

# Seamless PVC/FRP Dual Laminate Pipe and Fittings



## 1. SCOPE

This specification provides design information applicable to RPS Composites' PVC/FRP piping products (seamless PVC/FRP dual laminate). Standard manufacturing specifications and dimensions are provided, however, custom specifications and designs can be tailored for unique requirements. Consult RPS Composites for more information.

## 2. MATERIALS

- 2.1 Liner: PVC liners are seamless. Only virgin PVC is used in the extrusion of liners. This resin meets the requirements of ASTM D-1784 and may include less than 1% inorganic pigment for identification. A partial list of the physical properties is below:

PROPERTY	PVC VALUE	TEST
Specific Gravity	1.38	ASTM D-792
Tensile Strength	7,700	ASTM D-638

- 2.2 Bonding: Bonding of the PVC liner to the FRP structure results in a chemical linking of the structure to the liner. The shear strength of the bond as measured per BS 4994 B-10 is 1015 psi minimum.
- 2.3 Outer Structure: The bonded PVC liner is reinforced by filament wound (standard) or hand lay-up vinyl ester fiberglass structure yielding a totally bonded dual laminate. Hand lay-up construction when performed is per ASTM C582 Type II, Grade 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 specification are suitable for use in the design of pipe systems. Tolerances in subparagraph 3.3 should be considered in design.
- 3.2 Flanges for pipe spools and fittings shall have an internal diameter, outer diameter bolt circle, hole diameter and number of boltholes in accordance with ASME B16.5 Class 150, unless otherwise specified.

- 3.3 Pipe and fittings 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 pipe centerline)	± 3/64" (6" >)
Flanges	All dimensions except thickness	ASME B16.5
Fittings	Face to centerline	± 1/8"
	Flange alignment	± 1/32" (1" thru 4")
	(with pipe centerline)	± 3/64" (6" >)
ID/OD Radius		1/4" ± 1/16"

## 4. APPLICATION AND OPERATIONAL PARAMETERS

- 4.1 PVC/FRP liner material is suitable for operating temperatures from 0°F (-18°C) up to 170°F (77°C).
- 4.2 Pressure Ranges: PVC/FRP is suitable for continuous operation from full vacuum for 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: the Coefficient of Thermal expansion for PVC/FRP pipe is  $\sim 1.7 \times 10^{-5}$  in/in/°F when operating within the temperature range specified in subsection 4.1.
- 4.4 Chemical Resistance (liner): PVC/FRP's liner is chemically inert to a broad range of commercial chemicals including the following:
- Mineral acids
  - Alkalies
  - Salt solutions
  - Alcohols

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- 4.5 Chemical Resistance: PVC/FRP's vinyl ester structure 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 RPS Composites.
- 4.6 Gas Permeation: RPS' bonding technology eliminates air gaps between the PVC liner and vinyl ester structure. This eliminates condensation between the liner and structure which is a common problem in lined steel pipe. Since these gases/liquids are not trapped between PVC/FRP's liner and vinyl ester structure, no weep holes are required and internal corrosion of the structure is eliminated.
- 4.7 Insulation Qualities: PVC/FRP's vinyl ester structure yields a heat conduction factor (k) of ~ 1.5 Btu\*in/FT<sup>2</sup>/hr/°F. Check dimensional data for structure thickness. If additional thermal protection is necessary, contact RPS for details on Heat Traceable, Pre-insulated and/or Dual Contained PVC/FRP Systems.
- 4.8 Heat Tracing: PVC/FRP's vinyl ester structure is capable of handling dry heat trace applications up to 180°F. On pre-insulated PVC/FRP systems, channels can be provided for heat trace wire. Contact RPS Composites for more information.

## 5. INSPECTION

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

## 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 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 RPS Composites or supplied by customer. Supports should have a minimum 1/8" thick rubber liner. Verify actual pipe outside diameter before ordering supports.
- 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 on page 3. 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.
- 7.3 Gaskets: **GASKET MUST BE USED IN RPS' PVC/FRP PIPING SYSTEM.** Recommended gaskets are elastomeric materials of 55-70 durometer suitable for the intended chemical service.
- 7.4 Bolts: Size and grade per ASME specification. SAE washers shall be used on all flanged fittings. Standard hex nuts shall be used on fittings 1 1/2" 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. Lubricate all bolts and nuts with a suitable lubricant, finger tighten all nuts.
  - B. With torque wrench, using a criss-cross method, tighten each bolt 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.
- 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 assume that bolts are lubricated.

