

PTFE and PFA

Lined Piping Specification



the corrosion expert

This booklet serves as a practical guide to lined piping systems, helping engineers, designers, and project teams understand the key requirements for selecting, specifying, and maintaining corrosion-resistant pipework solutions.



PTFE and PFA Lined Piping Specification.

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



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Materials	CRP Static Dissipating PTFE Liners	Minimum Wall Thicknesses	<table><tr><td>NB</td><td>Min Wall (mm)</td><td>NB</td><td>Min Wall (mm)</td></tr><tr><td>½"</td><td>2.0</td><td>4"</td><td>4.5</td></tr><tr><td>¾"</td><td>2.0</td><td>6"</td><td>6.0</td></tr><tr><td>1"</td><td>3.0</td><td>8"</td><td>8.0</td></tr><tr><td>1.1/2"</td><td>3.0</td><td>10"</td><td>9.0</td></tr><tr><td>2"</td><td>3.0</td><td>12"</td><td>9.5</td></tr><tr><td>3"</td><td>3.0</td><td>14"</td><td>8.3</td></tr></table> Nb. All blind flanges are supplied with bonded on, 2mm thick PTFE liner.				NB	Min Wall (mm)	NB	Min Wall (mm)	½"	2.0	4"	4.5	¾"	2.0	6"	6.0	1"	3.0	8"	8.0	1.1/2"	3.0	10"	9.0	2"	3.0	12"	9.5	3"	3.0	14"	8.3
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CRP Virgin PFA Linings	Standards	PFA to ASTM D3307 type II Note PFA is the preferred lining material for fittings, with paste extruded PTFE liners also acceptable.																																
	Mechanical properties	Minimum Tensile Requirements: Tensile Strength at Break: 26.2 MPa (when tested to ASTM D3307 or ISO 12086) Elongation at Break: 300% (when tested to ASTM D3307 or ISO 12086) Minimum Melting Temperature: 300°C (when tested to ASTM D4591) Specific Gravity: 2.12-2.17 (when tested to ASTM D792) Melt Flow Rate: 1-3g/10mins (when tested to ASTM D3307 or ISO 12086)																																
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Products lined in PFA	• Class 150 90 degree elbows with standard centreline to face dimensions • Equal and reducing tees • Instrument tees • Equal and reducing: crosses; short stack tees; lateral tees • Concentric and eccentric reducers with more than one size reduction • Some reducing flanges • Isostatically moulded PTFE liners shall not be used except by specific concessions																																	
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CRP Static Dissipating PFA Linings	Standards	Not applicable, not covered by ASTM D3307																																
	Mechanical properties	Minimum Tensile Requirements: Tensile Strength at Break: 26.2 MPa (when tested to ASTM D3307 or ISO 12086) Elongation at Break: 300% (when tested to ASTM D3307 or ISO 12086) Typical Melting Temperature: 284°C (when tested to ASTM D4591) Specific Gravity: 2.12-2.17 (when tested to ASTM D792) Melt Flow Rate: 1-3g/10mins (when tested to ASTM D3307 or ISO 12086) Volume Resistivity: 0.10 Ωm (when tested to ISO 3915)																																



