

Seamless PP/FRP Dual Laminate Pipe and Fittings



1. SCOPE

This specification provides design information applicable to RPS Composites' PP/FRP piping products (seamless PP/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: PP liners are seamless through to 20" dia. Only virgin PP is used in the extrusion of liners. This resin meets the requirements of ASTM D-4101 and may include less than 1% inorganic pigment for identification. A partial list of the physical properties is below:

PROPERTY	PP/FRP VALUE	TEST
Specific Gravity	.90 - .91	ASTM D-792
Tensile Strength	4,500	ASTM D-638

- 2.2 Bonding Layer: A knit fiberglass tape is melt-bonded and partially embedded into the O.D. surface of the PP liner using a proprietary process. Bond strength between the PP liner and reinforced vinyl ester structure as measured by ASTM D1781 – Climbing Drum Peel Test for Adhesives, is a minimum of 35 in*lb/in.
- 2.3 Outer Structure: The bonded PP 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	DIMENSIONS	TOLERANCES
Pipe Spools	Length	± 1/8"
	Bolt hole alignment	± 1/16"
	Flange alignment (with pipe centerline)	± 1/32" (1" thru 4") ± 3/64" (6">)
Flanges	All dimensions except thickness	ASME B16.5
Fittings	Face to centerline	± 1/8"
	Flange alignment (with pipe centerline)	± 1/32" (1" thru 4")
ID/OD Radius		1/4" ± 1/16"

4. APPLICATION AND OPERATIONAL PARAMETERS

- 4.1 PP/FRP liner material is suitable for operating temperatures from 15°F (-10°C) up to 200°F (93°C). PP/FRP piping systems with a continuous operating temperature above 180°F (82°C) should be evaluated by RPS engineering to determine if the process conditions are acceptable.
- 4.2 Pressure Ranges: PP/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 PP/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): PP/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: PP/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 PP 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 PP/FRP's liner and vinyl ester structure, no weep holes are required and internal corrosion of the structure is eliminated.
- 4.7 Insulation Qualities: PP/FRP's vinyl ester structure yields a heat conduction factor (k) of $\sim 1.5 \text{ Btu}\cdot\text{in}/\text{FT}^2/\text{hr}/^\circ\text{F}$. 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 PP/FRP's Systems.
- 4.8 Heat Tracing: PP/FRP's vinyl ester structure is capable of handling dry heat trace applications up to 180°F. On pre-insulated PP/FRP's 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. Support 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' PP/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 PP/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:

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

SIZE/RATING:

1 1/2" – 12"	Full Vacuum	150 psi	15°F to 200°F
14" – 24"	Full Vacuum	100 psi	15°F to 200°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 PP 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. Molded weld neck stub flanges, if available, connected with either hot plate fusion welding or hot air hand welding, reinforced with FRP structure.
- B. Flat plate bonded and welded to face of flange, reinforced with FRP structure.

GASKETS:

Gasket material suitable for intended service conditions. Consult gasket manufacturer for recommendation. Garlock™, Envelon™ 3565 gasket material is comparable to PP/FRP's 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 1/2" thru 6"Ø if preferred.

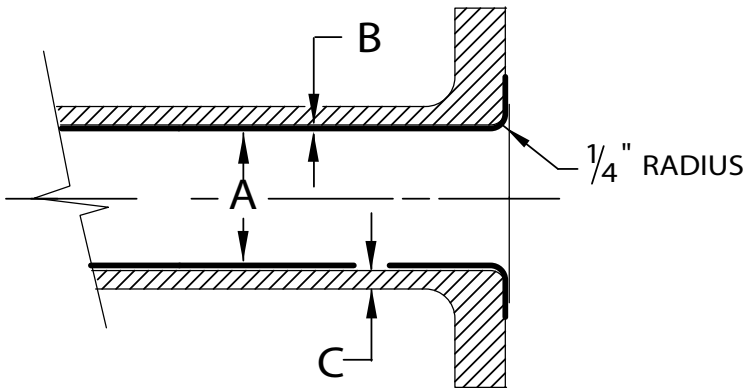
WELDING:

Assembly of PP/FRP piping components is accomplished by welding the liner sections and then laminating the components together. The liner weld is accomplished by flow fusion, hot plate, extrusion, 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).
4. PP/FRP piping systems with a continuous operating temperature above 180°F (82°C) should be evaluated by RPS engineering to determine if the process conditions are acceptable.

