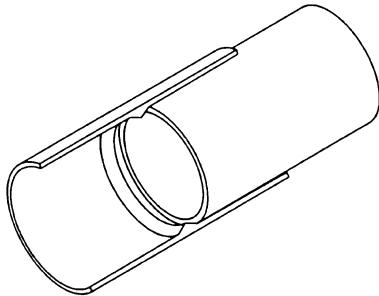




FIBERGLASS PIPE GROUP



Series 4000 Fiberglass Pipe and Fittings

for corrosive industrial service
2”-6” installs with no shaving required

Uses and applications

Acid drains
Chemical process piping
Corrosive slurries
Food processing
Geothermal
Nonoxidizing chemicals and acids

Listings

Meets USFDA requirements for food processing piping under Federal Regulations 21CFR175.105 and 21CFR177.2280 when bonded using Bondstrand RP6B adhesive.

Performance

Working pressure from 150 to 300 psig (1.0 to 2.0 MPa) depending on pipe size.

Operating temperatures to 250°F (120°C), depending on fluid. Subzero temperatures will not adversely affect mechanical properties.

Excellent corrosion resistance over a wide temperature range. See most recent release of Bondstrand Corrosion Guide (FP132) for specific applications.

Does not require thrust blocks at ambient temperatures when properly installed in most soils.

Smooth inner liner (Hazen-Williams C = 150) produces extremely low frictional loss for greater discharge and reduced pumping costs.

Individual system components may not have the same ratings as the pipe. Refer to the detailed product information for the specific components to determine the pressure rating for the system as a whole.

Joining systems

Quick-Lock® straight/taper adhesive-bonded joint. 2” through 6” pipe outside diameter is within tolerance for reliable bonding without shaving. Integral pipe stop in socket featured for predictable, precise laying length.

Flanges and flanged fittings.

Composition

Pipe

Filament-wound fiberglass reinforced epoxy pipe with nominal 0.050-inch (1.3 mm) resin-rich reinforced liner.

Nominal Pipe Size		ASTM Designation
(in)	(mm)	(D2996)
2-3	50-75	RTRP 11FW-2221
4-6	100-150	RTRP 11FW-2222
8-16	200-400	RTRP 11FE-1113

Filament-wound fittings

Furnished with reinforced liner using same materials as pipe.

Tees	90° and 45° elbows
Crosses	Nipples and couplings
45° laterals	Tapered body reducers
Saddles (no liner)	Threaded adapters (2 to 6 inch)
Victaulic adapters (2 to 6 inch)	

Molded fittings (General Service only)

Tees	90° and 45° elbows
Reducing flanges	Reducer bushings
Endcaps	Plugs

Flanges

2 to 16-inch flanges match ANSI B16.5 bolt hole pattern for CI 150 lb flanges.

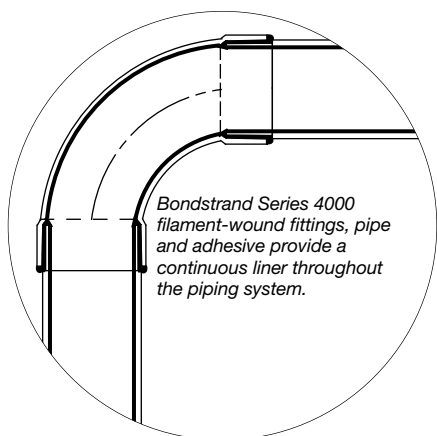
Other flange drilling patterns such as DIN, ISO, JIS, ANSI B16.5 CI 300, etc. available on special request.

Flanged fittings

2 to 12-inch filament-wound flanged fittings match ANSI B16.1 and ANSI B16.5 bolt hole pattern and laying length dimensions. ANSI 90° elbows must be specified as being either 'long' or 'short' when ordering.

Thermosetting adhesives

Bondstrand type PSX™•34 two-part epoxy adhesive for field fabrication.



