

PRODUCT AND MATERIAL SPECIFICATIONS

DATE OF PRINT

JANUARY 3, 2005

NON METALLIC RESOURCES, INC.

PAGE NO.

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PVDF/AR®

SEAMLESS PVDF/FRP DUAL LAMINATE PIPE AND FITTINGS

1. SCOPE

This specification provides design information applicable to NMR's PVDF/AR piping products (seamless PVDF/FRP dual laminate). Standard manufacturing specifications and dimensions are provided, however, custom specifications and designs can be accommodated. Consult manufacturer for more information.

2. MATERIALS

2.1 Liner: PVDF liners are **SEAMLESS** Kynar Flex® 2850, Polyvinylidene Fluoride resin. This resin meets the requirements of ASTM D5575 and may include less than 1% inorganic pigment for identification. A partial list of physical properties follows:

PROPERTY	VALUE	TEST
Specific Gravity	1.76	ASTM D-792
Tensile Strength	5700 PSI	ASTM D-638
Elongation	40%	ASTM D-638

2.2 Bonding Layer: Using a patented process, a seamless knit fiberglass sock is melt-bonded and partially embedded into the O.D. surface of the PVDF liner. Bond strength between the PVDF liner and reinforced vinyl ester casing as measured by ASTM D1781 – Climbing Drum Peel Test for Adhesives, is a minimum of 35 PLI.

2.3 Outer Casing: The bonded PVDF liner is reinforced by filament wound (standard) or hand lay-up vinyl ester fiberglass construction yielding a totally bonded dual laminate. This specification indicates filament wound thicknesses per drawings **STD** and **STD**. Hand lay-up construction when performed is per ASTM C582 Type II, Class V. Only premium grade vinyl ester resins are used with glass reinforcement and UV stabilized exterior gel coat.

3. DESIGN AND FABRICATION DETAILS

3.1 All dimensional drawings included in this paragraph are suitable for use in the design of pipe systems. Tolerances in subparagraph 3.4 should be considered in design.

3.2 Flanges for pipe spools and fittings shall have bolt circle, hole diameter and number of boltholes in accordance with ANSI 16.5 (150#), unless otherwise specified.

3.3 Fittings shall have standard face to centerline dimensions in accordance with ANSI 16.1 (150#), unless otherwise specified.

3.4 Pipe and fitting fabrication tolerances are as follows:

ITEM	DIMENSION	TOLERANCES
Pipe Spools	Length	±1/8"
	Bolt hole alignment	±1/16"
	Flange alignment	±1/32" (1" thru 4")
	(with theoretic pipe centerline)	±3/64" (6">)
Flanges	All dimensions except Thickness	ANSI 16.5
Fittings	Face to centerline	±1/8"
	Flange alignment	±1/32" (1" thru 4")
	(with theoretic pipe centerline)	±3/64" (6">)
ID/OD Radius		±1/16" (1" thru 6")
		±1/8" (8" thru 14")
		±1/4" (16" thru 24")



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- 3.5 Dimensional drawings of standard PVDF/AR products:
- SPEC-300 Piping Specification
 - STD- Flange Dimensions
 - STD- Pipe Dimensions, Pipe and Fitting Weights (1"φ thru 12"φ)
 - STD- Pipe Dimensions, Pipe and Fitting Weights (14"φ thru 24"φ)
 - STD- Fitting Dimensions (1"φ thru 4"φ)
 - STD- Fitting Dimensions (6"φ thru 24"φ)

NOTE: Non-Standard items will require customer-approved prints prior to fabrication.