Pipe Size	Max. Pipe Support Spacing (ft)	Max. Bolt Torque (ft)
1 1/2"	6.0	15
2"	6.0	25
3"	8.0	25
4"	8.5	25
6"	10.5	40
8"	11.5	60
10"	13.0	70
12"	14.0	80
14"	14.0	80
16"	15.0	90
18"	17.0	90
20"	19.0	100
24"	22.0	100

## 8. WARRANTY

All standard PVC/FRP products are warranted for one (1) year from being placed in service or 18 months from delivery. Consult RPS Composites for warranty information concerning customized parts or systems.

## 9. WAIVER

- 9.1 Every effort has been made to ensure 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.

## Piping Specification

### SERVICES:

As specified by user or RPS Composites.

### MATERIAL:

PVC/FRP as provided by RPS Composites dual laminate, seamless PVC liner with bonded fiberglass reinforced vinyl Ester structure.

### SIZE/RATING:

1 ½" – 12"	Full Vacuum	150 psi	0 to 170°F
14" – 24"	Full Vacuum	100 psi	0 to 170°F

### PIPE:

150# flanged spools      20'-0" standard length

### FITTINGS:

Flanged, ASME B16.5 Class 150 Dimensions.

### BRANCH CONNECTIONS:

Use full size or reducing tees

### INSTRUMENT CONNECTIONS:

Use tee

### FLANGES:

All flanges: drilling pattern per ASME B16.5 Class 150 dimensions (except thickness).

**Blinds:** Flat faced FRP with PVC liner bonded to face.

**Fixed:** Full face flanges to be fabricated on pipe spools by pipe manufacturer.

**Lap Joint:** Stub end with loose ring fabricated on pipe by pipe manufacturer.

Fixed or Lap Joint flanges available as:

- A. Solvent socket weld where available
- B. Fabricated with flat sheet welded and bonded to face
- C. Flared over face of flange to the inside of the bolt holes.

### GASKETS:

Gasket material suitable for intended service conditions. Consult gasket manufacturer for recommendation. Garlock™, Envelon™ 3565 gasket material is comparable to PVC/FRP liner material. Ring type or full face. 1/16" min. – 1/8" max. thick.

### BOLTING:

Alloy steel machine bolts or studs with (2) SAE washers and standard nuts 1 ½" thru 6"Ø if preferred.

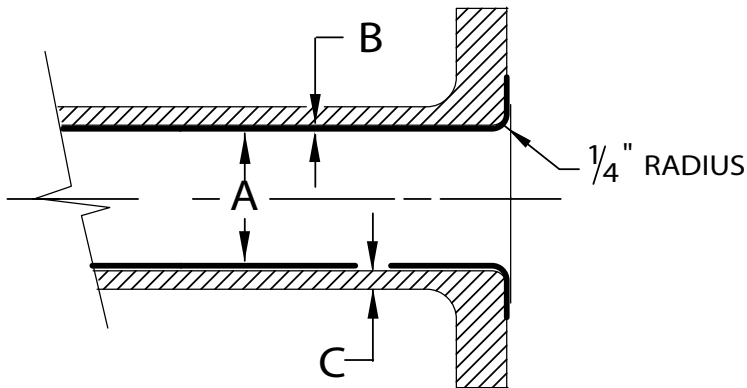
### WELDING:

Assembly of PVC/FRP piping components is accomplished by welding the liner sections and then laminating the components together. The liner weld is accomplished by solvent, hot plate, or hot gas welding. Welds are spark tested to detect pinholes prior to laminating.

### NOTES:

1. Instrument connections (including vents and drains) may be fabricated directly into pipe spools minimum size is 1" diameter.
2. Piping may be shop fabricated or field welded by manufacturer
3. One inch (1") piping is available in short spools only (24" or less).