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Materials	CRP Static Dissipating PFA Linings	Minimum Wall Thicknesses	<table><tr><td>NB</td><td>Min Wall (mm)</td><td>NB</td><td>Min Wall (mm)</td></tr><tr><td>1"</td><td>3.0</td><td>6"</td><td>5.0</td></tr><tr><td>1.1/2"</td><td>3.0</td><td>8"</td><td>6.5</td></tr><tr><td>2"</td><td>3.0</td><td>10"</td><td>7.5</td></tr><tr><td>3"</td><td>3.0</td><td>12"</td><td>8.5</td></tr><tr><td>4"</td><td>4.0</td><td>14"</td><td>8.5</td></tr></table>				NB	Min Wall (mm)	NB	Min Wall (mm)	1"	3.0	6"	5.0	1.1/2"	3.0	8"	6.5	2"	3.0	10"	7.5	3"	3.0	12"	8.5	4"	4.0	14"	8.5
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	Metalwork	Spools	Flanges: ASTM A105N Pipe: ASTM A106 Grade B/API 5L Grade B Stub Ends: BS1501-161-430A																											
		Cast Fittings	Cast Steel: ASTM A216 Grade WCB Ductile Iron: ASTM A395 Grade 60-40-18																											
		Fabricated Fittings	Flanges: ASTM A105N Pipe: ASTM A106 Grade B/API 5L Grade B Forged Bends: ASTM A234 Grade WPB Stub Ends: BS1501-161-430A Plate: BS1501-161-430A																											
		NDE	Not required																											
Heat Treatment		Not required																												
Venting		Bosses	Castings: As per parent metal Fabrications: Drawn mild steel bar																											
	Plugs	Virgin PTFE																												
Dimensions	Spools	NB & Length	Van Stone Class 150			Welded Fixed/Rotating Class 150																								
			NB	Min (mm)	Max (mm)	NB	Min (mm)	Max (mm)																						
			½"	250	6000	½"	90	6000																						
			¾"	250	6000	¾"	90	6000																						
			1"	250	6000	1"	90	6000																						
			1.1/2"	250	6000	1.1/2"	95	6000																						
			2"	250	6000	2"	110	6000																						
			3"	250	6000	3"	120	6000																						
			4"	250	6000	4"	125	6000																						
			6"	500	6000	6"	140	6000																						
8"	500		3000	8"	150	3000																								
				10"	165	3000																								
				12"	170	3000																								
				14"	190	3000																								
Flange Arrangement	1" to 8" Van Stone construction flanged pipe with 2 rotating flanges. 10" to 14" Welded construction 1 flange fixed, 1 flange rotating.																													
Stub End Sizes for welded construction	NB	OD (mm)	Thickness (mm)	NB	OD (mm)	Thickness (mm)																								
	½"	44	10	4"	171	16																								
	¾"	54	12	6"	216	18																								
	1"	64	12	8"	270	20																								
	1.1/2"	83	12	10"	324	22																								
	2"	102	14	12"	381	22																								
	3"	133	16	14"	413	24																								
Pipe & Flange Specs	Pipe: ½" – 6" NB: Sch.40; 8" – 14": Sch.30 Flanges: ASME B16.5 Class 150																													