4. APPLICATION AND OPERATIONAL PARAMETERS

- 4.1 Temperature Range: PVDF/AR is suitable for continuous operation from <32°F (0°C) to 250°F (120°C), unless otherwise specified.
- 4.2 Pressure Range: PVDF/AR is suitable for continuous operation from full vacuum to 150 PSI for 1" diameter through 12" diameter and full vacuum to 100 PSI for 14" diameter through 24" diameter when operating within the temperature range specified in subsection 4.1.
- 4.3 Thermal Expansion: PVDF/AR will expand (and contract) 1.7×10^{-5} in/in/°F when operating within the temperature range specified in subsection 4.1.
- 4.4 Chemical Resistance (liner): PVDF/AR 's liner is chemically inert to a broad range of commercial chemicals including the following:
- All acids including hydrofluoric, hydrochloric, sulfuric, and aqua regia
 - All chlorides – organic and inorganic
 - All sulfates – organic and inorganic
 - All bleach solutions
 - All solvents, all caustics, all phenols, all peroxides
- *For specific corrosion resistance data, consult corrosion chart or manufacturer.
- 4.5 Chemical Resistance (structural casing): PVDF/AR's vinyl ester casing is inherently corrosion resistant. This typically allows open air or direct burial installation in harsh chemical environments with no additional protection. Gel coat exterior contains UV stabilizer. Fire retardant protection is available. For specific environments, consult manufacturer.
- 4.6 Gas Permeation: PVDF/AR's patented bonding technology eliminates air gaps between the PVDF liner and vinyl ester casing. If a gas permeates the PVDF liner, it is conducted directly to the vinyl-ester casing, which permeates at a higher rate than the PVDF liner. This eliminates condensation between the liner and casing which is a common problem in lined steel pipe. Since these gases are not trapped between PVDF/AR's PVDF liner and vinyl ester casing, no weep holes are required and internal corrosion of the structure is eliminated.
- 4.7 Insulation Qualities: PVDF/AR's vinyl ester casing yields a heat conduction factor (k) of 1.5 Btu*in/FT²/hr/°F. Check dimensional data for casing thickness. If additional thermal protection is necessary, more information is available under the PRE-INSULATED and DUAL CONTAINMENT tabs of this manual or contact the manufacturer for details on Heat Traceable, Pre-insulated and/or Dual Contained MAXAR® Systems.
- 4.8 Heat Tracing: PVDF/AR's vinyl ester casing is capable of handling dry heat trace applications up to 180°F. On pre-insulated PVDF/AR systems, channels can be provided for heat trace wire. More information is available under the PRE-INSULATED tab of this manual or contact the manufacturer.

5. INSPECTION

- 5.1 All extruded liners are inspected prior to fabrication for pinholes, cracks, gouges, nicks, or inclusion of foreign particles.
- 5.2 Completed fittings shall be subjected to a 10,000-volt, non-destructive, electrostatic test to detect pinholes. This test is to be performed by manufacturer only with properly controlled voltage and procedures.

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6. HANDLING AND SHIPPING

- 6.1 The gasket face of each spool or fitting shall be protected by end plates or other suitable protective means.
- 6.2 All spools and fittings shall be suitably packed to provide necessary protection during handling, shipping, and storage.

7. INSTALLATION AND ASSEMBLY DATA

- 7.1 Supports: Hangers and supports may be ordered from NMR or supplied by customer. Supports should have a 1/8" thick rubber liner. Verify actual pipe outside diameter before ordering supports. See attached drawings STD-300 and STD-304.
- 7.2 Support spacing: Support spacing can vary depending on actual service conditions and piping configuration. Supports for piping with the longitudinal axis in approximately a horizontal position shall be spaced to prevent excessive sag, bending and shear stresses in the piping with special consideration given where components such as flanges and valves impose concentrated loads. Where calculations are not made, suggested maximum spacing of supports are given in the table below. Vertical supports shall be spaced to prevent the pipe from being overstressed from the combination of all loading effects (ANSI B31.1). In addition, Appendix III, Non-Mandatory Rules for Nonmetallic Piping of ANSI B31.1 should be taken into consideration. The values listed in the table are based on maximum operating conditions but do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc.

