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.

(5) 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.

(6) 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.

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

(8) 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, the take off points must be clearly marked on the permanent side, indicating the fluid contained.

(9) While CRP apply 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.

(10) 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.

(11) 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.

(12) 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.

(13) If lined equipment is to be used to for wet chlorine duty, the maximum temperature must not exceed 150℃. 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

NB. Numbered items in the following sections are addenda to the section of the same number in section 1.1 "Generic Information" above.

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

4.2.1 ½" NB – 12" NB Spools & Lined Fittings

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).

Flange Class	Temp (°C)	Flange Material Type						
		1	2	3	4	5	6	7
ASME B16.5, Class 150	-29 to 38	19.7	19.0	19.0	15.9		17.2	18.3
	93	17.9	15.9	16.2	13.4		16.2	17.2
	149	15.9	14.1	14.8	12.1		14.8	15.9
	200	13.8	13.1	13.4	11.0		13.8	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	8.0		
	150	9.7	6.8	7.1	5.7	7.5		
	200	9.4	6.3	6.6	5.3	6.9		
BS EN 1092- 1 PN16	-10 to 50	16.0	14.7	14.7	12.3	16.0		
	100	16.0	12.1	12.1	10.2	12.8		
	150	15.6	11.0	11.0	9.2	11.9		
	200	15.1	10.2	10.2	8.5	11.0		

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. DIN 17100 R.St 37.2
6. ASTM A395
7. BS1501-161 Grade 430A

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 table below shows 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. Nb. The pressures shown here (given in bar(g)) are applicable across the entire operating temperature range.

Pipe NB	Pipe Schedule	Material (All to ASTM A312)			
		TP304	TP304L	TP316	TP316L
6	10	27.64	23.50	28.71	30.22
8	10	23.45	19.94	24.35	19.45
10	10	20.98	17.83	21.79	17.39
12	10	19.29	16.41	20.04	16.00
12	20	N/a	27.83	27.83	22.22

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
Fittings	1/2" – 6" NB	full vacuum	-29°C to +200°C
Fittings	8" – 12" NB	consult factory	

4.2.2 Spacers – Types 1, 2, & 3

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	-29 to 38	19.7
	93	17.9
	149	15.9
	200	13.8
ASME B16.5, Class 300	-29 to 38	31.0
	93	27.8
	149	23.7
	200	20.0
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.

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 pressures. 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℃ to 150℃. 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. BS1501-161-430
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

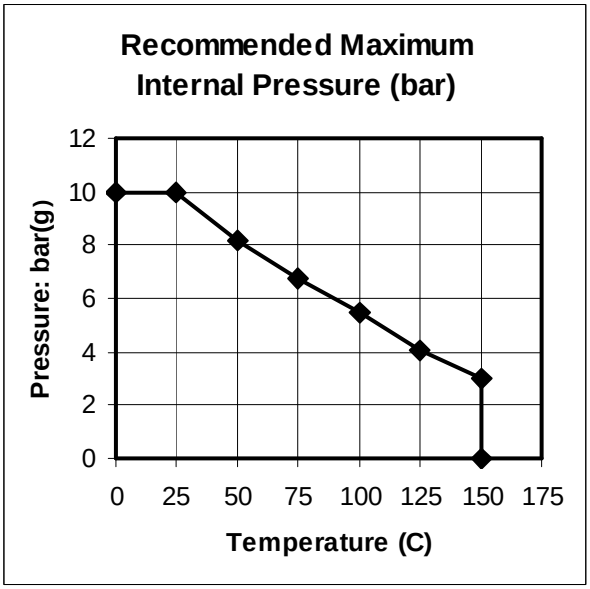
Further with the BFSG Range of products, the floating ball is the limiting pressure factor. With all sizes of BFSG, the pressure is limited to 4bar(g) across the entire temperature range.

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.

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 opposite).



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	10.3	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. BS1501-161-430
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.

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℃ to +200℃.
	Pressure range:	-1 to 19.7 bar(g).
SPCV	Temperature range:	-29℃ to +150℃.
	Pressure range:	-1 to 10.0 bar(g).

FPCV: See tables 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)	Flange Material Type 1	2	3	4	5	6
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
BS EN 1092-1 PN10	-10 to 50	10.0	9.1	9.1	7.6	10.0	10.0
	100	10.0	7.5	7.8	6.3	8.0	9.3
	150	9.7	6.8	7.1	5.7	7.5	8.7
	200	9.4	6.3	6.6	5.3	6.9	7.8
BS EN 1092- 1 PN16	-10 to 50	16.0	14.7	14.7	12.3	16.0	16.0
	100	16.0	12.1	12.5	10.2	12.8	14.9
	150	15.6	11.0	11.4	9.2	11.9	13.9
	200	15.1	10.2	10.6	8.5	11.0	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
3. ASTM Grade F316
4. ASTM A182 Grades F304L and F316L
5. DIN 17100 R.St 37.2
6. BS1501-161 Grade 430A

4.2.6 Dip Legs and Dip Pipes

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 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

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

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 opposite:

DN	Maximum Pressures (bar(g)) Blanking Spades -29°C to 149°C	Blanking Spades 150°C to 200°C	PTFE/PFA Lined Steel Spectacle Blinds	Solid PTFE Spectacle Blinds 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
1. For PTFE/PFA lined items, the operating temperature range is –29℃ to 200℃. For FEP lined items the range is –29℃ to 150℃.
2. 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.
3. All pressures are shown in bar(g).

