

## **Series 2000 Fiberglass Pipe and Fittings**

for general industrial service,  
maintenance and repair  
2" - 6" installs with no shaving required

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### **Uses and applications**

Chemical process piping  
Cooling water piping  
Deionized water systems  
Drainage systems  
Food processing plant piping  
Jet engine air start systems  
Jet fuel and liquid petroleum piping  
Piping systems for alkalis and nonoxidizing chemicals  
Potable water lines  
Waste water and sewage systems  
General industrial service for moderately corrosive liquids

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### **Listings**

Mil-P-29206A for jet fuel and petroleum liquids  
U.S. Federal Regulations 21CFR175.105 and 21CFR177.2280 for conveying foodstuffs when joined with Bondstrand RP6B epoxy adhesive.

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### **Performance**

Pipe designs to 450 psi (3.1 MPa) using an 8000 psi (41.2 MPa) hydrostatic design stress in accordance with ASTM D2992 (B).  
Continuous operating temperatures to 250°F (121°C).  
Excellent corrosion resistance over a wide temperature range. See most recent release of Bondstrand Corrosion Guide (FP132) for specific applications.  
Weighs 1/6<sup>th</sup> as much as Sch. 40 steel.  
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.  
Low thermal conductivity (1/100<sup>th</sup> of steel) minimizes heat losses.  
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"-6" pipe outside diameter is within tolerance for reliable bonding without shaving. Integral pipe stop in socket featured for predictable, precise laying lengths.

Flanges and flanged fittings.

## Composition

### Pipe

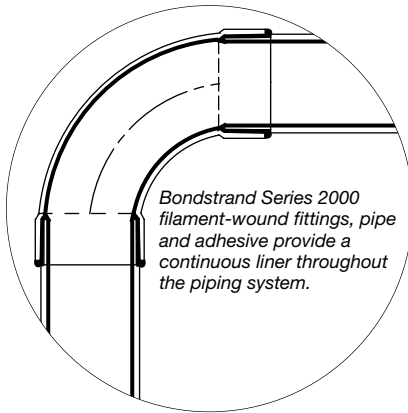
Filament-wound fiberglass-reinforced epoxy resin pipe with integral resin-rich reinforced liner of 20 mil (0.5 mm) nominal thickness.

### Filament-wound fittings

Furnished with 50 mil (1.3 mm) reinforced liner using same materials as the pipe.

Tees	Flanges*
90° and 45° elbows	Nipples and couplings
Crosses	Tapered body reducers
45° laterals	Saddles*

\*No liner.



### Molded fittings

Tees  
 90° and 45° elbows  
 Reducing flanges  
 Plugs and end-caps  
 Reducer bushings  
 Blind flanges

### Flanged fittings

2-12 inch filament-wound flanged fittings match ANSI B16.1 and ANSI B16.5 bolt hole pattern and face-to-face dimensions for 150 lb flanges.

1-16 inch flanges match ANSI B16.1 and ANSI B16.5 bolt hole pattern for 150 lb flanges.

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

### Thermosetting adhesives

PSX™•34 two-part epoxy adhesive for general industrial service.

RP6B two-part epoxy adhesive for service in compliance with U.S. Federal Regulations 21CFR175.105 and 21CFR177.2280.

## Pipe lengths

Nominal Pipe Size		Random Lengths <sup>1</sup>	
(in)	(mm)	(ft)	(m)
1-1½	25-40	10	3
2-6	50-150	20 or 40	6 or 12
8	200	20 or 30	6 or 9
10-16	250-400	20	6

1) Other lengths and exact lengths available on special request.