Maximum Pipe Support Spacing (ft) At Pressure Rating (psi) and Pipe Size (in)

PIPE SIZE	25	50	75	100	125	150
1"	6.0	6.0	6.0	6.0	6.0	6.0
1 ½"	6.0	6.0	6.0	6.0	6.0	6.0
2"	6.0	6.0	6.0	6.0	6.0	6.0
3"	6.5	6.5	6.5	6.5	8.0	8.0
4"	7.0	7.0	7.0	8.5	8.5	8.5
6"	8.0	8.0	9.0	9.0	10.0	10.5
8"	8.5	10.0	10.0	10.5	11.0	11.5
10"	9.5	10.5	11.5	12.0	12.5	13.0
12"	10.0	11.5	12.5	13.0	13.5	14.0
14"	10.5	12.0	13.0	14.0		
16"	11.0	12.5	13.5	15.0		
18"	12.0	13.5	14.5	17.0		
20"	12.5	14.0	16.0	19.0		
24"	15.0	17.5	19.0	22.0		

- 7.3 Gaskets: **GASKETS MUST BE USED IN MAXAR PIPING SYSTEMS.** Recommended gaskets are Garlock's Envelon™ Style 3565.
- 7.4 Bolts: Size and grade per ANSI specification. SAE washers shall be used on all flanged fittings. Standard hex nuts shall be used on fittings 1 ½" diameter through 6" diameter. Fittings 8" and up can accommodate heavy hex nuts if preferred.
- 7.5 Torquing Procedure: The following procedure will insure that the necessary forces are applied to seat Envelon™ Style 3565 gaskets using the torque values of subsection 7.6. When other gasket materials are used, they should not exceed 70 durometer to assure proper seating.
 - A. Grease all bolts and nuts with a suitable grease, finger tighten all nuts.
 - B. With torque wrench, using a criss-cross method, tighten each bolt in increments as outlined below until appropriate torque values are met as specified in the Maximum Bolt Torque table under subsection 7.6.
 - C. After 24-30 hours, a temperature cycle, or a pressure cycle, torque for each bolt shall be checked. Those below the minimum are to be re-torqued to the values listed in subsection 7.6.



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7.6 Bolt Torque: Clamping forces between flanges can vary greatly depending on whether or not lubricated bolts are used when torquing bolts. The values listed in the table below assume that bolts are lubricated.

Maximum Bolt Torque (ft) At Pressure Rating (psi) and Pipe Size (in)

PIPE SIZE	25	50	75	100	125	150
1"	15	15	15	15	15	15
1 1/2"	15	15	15	15	15	15
2"	25	25	25	25	25	25
3"	25	25	25	25	25	25
4"	25	25	25	25	25	25
6"	25	25	25	25	25	40
8"	25	25	30	40	50	60
10"	25	25	30	40	50	70
12"	25	25	35	45	60	80
14"	35	45	60	80		
16"	40	50	70	90		
18"	50	60	80	90		
20"	60	70	80	100		
24"	60	70	90	100		

*Indicated bolt torque is required to seat gaskets of 70 durometer on full-face flanges.

8. WARRANTY

All standard PVDF/AR products are warranted for one (1) year from start-up or 18 months from delivery. Consult manufacturer for warranty information concerning customized parts or systems.

9. WAIVER

- 9.1 Every effort has been made to insure that the information provided in this specification is accurate. Changes or updates may occur without notice.
- 9.2 This specification does not purport to address any personnel safety issues associated with handling, installing, and operating pressure or vacuum pipe systems. For specific information regarding these issues, refer to applicable ASME/ANSI Codes and Standards, ASTM Standards, OSHA Regulations and qualified piping and safety engineers.