Pipe lengths

Nominal Pipe Size		Random Length	
(in)	(mm)	(ft)	(m)
2- 6	50-150	20 or 40	6 or 12
8	200	20 or 30	6 or 9
10-16	250-400	20	6

Typical pipe dimensions and weights

Nominal Pipe Size		Pipe ID		Nominal Wall Thickness ¹		Average Sectional Area ²		Pipe Weight	
(in)	(mm)	(in)	(mm)	(in)	(mm)	(in ²)	(mm ²)	(lb/ft)	(kg/m)
2	50	2.10	53	.123	3.1	0.52	335	0.7	1.1
3	80	3.21	82	.126	3.2	0.81	525	1.0	1.5
4	100	4.14	105	.151	3.8	1.38	890	1.6	2.4
6	150	6.19	157	.181	4.6	2.63	1700	2.5	3.7
8	200	8.22	209	.229	5.8	5.83	3760	4.1	6.1
10	250	10.35	263	.229	5.8	7.31	4720	5.1	7.7
12	300	12.35	314	.229	5.8	8.69	5610	6.1	9.1
14	350	13.56	344	.250	6.3	10.40	6710	7.4	11.0
16	400	15.50	394	.286	7.3	13.40	8650	9.6	14.0

- 1) The minimum wall thickness shall not be less than 87.5% of nominal wall thickness in accordance with ASTM D2996.
- 2) Use these values for calculating longitudinal thrust.

Typical pipe performance

Nominal Pipe Size		Internal Pressure Rating ¹		Ultimate Collapse Pressure	
(in)	(mm)	(psig)	(MPa)	(psig)	(MPa)
2	50	300	3.10	215	1.46
3	80	300	2.21	61	0.40
4	100	300	2.41	100	0.56
6	150	300	1.72	68	0.17
8	200	220	1.52	16	0.11
10	250	175	1.21	8	0.06
12	300	150	1.03	5	0.03
14	350	150	1.03	5	0.03
16	400	150	1.03	6	0.04

- 1) At 200°F (93°C) using Bondstrand type PSX™•34 adhesive. For sustained service above 200°F, reduce rating linearly from tabulated 200°F values to 50% of those values at 250°F (121°C). Above 250°F, reduce ratings linearly to 0 at 300°F (149°C).
- 2) At 70°F (21°C). Reduce linearly to 90% at 150°F (66°C), 80% at 200°F and 65% at 230°F (110°C).

Fittings pressure ratings

Nominal Pipe Size		Filament-Wound Elbows & Tees		Molded Elbows & Tees		Tapered Body Reducers & Flanges	
(in)	(mm)	(psig)	(MPa)	(psig)	(MPa)	(psig)	(MPa)
2	50	375	2.59	300	2.07	450	3.10
3	80	325	2.24	225	1.55	350	2.41
4	100	300	2.07	175	1.21	350	2.41
6	150	225	1.55	150	1.03	250	1.72
8	200	225	1.55	-	-	225	1.55
10	250	200	1.38	-	-	175	1.21
12	300	175	1.21	-	-	150	1.03
14	350	150	1.03	-	-	150	1.03
16	400	150	1.03	-	-	150	1.03

Nominal Pipe Size		Laterals		Crosses		Blind Flanges & Saddles	
(in)	(mm)	(psig)	(MPa)	(psig)	(MPa)	(psig)	(MPa)
2	50	275	1.90	150	1.03	150	1.03
3	80	250	1.72	150	1.03	150	1.03
4	100	200	1.38	150	1.03	150	1.03
6	150	150	1.03	100	0.69	150	1.03
8	200	150	1.03	100	0.69	150	1.03
10	250	150	1.03	100	0.69	150	1.03
12	300	150	1.03	100	0.69	150	1.03
14	350	150	1.03	-	-	150	1.03
16	400	150	1.03	-	-	150	1.03

1) All pressure ratings valid from room temperature to 225°F (107°C) using Ameron epoxy adhesives. For service above 225°F, reduce the ratings shown linearly by 50% from 225°F to 250°F (121°C).

Typical physical properties

Pipe Property	Units	Value		ASTM Method
		2"-6"	8"-16"	
Nominal Pipe Size		2"-6"	8"-16"	
Thermal conductivity Pipe wall	Btu•in/(hr•ft ² •°F) W/m•°C	1.70 0.25	1.70 0.25	C177
Thermal expansion Linear	10 ⁻⁶ in/in/°F 10 ⁻⁶ mm/mm°C	8.50 15.30	10.00 18.00	D696
Flow coefficient	Hazen-Williams	150.00	150.00	-
Absolute roughness	10 ⁻⁶ ft 10 ⁻⁶ m	17.40 5.30	17.40 5.30	-
Specific gravity	-	1.80	1.80	D792
Density	lb/in ³	0.07	0.07	