## Typical pipe dimensions and weights

Nominal Pipe Size		Pipe ID		Nominal Wall Thickness <sup>1</sup>		Average Sectional Area <sup>2</sup>		Pipe Weight	
(in)	(mm)	(in)	(mm)	(in)	(mm)	(in <sup>2</sup> )	(mm <sup>2</sup> )	(lb/ft)	(kg/m)
1	25	1.07	27	.140	3.6	0.50	323	0.4	0.6
1½	40	1.67	42	.140	3.6	0.80	516	0.7	1.0
2 <sup>3</sup>	50	2.10	53	.123	3.7	.73	730	0.7	1.3
3 <sup>3</sup>	80	3.21	82	.126	3.7	1.07	1100	1.1	1.8
4 <sup>3</sup>	100	4.14	105	.151	3.8	1.78	1760	1.7	3.0
6 <sup>3</sup>	150	6.19	159	.181	4.6	3.22	2620	2.6	4.5
8	200	8.22	209	.226	5.7	5.83	3760	4.3	6.4
10	250	10.35	263	.226	5.7	7.31	4720	5.4	8.0
12	300	12.35	314	.226	5.7	8.69	5610	6.4	9.5
14	350	13.56	344	.250	6.4	10.32	6660	7.4	11.0
16	400	15.50	394	.269	6.8	13.33	8600	9.5	14.1

1) 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.

3) No-shave pipe.

## Typical pipe performance

Nominal Pipe Size		Internal Pressure Rating <sup>1</sup>		Collapse Pressure Rating <sup>2</sup>		Designation
(in)	(mm)	(psig)	(MPa)	(psig)	(MPa)	(per ASTM D2996)
1	25	450	3.10	945	6.52	RTRP-11FE-1112
1½	40	450	3.10	280	1.93	RTRP-11FE-1114
2 <sup>3</sup>	50	450	3.10	260	1.80	11FW-2232
3 <sup>3</sup>	80	450	3.10	80	0.55	11FW-2232
4 <sup>3</sup>	100	450	3.10	70	0.48	11FW-2232
6 <sup>3</sup>	150	375	2.59	50	0.34	11FW-2232
8	200	250	1.72	30	0.21	RTRP-11FE-1114
10	250	200	1.38	14	0.097	RTRP-11FE-1114
12	300	170	1.17	8	0.055	RTRP-11FE-1114
14	350	165	1.14	8	0.055	RTRP-11FE-1115
16	400	165	1.14	8	0.055	RTRP-11FE-1116

1) At 200°F (94°C) using Bondstrand type PSX™•34 adhesive. For sustained service above 200°F, reduce ratings linearly to 50% from 200°F to 250°F (121°C).

2) At 70°F (21°C). Reduce linearly to 90% at 150°F (66°C), 80% at 200°F (94°C), and 65% at 230°F (110°C).

3) No-shave pipe.

## Fittings pressure ratings

Nominal Pipe Size		Elbows & Tees				Tapered Body Reducers & Flanges		Blind Flanges & Bushed Saddles <sup>2</sup>	
(in)	(mm)	Filament-Wound		Molded		(psig)	(MPa)	(psig)	(MPa)
1	25	300	2.07	-	-	600	4.14	150	1.03
1½	40	300	2.07	-	-	550	3.79	150	1.03
2 <sup>3</sup>	50	375	2.59	300	2.07	450	3.10	150	1.03
3 <sup>3</sup>	80	325	2.24	225	1.55	350	2.41	150	1.03
4 <sup>3</sup>	100	300	2.07	175	1.21	350	2.41	150	1.03
6 <sup>3</sup>	150	225	1.55	150	1.03	250	1.72	150	1.03
8	200	225	1.55	-	-	225	1.55	150	1.03
10	250	200	1.38	-	-	175	1.21	150	1.03
12	300	175	1.21	-	-	150	1.03	150	1.03
14	350	150	1.03	-	-	150	1.03	-	-
16	400	150	1.03	-	-	150	1.03	-	-

1) Refer to FP282 for fittings dimensions.

2) With 316 stainless steel outlet. Other outlet materials available on special order.