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

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.

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)	Min	Operating Pressures (Bar(g)) Max ASTM A395	Max ASTM A216 WCB
-29 to 38	-1	17.2	19.7
93	-1	16.2	17.9
149	-1	14.8	15.9
200	-1	13.8	13.8

Fabricated Sight Glasses

Flange Class	Temp (°C)	Flange Material Type 1	2	3
ASME B16.5, Class 150	-29 to 38	19.7	18.3	
	93	17.9	17.2	
	149	15.9	15.9	
	200	13.8	13.8	
BS EN 1092-1 PN10	-10 to 50	10.0	10.0	10.0
	100	10.0	9.3	8.0
	150	9.7	8.7	7.5
	200	9.4	7.8	6.9
BS EN 1092- 1 PN16	-10 to 50	16.0	16.0	16.0
	100	16.0	14.9	12.8
	150	15.6	13.9	11.9
	200	15.1	12.4	11.0
		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 1501-16-430, DIN 2528 C22.8
3. DIN 17100 R.St 37.2

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.

Maximum and Minimum Allowable Operating Pressures and Temperatures

STCV: Temperature range: -29℃ to +200℃.
Pressure range: -1 to 19.7 bar(g).

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

EC Declaration of Conformity

I hereby declare that the products listed below, comply with the requirements of the relevant sections of the Pressure Equipment Regulations 1999 / Pressure Equipment Directive 97/23/EC.

Manufactured by:

CRP Flex-Rite Ltd, Todmorden Road, Littleborough, OL15 9EG, UK.

Assessed by the notified body:

HSB Inspection Quality Limited, Cairo House, Greenacres Road, Waterhead, Oldham, Lancashire, OL4 3JA, UK.

Assessed against the requirements of the Conformity Assessment Procedure:

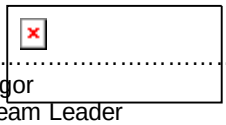
Module H

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

API 5L.	ASTM A234.	BS 10.	DIN 2528.
ASME Boiler and Pressure Vessel Code, Part IX.	ASTM A240.	BS 1501-1.	DIN 2605.
	ASTM A269.	BS 1560.	DIN 2615.
ASME B16.10.	ASTM A312.	BS 287.	DIN 2616.
ASME B16.42.	ASTM A333.	BS 288.	DIN 2848.
ASME B16.5.	ASTM A350.	BS 4360	EN 10025 (DIN 17100).
ASME B16.9.	ASTM A351.	BS 5500.	ISO 1609.
ASME B31.3.	ASTM A395.	BS 6564-3 (1990).	ISO 3585.
ASME B36.10.	ASTM A587.	BS 970:1991.	ISO 9000.
ASME B36.19.	ASTM D1457.	BS EN 1092-1.	SMS 1145.
ASTM A105.	ASTM D2116.	BS EN ISO 1595:1997.	SMS 1146.
ASTM A106.	ASTM D3307.	DIN 11851.	
ASTM A182.	ASTM F1545.	DIN 1626.	
ASTM A216.	ASTM F423.	DIN 1629.	

Product Range:

Description	**Nominal Bore Size Range**
PTFE Lined Pipe Spools:	>DN25 – DN300
CTSG & DTSG Tubular Sight Glasses	>DN25 – DN300
BFSG Tubular Sight Glasses	>DN25 – DN150
FEP Lined Dip Pipes/Dip Legs	>DN25 – DN200
PTFE Lined Dip Pipes/Dip Legs	>DN25 – DN100
LGSG Tubular Sight Glasses	DN40 with DN25, DN40 & DN50 flanges
PTFE/PFA Lined Elbows (all angles up to 180°)	>DN25 – DN300
PFA Lined Tees (equal and reducing)	>DN25 – DN150
PFA Lined Lateral Tees (equal and reducing)	>DN25 – DN150
PFA Lined Instrument Tees	>DN25 – DN300
PFA Lined Short Stack Tees	>DN25 – DN150
PFA Lined Crosses (equal and reducing)	>DN25 – DN150
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, TFSC, and ISPC 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



Signed ……
David MacGregor
Engineering Team Leader

Other Products in the CRP Portfolio

Ball Valves

PFA lined ductile iron in full and reduced bore, long pattern and short pattern designs.

PTFE / PFA lined piping systems

In ASME & Din configurations.

Butterfly Valves

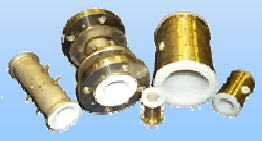
PTFE / PFA lined high performance, with unique energised seat design with bubble tight shutoff. One piece stem & disc design. Size range 2 - 24” NB.

Bellows

Heavy duty virgin paste extruded PTFE expansion bellows. Designs with 2 - 7 bellows available.

PFA Moulded Specials

In house tool design & PFA injection moulding of OEM components.



Check Valves

PFA lined Poppet and Swing check valves for the most arduous process duties.

Flexible Hose Assemblies

The new CRP range of PTFE & rubber hoses for the Chemical & Pharmaceutical industries.

Dip Pipes

Continuously PTFE lined, Hastelloy or stainless steel.

Valve Actuation

Complete assembly and testing Capability in-house. Norbro & Automax actuators stocked.

Sightglasses

Tubular and bulls eye sightglasses, PFA lined carbon steel or stainless steel flanges with borosilicate glass.

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