Typical mechanical properties

Pipe Property	Units	70°F 21°C		200°F 93°C		ASTM Method
Nominal Pipe Size		1", 1½" 8"-16"	2"-6"	1", 1½" 8"-16"	2"-6"	
Circumferential						
Tensile stress at weeping	10 ³ psi MPa	18.50 128.00	32.00 220.00	- -	- -	D1599
Tensile modulus	10 ⁶ psi GPa	3.65 25.20	4.20 29.00	3.20 22.10	3.70 25.50	
Poisson's ratio		0.56	0.26	0.68	0.32	D2105
Longitudinal						
Tensile strength	10 ³ psi MPa	8.50 58.60	16.00 110.00	6.90 47.60	13.00 90.00	D2105
Tensile modulus	10 ⁶ psi GPa	1.60 11.10	3.00 20.70	1.24 8.60	2.40 16.50	D2105
Poisson's ratio		0.37	0.16	0.41	0.20	D2105
Beam apparent Elastic modulus	10 ⁶ psi GPa	1.70 11.70	2.40 16.60	1.08 6.90	1.77 12.20	D2925
Hydrostatic design basis (cyclic)	10 ³ psi MPa	6.00 41.40	16.00 ¹ 110.00	- -	- -	D2992

1) Static

Nominal Pipe Size		Stiffness Factor ³		Pipe Stiffness ³		Beam Moment of Inertia ⁴	
(in)	(mm)	(lb·in)	(N·m)	(psi)	(MPa)	(in ⁴)	(10 ⁶ mm ⁴)
2	50	95	10.7	420	2.90	0.38	0.16
3	80	105	11.9	200	1.40	1.16	0.48
4	100	230	26.9	155	1.10	3.25	1.35
6	150	500	56.5	110	0.76	13.60	5.66
8	200	1288	146.0	114	0.78	40.10	16.70
10	250	1288	146.0	68	0.40	78.60	32.70
12	300	1288	146.0	35	0.24	132.00	55.00
14	350	1759	199.0	36	0.25	194.00	80.90
16	400	2761	312.0	38	0.26	338.00	141.00

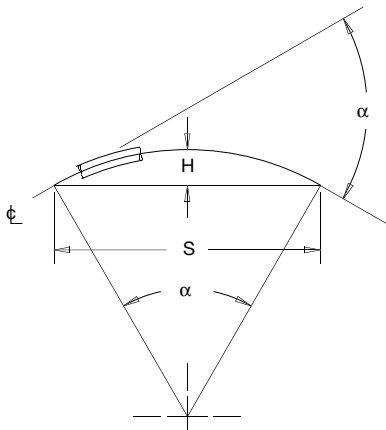
1) Based on structural wall thickness.

2) At 150°F (66°C).

3) Per ASTM D2412.

4) Use these values to calculate permissible spans.

Bending radius



Nominal Pipe Size		Bending Radius ¹ (R)		Maximum Allowable Deflection, H, for 100-ft (30 m) Bending Length		Turning Angle (α)
(in)	(mm)	(ft)	(m)	(ft)	(m)	(deg)
2	50	75	22.9	15.9	4.8	76
3	80	100	30.5	12.1	3.7	57
4	100	200	70.0	6.4	2.0	29
6	150	250	76.2	5.0	1.5	23
8	200	304	93.0	4.1	1.3	19
10	250	379	116.0	3.3	1.0	15
12	300	450	137.0	2.8	0.85	13
14	350	494	151.0	2.5	0.76	12
16	400	564	172.0	2.2	0.67	10

1) Do not bend pipe until adhesive has cured. At rated pressure sharper bends may create excessive stress concentrations.

Buried installations

Thrust blocks: most properly bedded installations do not require thrust blocks at ambient operating temperatures. Consult Ameron for information regarding blocking of buried pipelines for your specific application.

Live loads: when properly bedded in compacted sand in stable soils and provided with at least 3 ft (1 m) of cover, Bondstrand 4000 will carry H2O wheel loadings of at least 16,000 lb (7250 kg) per axle.

Span lengths

Recommended maximum support spacings for Bondstrand Series 4000 pipe at various operating temperatures. Values based on 0.5-inch (12 mm) deflection at midspan for fluid specific gravity = 1.0.

Nominal Pipe Size		Continuous Spans (ft)				Single Spans (ft)			
(in)	(mm)	100°F	150°F	200°F	250°F	100°F	150°F	200°F	250°F
2	50	13.6	12.9	12.0	10.8	9.1	8.6	8.0	7.2
3	80	15.6	14.7	13.7	12.4	10.4	9.8	9.1	8.3
4	100	17.9	17.0	15.8	14.3	12.0	11.3	10.5	9.5
6	150	20.0	18.9	17.6	15.9	13.4	12.6	11.8	10.6
8	200	22.3	21.1	19.6	17.7	14.8	14.0	13.1	11.8
10	250	23.6	22.3	20.8	18.8	15.7	14.9	13.8	12.5
12	300	24.7	23.4	21.8	19.7	16.5	15.6	14.4	13.1
14	350	26.0	24.6	22.9	20.7	17.3	16.4	15.3	13.8
16	400	28.0	26.5	24.6	22.2	18.6	12.6	16.4	14.8