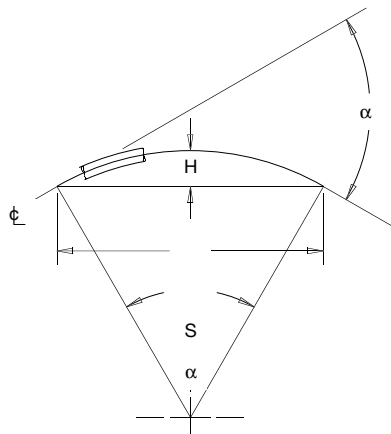
3) No-shave pipe.

Nominal Pipe Size		Laterals		Crosses		Reducer Bushings	
(in)	(mm)	(psig)	(MPa)	(psig)	(MPa)	(psig)	(MPa)
1	25	-	-	-	-	50	.35
1½	40	-	-	-	-	50	.35
2 <sup>2</sup>	50	275	1.90	150	1.03	50	.35
3 <sup>2</sup>	80	250	1.72	150	1.03	50	.35
4 <sup>2</sup>	100	200	1.38	150	1.03	50	.35
6 <sup>2</sup>	150	150	1.03	100	0.69	50	.35
8	200	150	1.03	100	0.69	50	.35
10	250	150	1.03	100	0.69	50	.35
12	300	150	1.03	100	0.69	50	.35
14	350	150	1.03	100	0.69	50	.35
16	400	150	1.03	100	0.69	50	.35

1) Reducer bushings bonded into flanges will have the same rating as the flange. Otherwise, rated as shown.

2) No-shave pipe.

## Bending radius



Nominal Pipe Size		Bending Radius <sup>1</sup> (R)		Maximum Allowable Deflection, H, for 100-ft (30 m) Bending Length, S		Turning Angle (α)
(in)	(mm)	(ft)	(m)	(ft)	(m)	(deg)
1	25	45.2	13.8	24.9	7.6	127
1½	40	66.4	20.2	17.9	5.5	86
2 <sup>2</sup>	50	75	22.9	15.9	4.8	76
3 <sup>2</sup>	80	100	30.5	12.1	3.7	57
4 <sup>2</sup>	100	200	70.0	6.4	2.0	29
6 <sup>2</sup>	150	250	76.2	5.0	1.5	23
8	200	304	93	4.1	1.2	19
10	250	379	116	3.3	1.0	15
12	300	450	137	2.8	0.85	13
14	350	494	151	2.5	0.76	12
16	400	564	172	2.2	0.67	10

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

2) No-shave pipe.

## 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 <sup>3</sup> psi MPa	24.00 165.00	32.00 22.00	- -	- -	D1599
Tensile modulus	10 <sup>6</sup> 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	0.70	0.32	D2105
Longitudinal						
Tensile strength	10 <sup>3</sup> psi MPa	8.50 58.60	16.00 110.00	6.90 47.60	13.00 90.00	D2105
Tensile modulus	10 <sup>6</sup> psi GPa	1.60 11.00	3.00 20.70	1.24 8.50	2.40 16.50	D2105
Poisson's ratio		0.37	0.16	0.41	0.20	D2105
Beam apparent Elastic modulus	10 <sup>6</sup> psi GPa	1.70 11.70	2.40 16.60	1.00 6.90	1.77 12.20	D2925
Hydrostatic design basis (cyclic)	10 <sup>3</sup> psi MPa	6.00 <sup>1</sup> 41.40	16.00 <sup>1,2</sup> 110.00	- -	- -	D2992

1) At 150°F (66°C).