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	1.00	.114	.15
1 1/2	1.60	.181	.15
2	2.02	.228	.17
3	2.90	.323	.21
4	4.06	.134	.21
6	5.90	.193	.21
8	7.40	.244	.25
10	9.24	.303	.36
12	11.63	.382	.39
14	13.12	.429	.39
16	14.78	.484	.39
18	16.63	.543	.43
20	18.46	.602	.46

Nom. Dia.	Pipe per foot	Flange	10' Spool	20' Spool
1	.6	1.0	N/A	N/A
1 1/2	1.4	1.3	17	31
2	1.7	2.0	21	38
3	2.5	4.0	33	59
4	3.4	1.5	43	77
6	5.6	7.0	70	126
8	8.3	11.5	106	189
10	12.8	15.0	158	286
12	16.6	24.0	214	380
14	17	27	224	394
16	21	35	280	490
18	26	37	334	594
20	31	49	408	718
24	40	65	530	980

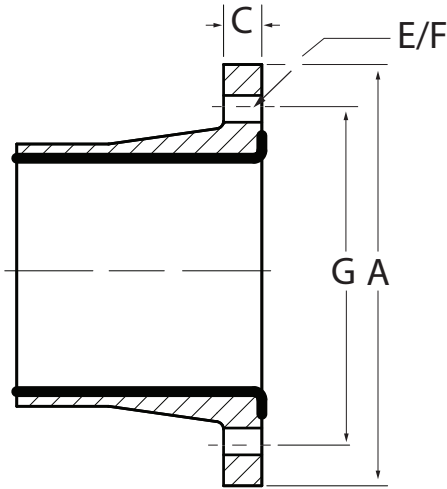
Note:

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

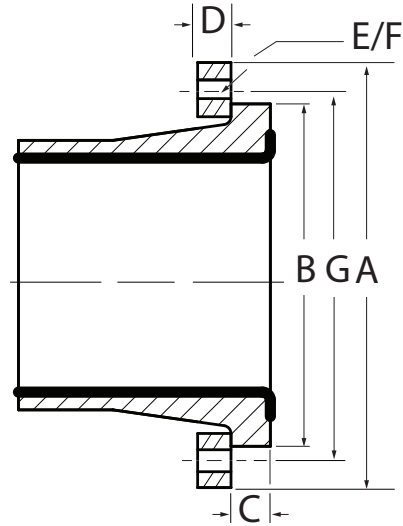
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Standard Flange Dimensions

Standard Flange



Lap Joint Flange

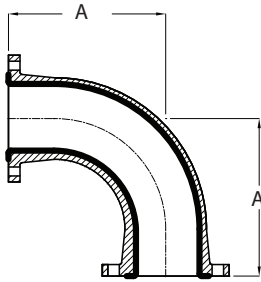


Nom Size	A O.D. Flange	B O.D. Stub End	C Flg/Stub Thickness	D Lap Jt. Thickness	E No. Holes	F Hole Size	G Bolt Circle	Bolt Size See Notes 1 and 3
1	4 1/4	2 1/2	1	1	4	5/8	3 1/8	1/2
1 1/2	5	3 1/4	1	1	4	5/8	3 7/8	1/2
2	6	4	1 1/8	1 1/4	4	3/4	4 3/4	5/8
3	7 1/2	5 1/4	1 1/8	1 1/4	4	3/4	6	5/8
4	9	6 3/4	1 1/4	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

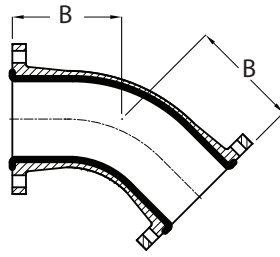
Notes

1. For all PP/FRP add appropriate liner thickness to get bolt lengths. Thickness may vary.
2. For bolt lengths when using lap joint flanges, add lap joint flange thickness to length shown.

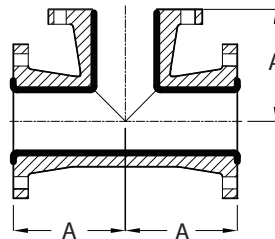
Fittings Dimensions



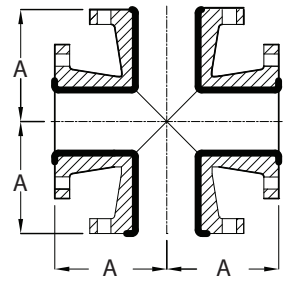
90° Elbow
See Note 1 & 3



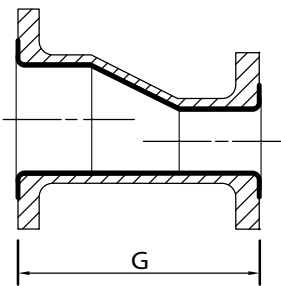
45° Elbow
See Note 1 & 3



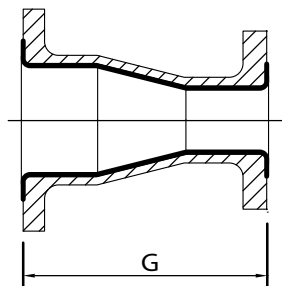
Tee
See Note 1 & 3



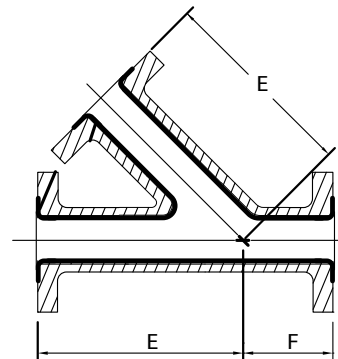
Cross
See Note 3



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 PP/FRP Specifications

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