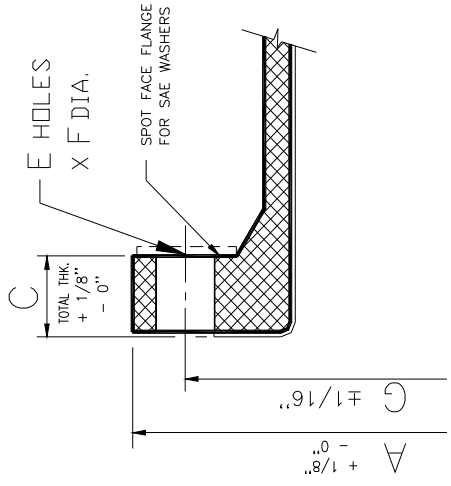


NOM. SIZE	A O.D. FLANGE	B O.D. STUB END	C FLG./STUB THK.	D LAP JT. THK.	E NO. HOLES	F HOLE SIZE	G BOLT CIRCLE	BOLT SIZE SEE NOTE 3
1	4 1/4	2 1/2	1	1	4	5/8	3 1/8	1/2 X 3
1 1/2	5	3 1/4	1	1	4	5/8	3 7/8	1/2 X 3
2	6	4	1 1/8	1 1/4	4	3/4	4 3/4	5/8 X 3 1/2
3	7 1/2	5 1/4	1 1/8	1 1/4	4	3/4	6	5/8 X 3 1/2
4	9	6 3/4	1 1/4	1 3/8	8	3/4	7 1/2	5/8 X 3 3/4
6	11	8 5/8	1 1/2	1 3/4	8	7/8	9 1/2	3/4 X 4 1/4
8	13 1/2	10 7/8	1 3/4	2	8	7/8	11 3/4	3/4 X 4 3/4
10	16	13 1/4	1 3/4	2	12	1	14 1/4	7/8 X 5
12	19	16	2	2 1/4	12	1	17	7/8 X 5 1/2
14	21	17 5/8	2	2 1/4	12	1 1/8	18 3/4	1 X 5 1/2
16	23 1/2	20 1/8	2 1/8	2 3/8	16	1 1/8	21 1/4	1 X 5 3/4
18	25	21 1/2	2 1/4	2 1/2	16	1 1/4	22 3/4	1 1/8 X 6 1/4
20	27 1/2	23 3/4	2 1/2	2 3/4	20	1 1/4	25	1 1/8 X 6 3/4
24	32	28 1/8	2 5/8	2 7/8	20	1 3/8	29 1/2	1 1/4 X 7

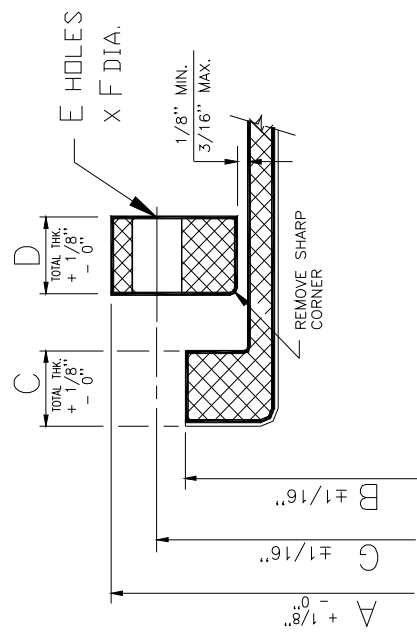
** FLANGE PRESSURE RATING: 150 PSI THRU 12"
100 PSI 14" - 24"

NOTES

- DIMENSIONS SHOWN ARE FOR ALL FLANGES AND INCLUDES THERMOPLASTIC FLANGE FACE WHERE APPLICABLE.
- FOR BOLT LENGTHS WHEN USING LAP JOINT FLANGES, ADD LAP JOINT FLANGE THICKNESS TO LENGTH SHOWN.



FIXED FLANGE



LAP JOINT FLANGE

 NMR <i>engineered thermoplastics</i> NON METALLIC RESOURCES INC. MOBILE, ALABAMA	STANDARD	
	FLANGE DIMENSIONS	
DRAWN: JES	JOB NO.	STD-101
DATE: 4-90	P.D. NO.	
CHK'D:	SCALE	NONE
DATE:	REV.	1

NO	DATE	BY	DESCRIPTION	CKD
1	11-30-98	BLS	GENERAL UPDATE	
REVISIONS				