2) Static

Nominal Pipe Size		Stiffness Factor <sup>1</sup>		Pipe Stiffness		Beam Moment of Inertia <sup>2</sup>	
(in)	(mm)	(lb•in)	(N•m)	(psi)	(MPa)	(in <sup>4</sup> )	(10 <sup>6</sup> mm <sup>4</sup> )
1	25	770	87	26400	182	0.09	0.037
1½	40	1610	182	17200	119	0.36	0.150
2 <sup>3</sup>	50	265	30	1350	9.3	0.46	0.191
3 <sup>3</sup>	80	285	32	550	3.80	1.57	0.653
4 <sup>3</sup>	100	500	56	335	2.30	4.13	1.72
6 <sup>3</sup>	150	925	104	200	1.40	16.5	6.87
8	200	1890	214	170	1.17	45.1	18.8
10	250	1890	214	86	0.59	88.6	36.9
12	300	1890	214	51	0.35	149.0	62.0
14	350	2230	252	46	0.32	208.0	86.6
16	400	3250	367	45	0.31	353.0	147.0

1) Per ASTM D2412.

2) Use these values to calculate permissible spans.

3) No-shave pipe.

## Typical physical properties

Pipe Property	Units	Value		ASTM Method
Nominal Pipe Size		1", 1½" 8"-16"	2"-6"	
Thermal conductivity Pipe wall	Btu•in/(hr•ft <sup>2</sup> •°F) W/m•°C	2.00 0.29	1.70 10.25	C177
Thermal expansion Linear	10 <sup>-6</sup> in/in/°F 10 <sup>-6</sup> mm/mm°C	10.00 18.00	8.50 15.30	D696
Flow coefficient	Hazen-Williams	150.00	150.00	-
Absolute roughness	10 <sup>-6</sup> ft 10 <sup>-6</sup> m	17.40 5.30	17.40 3.30	-
Specific gravity	-	1.80	1.80	D792
Density	lb/in <sup>3</sup> g/cm <sup>3</sup>	0.07 1.80	0.07 1.80	

## Buried installations

### Thrust blocks

Most installations at ambient operating temperatures do not require thrust blocks. Consult Ameron for information regarding blocking of buried pipelines for your specific application.

### Live loads

Bondstrand 2000 will carry H20 wheel loadings of at least 16,000 lb (7250 kg) per axle when properly bedded in compacted sand in stable soils and provided with at least 3 ft (1 m) of cover.

### Earth loads on buried pipe

Nominal Pipe Size		Maximum Earth Cover <sup>1</sup>					
		100 psi	0.69 MPa	125 psi	0.86 MPa	150 psi	1.03 MPa
(in)	(mm)	(ft)	(m)	(ft)	(m)	(ft)	(m)
1	25	30	9	30	9	30	9
1½	40	30	9	30	9	30	9
2 <sup>2</sup>	50	30	9	30	9	30	9
3 <sup>2</sup>	80	30	9	30	9	30	9
4 <sup>2</sup>	100	30	9	30	9	30	9
6 <sup>2</sup>	150	30	9	24	7	23	7
8	200	23	7	22	6	21	6
10	250	23	7	21	6	19	5
12	300	23	7	21	6	18	5
14	350	23	7	21	6	17	5
16	400	23	7	20	6	16	5

1) Based on a 120 lb/ft<sup>3</sup> (1925 kg/m<sup>3</sup>) soil density and 1000 psi (6.9 MPa) modulus of soil reaction.

2) No-shave pipe.

## Span lengths

Recommended maximum support spacings for Bondstrand Series 2000 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)				Simple Spans (ft)			
		100°F	150°F	200°F	250°F	100°F	150°F	200°F	250°F
(in)	(mm)								
1	25	11.7	11.1	10.3	9.3	7.3	7.4	6.7	6.2
1½	40	13.8	13.0	12.1	11.0	9.2	8.7	8.1	7.3
2 <sup>4</sup>	50	14.3	13.5	12.6	11.4	9.5	9.0	8.4	7.6
3 <sup>4</sup>	80	16.2	15.4	14.3	12.9	10.8	10.2	9.5	8.6
4 <sup>4</sup>	100	18.5	17.5	16.3	14.7	12.3	11.7	10.9	9.8
6 <sup>4</sup>	150	20.7	19.6	18.2	16.5	13.8	13.1	12.1	11.0
8	200	22.9	21.7	20.2	18.2	15.3	14.5	13.5	12.2
10	250	24.3	23.0	21.4	19.3	16.2	15.3	14.3	12.9
12	300	25.5	24.1	22.4	20.3	17.0	16.1	15.0	13.5
14	350	26.5	25.0	23.3	21.1	17.6	16.7	15.5	14.0
16	400	28.2	26.7	24.9	22.5	18.9	17.8	16.6	15.0