- 1) Span recommendations include no provision for weights (fittings, valves, flanges, etc.) or thrusts (branches, turns, etc.).
- 2) Span recommendations are calculated for a maximum long-term deflection of 1/2 inch to ensure good appearance and adequate drainage.
- 3) Continuous spans are defined as interior (not end) spans that are uniform in length and free from structural rotation at the supports. Single spans are supported only at the ends and are hinged or free to rotate at the supports.

Field testing

Bondstrand 4000 piping systems are designed for hydrostatic testing at 150% of rated operating pressure. Pneumatic testing is not recommended.

Bondstrand® Guide Specification

Pipe construction

The structural wall of Bondstrand 4000 pipe in 2 through 16-inch sizes shall have continuous glass fibers wound in a matrix of aromatic amine cured epoxy resin. The integral reinforced resin-rich liner shall consist of C-glass and a resin/hardener system identical to that of the structural wall, and shall have a 50-mil nominal thickness. Non-reinforced pure resin-type corrosion barriers (liners) shall not be allowed due to their potential for severe fracturing during transportation, installation and operation of the pipe.

Pipe in 2 through 16-inch sizes shall be rated for a minimum of 150 psig at 200°F. In 2 through 6-inch sizes the pipe shall have full vacuum capability at 70°F.

Pipe shall be manufactured according to ASTM D2996 Specification for filament-wound Reinforced Thermosetting Resin Pipe (RTRP). When classified under ASTM D2310, the pipe shall meet Type 1, Grade 1 and Class F (RTRP-11FE or -11FW) cell limits in 2 through 16-inch nominal pipe sizes.

Filament-wound epoxy fiberglass pipe shall be translucent to allow for inspection of damage.

Pipe in 2 through 8-inch sizes shall be furnished in 30 or 40-ft random lengths to minimize the number of field-bonded joints for rapid installation.

Standard fittings construction

Fittings in 2 through 16-inch sizes shall be filament wound with a reinforced resin-rich liner of 50-mil nominal thickness and of the same glass and resin type as the pipe. When properly installed with Ameron adhesive and lined filament-wound Bondstrand fittings, Series 4000 piping systems shall provide the equivalent of a continuous resin-rich liner throughout.

Compression-molded fittings in 2, 3, 4 and 6-inch nominal sizes may also be allowed upon agreement between purchaser and manufacturer. Contact-molded, spray-up or hand-layup fittings shall not be allowed.

Pipe and fittings shall be joined using a bell x straight spigot joint with a 0.5° taper and pipe stop inside the bell to allow precise makeup.

Workmanship

The pipe and fittings shall be free from all defects, including delaminations, indentations, pinholes, foreign inclusions, bubbles and resin-starved areas which, due to their nature, degree or extent, detrimentally affect the strength and serviceability of the pipe or fittings. The pipe and fittings shall be as uniform as commercially practicable in color, density and other physical properties.

Testing

Samples of pipe and couplings shall be tested at random, based on standard quality control practices to determine conformance of the materials to American Society for Testing and Materials guidelines for testing fiberglass pipe products: ASTM D1599, D2105, D2925, D2992A or D2992B.

Test samples may be hydrostatically tested by the manufacturer to 1.5 times the pressure rating for signs of leakage.

Conversions

1 psi = 6895 Pa = 0.07031 kg/cm²
1 bar = 10⁵ Pa = 14.5 psi = 1.02 kg/cm²
1 MPa = 10⁶ Pa = 145 psi = 10.2 kg/cm²
1 GPa = 10⁹ Pa = 145,000 psi = 10,200 kg/cm²
1 in = 25.4 mm
1 ft = 0.3048 m
1 lb•in = 0.113 N•m
1 in⁴ = 4.162 x 10⁻⁷m⁴
°C = $\frac{5}{9}$ (°F - 32)

Important Notice

This literature and the information and recommendations it contains are based on data reasonably believed to be reliable. However, such factors as variations in environment, application or installation, changes in operating procedures, or extrapolation of data may cause different results. Ameron makes no representation or warranty, express or implied, including warranties of merchantability or fitness for purpose, as to the accuracy, adequacy or completeness of the recommendations or information contained herein. Ameron assumes no liability whatsoever in connection with this literature or the information or recommendations it contains. Product specifications are subject to change.



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