## Pipe and Fittings Dimensions, Pipe and Fitting Weights



## Approximate Weight of Pipe and Fittings (lbs.)

Nom. Dia.	A (I.D.)	B (Liner Thickness)	C (F.W. Thickness)
1	.96	.18	.15
1 1/2	1.50	.20	.15
2	1.94	.22	.17
3	2.90	.30	.21
4	3.83	.34	.21
6	6.07	.28	.21
8	7.98	.32	.25
10	10.02	.37	.36
12	11.938	.41	.39
14	13.124	.44	.39
16	15.000	.50	.39
18	17.828	.17	.43
20	19.80	.20	.46
24	23.77	.23	.50

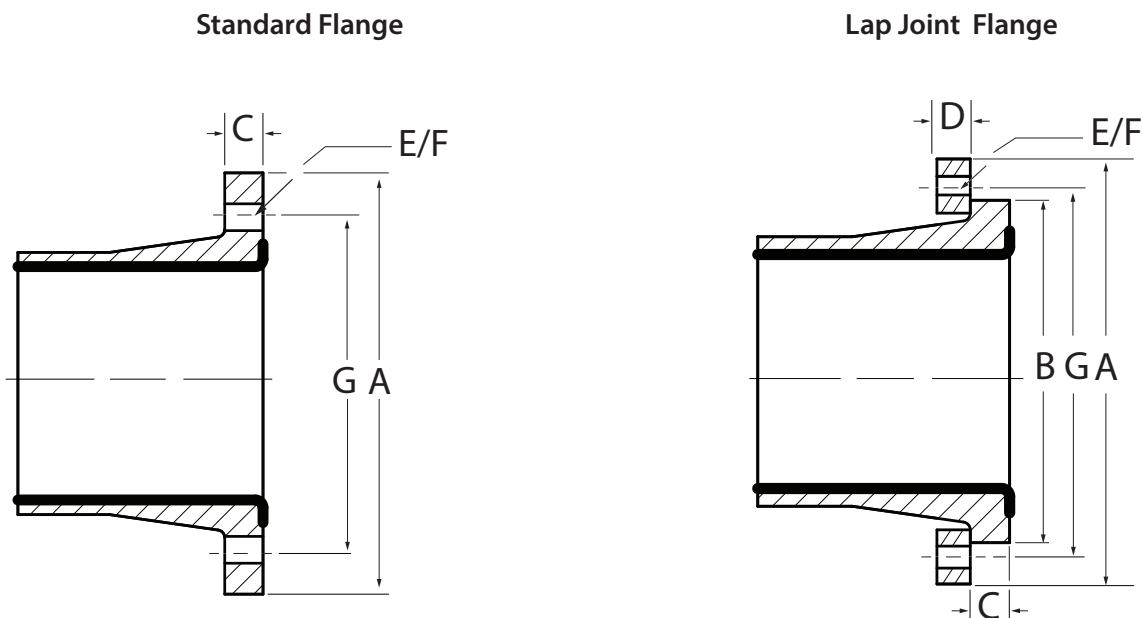
Nom. Dia.	Pipe per foot	Flange
1	.7	1.0
1 1/2	1.5	1.3
2	1.9	2.0
3	3.0	4.0
4	4.0	4.5
6	7.3	7.0
8	11.1	11.5
10	17.3	15.0
12	23.0	24.0
14	25.0	27.0
16	32.0	35.0
18	38.0	37.0
20	48.0	49.0
24	64.0	65.0

Note:

1. Please consult with RPS Composites for additional dimensional information on the PVC/FRP Product

# Seamless PVC/FRP Specifications

## Standard Flange Dimensions

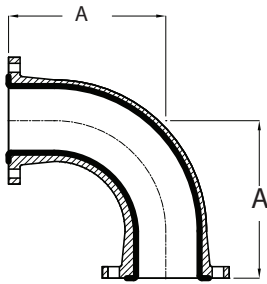


Nom. Size	A O.D. Flange	B O.D. Stub End	C Flg/Stub Thickness	D Lap Jt. Thickness	E No. Holes	F Hole Size	G Bolt Circle	Bolt Size See Notes 1 and 3
1	4 1/4	2 1/2	1	1	4	5/8	3 1/8	1/2
1 1/2	5	3 1/4	1	1	4	5/8	3 7/8	1/2
2	6	4	1 1/8	1 1/4	4	3/4	4 3/4	5/8
3	7 1/2	5 1/4	1 1/8	1 1/4	4	3/4	6	5/8
4	9	6 3/4	1 1/4	1 3/8	8	3/4	7 1/2	5/8
6	11	8 5/8	1 1/2	1 3/4	8	7/8	9 1/2	3/4
8	13 1/2	10 7/8	1 3/4	2	8	7/8	11 3/4	3/4
10	16	13 1/4	1 3/4	2	12	1	14 1/4	7/8
12	19	16	2	2 1/4	12	1	17	7/8
14	21	17 5/8	2	2 1/4	12	1 1/8	18 3/4	1
16	23 1/2	20 1/8	2 1/8	2 3/8	16	1 1/8	21 1/4	1
18	25	21 1/2	2 1/4	2 1/2	16	1 1/4	22 3/4	1 1/8
20	27 1/2	23 3/4	2 1/2	2 3/4	20	1 1/4	25	1 1/8
24	32	28 1/8	2 5/8	2 7/8	20	1 3/8	29 1/2	1 1/4

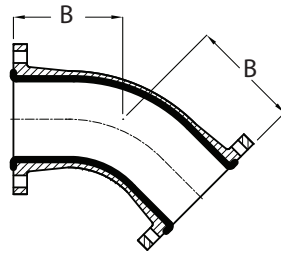
### Notes:

1. For all PVC/FRP add appropriate liner thickness to get bolt lengths. Thickness may vary.
2. Flared polyvinyl chloride liner may not seat to face of flange until bolt up.
3. For bolt lengths when using lap joint flanges, add lap joint flange thickness to length shown.

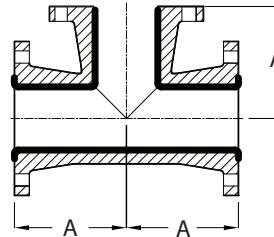
## Fittings Dimensions



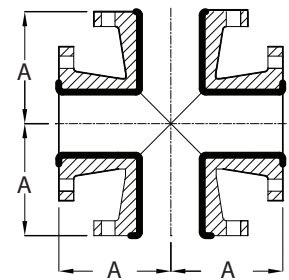
90° Elbow  
See Note 1 & 3



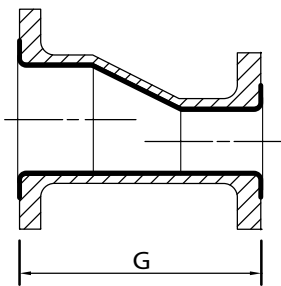
45° Elbow  
See Note 1 & 3



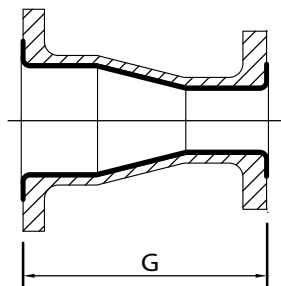
Tee  
See Note 1 & 3



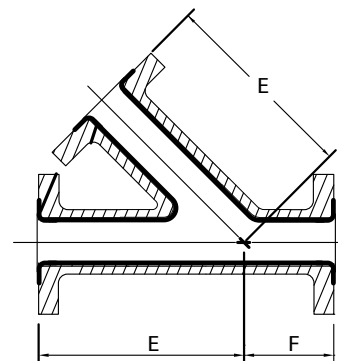
Cross  
See Note 3



Eccentric Reducer



Concentric Reducer



45° Lateral  
See Note 3

Nom. Dia.	A	B	E	F	G
1 1/2	4	2 1/4	7	2	5
2	4 1/2	2 1/2	8	2 1/2	5
3	5 1/2	3	10	3	6
4	6 1/2	4	12	3	7
6	8	5	14 1/2	3 1/2	9
8	9	5 1/2	17 1/2	4 1/2	11
10	11	6 1/2	20 1/2	5	12
12	12	7 1/2	24 1/2	5 1/2	14
14	21	8 3/4	30	12	12
16	24	10	32	14	12
18	27	11 1/4	36	14	12
20	30	12 1/2	38	16	12
24	36	15	42	18	15

### Notes

1. See page 6 for flange dimensions.
2. See page 5 for wall and liner thicknesses.
3. Tees, crosses and laterals are also available with reducing branch connections. Dimensions are same as full size.
4. Fittings are also available with non-standard dimensions. Contact RPS Composites for details.

## Seamless PVC/FRP Specifications

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