1) Span recommendations include no provision for weights (fittings, valves, flanges, etc.) or thrusts (branches, turns, etc.). Fittings, valves, flanges and other appurtenances must be supported separately.

2) Span recommendations are calculated for a maximum long-term deflection of ½ 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. Simple spans are supported only at the ends and are hinged or free to rotate at the supports.

4) No-shave pipe.

## Field testing

Bondstrand 2000 piping systems are designed for hydrostatic field testing at 150% of rated operating pressure. Pneumatic testing is *not* recommended.

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## Pipe construction

The structural wall of fiberglass pipe shall have continuous glass fibers 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 20 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 1 through 16-inch sizes shall be rated for a minimum of 165 psig at 250°F. In 1 through 6-inch sizes the pipe shall have full vacuum capability at 70°F, when installed above ground with a safety factor of 3:1.

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 W) cell limits in 1 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. length to minimize the number of field-bonded joints for rapid installation.

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## Standard fittings construction

Fittings in 1 through 16-inch sizes shall be filament wound with a reinforced resin-rich liner of 50 mil minimum thickness and of the same glass and resin type as the pipe. Pipe, filament-wound fittings and adhesive shall, as an assembly, provide a continuous liner throughout the system.

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 straight spigot by socket with a 0.5° taper angle and a pipe stop inside the socket to allow precise makeup.

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## 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.

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## 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.

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## Conversions

1 psi = 6895 Pa = 0.07031 kg/cm<sup>2</sup>  
1 bar = 10<sup>5</sup> Pa = 14.5 psi = 1.02 kg/cm<sup>2</sup>  
1 MPa = 10<sup>6</sup> Pa = 145 psi = 10.2 kg/cm<sup>2</sup>  
1 GPa = 10<sup>9</sup> Pa = 145,000 psi = 10,200 kg/cm<sup>2</sup>  
1 in = 25.4 mm  
1 ft = 0.3048 m  
1 lb•in = 0.113 N•m  
1 in<sup>4</sup> = 4.162 x 10<sup>-7</sup>m<sup>4</sup>  
°C =  $\frac{5}{9}$  (°F - 32)

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## 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.



FIBERGLASS PIPE GROUP

### GROUP HEADQUARTERS

P.O. Box 801148 • Houston, TX 77280 • Tel: (713) 690-7777 • Fax: (713) 690-2842 • <http://www.ameron.com>

### Fiberglass Pipe Division Asia

Ameron (Pte) Ltd.  
No. 7A, Tuas Avenue 3  
Singapore 639407  
Tel: 65 861 6118  
Fax: 65 862 1302/861 7834

### Fiberglass Pipe Division Europe

Ameron B.V.  
J.F. Kennedylaan 7  
4191 MZ Geldermalsen  
The Netherlands  
Tel: +31 345 587 587  
Fax: +31 345 587 561

### Fiberglass Pipe Division Americas

P.O. Box 878  
Burkburnett, TX 76354  
Tel: (940) 569-1471  
Fax: (940) 569-2764

### Ameron Composites

P.O. Box 71370  
11 McBride Street  
Newnan, Georgia 30263  
Tel: (770) 253-2000  
Fax: (770) 253-9234

### Fiberglass Pipe Division Centron International

P.O. Box 490  
600 FM 1195 South  
Mineral Wells, Texas 76068  
Tel: (940) 325-1341  
Fax: (940) 325-9681