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



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		CRP PFA Lined Items	No specific venting required, with the injection boss acting as a vent.
			Permeant Service Venting: Vent Boss Description (see fig 3 below): The injection boss on the fitting shall be used for the venting system. The injection boss will be drilled and tapped ½” BSP parallel. The tapping drill hole will extend 2 – 3mm beyond the end of the threads. A flat bottomed drill will be used. A ½” BSP parallel x ¼” BSP parallel reducing bush will be fitted to the injection boss.
Dimensions	Venting	PFA Lined Items	Vent Plugs: Vent plugs shall be made from Virgin PTFE, and the design shall be as shown in Fig 1 below. Every fitting shall be supplied with a vent plug fitted into the reducing bush in the injection boss.
		Vent Extensions – All items	If vent extensions are required for insulated lines, there shall be a threaded ¼” BSPP half coupling welded over the vent hole and a carbon steel taper threaded pipe fitted over this to create a 70mm tall assembly. For PFA lined fittings a threaded steel reducer is fitted to the injection bosses to take the extension pipe. Permeant Service Venting: The permeant service vent boss is fitted either directly to pipe spools or as part of a reducer in PFA fittings and a 5mm hole extension piece fitted (see Figs 4 & 5
		Notes	Each pipe and fitting including reducing flanges, instrument tees, lined spacers etc. shall be provided with a venting system that will release any gas which, during service, may permeate through the lining and will also indicate any leakage due to failure of the lining. Variable angle outlet PTFE vent plugs (see Fig 6 below) can be retro-fitted to vent plugs if required.
Earthing			Earth continuity shall be achieved by the use of star washers on two of the joint bolts and a CRP spikey washer behind all rotating flanges.
In Process Testing	CRP PTFE Liners		Visual Outside Diameter Wall thickness (4 positions) Acceptable sintering profile Longitudinal Tensile Strength Transverse Tensile Strength Longitudinal Elongation at Break Transverse Elongation at Break SG determination of PTFE
Finished Product Testing	Class 150 flanged spools & fittings		Hydrostatic Test: Raise pressure to 29 bar g, hold for 3 minutes, and reduce pressure. Repeat cycle. Electrostatic Test: 25kV all over surface of lining.
			Hydrostatic Test: Any evidence of leakage shall be cause for rejection. Electrostatic Test: Any audible or visible spark through the lining shall be cause for rejection. The electrostatic test shall be carried out after the hydrostatic test. All covered in CRP standard testing.
CRP Standard Paint Finish			As standard all items will be supplied painted with CRP standard two component low VOC, high solids fast curing epoxy primer/finish containing zinc phosphate anti-corrosive pigmentation: Intergard 345, RAL 5015, blue semi-gloss. Typical thickness 60 microns. Other paint colours and systems are available by agreement.
Packing PFA lined items	PTFE lined items		Timber end boards bolted to all flange faces.
			Push fit plastic end caps to all flange faces.
Certification			Standard certificate of conformity provides details of materials used and details of Electrostatic Test and Hydrostatic Test. All material test certificates if requested at time of order.
Identification on Fittings	Spools		NB, size, length, supplier order number, line item number and customer name to be marked on end boards.
			Supplier order number and line item number to be marked on end caps.
Traceability			All products should be reverse traceable from component through the manufacturing process to original polymer certification. This is provided on fittings via a unique number stamped upon the component flange and on pipe spools via the PTFE run reference stamped upon the component flange. All records relating to the manufacture and test of these items shall be available for scrutiny.



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Quality Systems	Certificate 020-QMS-001 for ISO9001:2015 for the development and manufacture of fluoropolymer lined and metallic piping systems, associated pipeline equipment and sampling systems. The stocking and supply of third party valve and actuation products and associated pipeline equipment. Sub-contract fluoropolymer moulding and lining services. PED compliant, suitable for Group 1 Gases. Registration BES 399303-1/2 in respect of a Quality Management System which has been assessed and found to comply with the requirements of modules D1, E1 and H of Annex III of the Pressure Equipment Directive 97/23/EC and Schedule 4 of the UK Pressure Equipment Regulations 1999 (SI 2001) for the design and manufacture of fluoropolymer lined and metallic piping systems, associated piping equipment, PTFE bellows and sampling systems. The scope of these approvals covers the core products provided by CRP for corrosive fluid handling applications.
Qualification Tests	ASTM F1545 BS EN 61340-2-3 third party testing determining that static-dissipating lined pipe and fittings manufactured by CRP have been proven as static-dissipative.
Diagram of permeant venting arrangements Fig 1 Fig 2 Fig 3 Fig 4 Fig 5 Fig 6 Fig 1 PTFE Vent Plug Fig 2 Vent Boss & PTFE Vent Plug for PTFE Lined Items Fig 3 Vent Boss, Threaded Adaptor & PTFE Vent Plug for PFA Lined Items Fig 4 Vent Boss, Stainless Steel Vent Extension & PTFE Vent Plug for PTFE Lined Items (Insulated Lines) Fig 5 Vent Boss, Threaded Adaptor, Stainless Steel Vent Extension & PTFE Vent Plug for PFA Lined Items (Insulated Lined) Fig 6 Optional Variable Angle Outlet PTFE Vent Plug	



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