

# Bondstrand Series 2000M Fiberglass Pipe and Fittings

for shipboard and offshore platform service

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## Uses and applications

### Offshore platform piping

Brine  
 Column piping  
 Drainage  
 Electrical conduit  
 Fire protection systems (wet and dry)  
 Gas trap piping  
 Potable water  
 Produce water  
 Sanitary service  
 Semisubmersible platform ballast  
 Sewage  
 Submersible pump systems

### Shipboard piping

Air cooling circulating water  
 Auxiliary equipment cooling  
 Ballast/segregated ballast  
 Eductor systems  
 Exhaust piping  
 Fresh water/saltwater service (nonvital)  
 Inert gas effluent  
 Main engine cooling  
 Sanitary service  
 Sounding tubes/vent lines  
 Steam condensate  
 Tank cleaning (saltwater system)

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## Listings and approvals

American Bureau of Shipping (U.S.)  
 Bureau Veritas (France)  
 Canadian Coast Guard  
 Det norske Veritas  
 Dutch Scheepvaartinspectie  
 Food and Drug Administration (U.S.)  
 Germanischer Lloyd

Lloyd's Register of Shipping (U.K.)  
 National Sanitation Foundation (U.S.)  
 Nippon Kaiji Kyokai  
 Polski Rejestr Statków  
 Registro Italiano Navale  
 United States Coast Guard  
 Russian Register of Shipping

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## Performance

Bondstrand Series 2000M piping meets all applicable requirements of ASTM F1173 for fiberglass-reinforced epoxy resin pipe and fittings.

Standard operating pressure rating for pipe and fittings is 150 psi at 200°F (10 bar at 93°C). Systems with 225 psig (16 bar) rating available on request.

Minimum ultimate collapse pressure of pipe and fittings is not less than 100 psi at 200°F (8.6 bar at 93°C) to withstand external pressure at bottom of filled cargo or ballast tanks under full suction.

Consult Ameron for the availability of Series 2000M pipe and fittings with higher pressure ratings than those given above.

Bondstrand Series 2000M piping systems are in accordance with International Marine Organization (IMO) Regulations.

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## Composition

### Pipe

Filament-wound fiberglass-reinforced epoxy pipe with nominal 0.020-inch (0.5 mm) integral resin-rich reinforced liner.

### Fittings

Wide range of lined filament-wound fiberglass-reinforced epoxy fittings employing Quick-Lock® adhesive-bonded joint in 1 to 16-inch (25 to 400 mm) sizes and flanged ends in all sizes.

### Flanges

Filament-wound fiberglass-reinforced epoxy

### Blind flanges

Compression-molded fiberglass-reinforced epoxy in 2 to 12-inch sizes

### Thermosetting adhesives

RP34 two-part epoxy for Quick-Lock joints (outside U.S.)

RP34C two-part epoxy for Quick-Lock joints (in U.S.)

A20LT two-part epoxy adhesive for 18-inch sizes and above (in U.S.)

RP48 two-part epoxy adhesive for 18-inch sizes and above (outside U.S.)

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## Joining systems

### 1 to 16-inch (25 to 400 mm)

Quick-Lock straight/taper adhesive-bonded joint featuring integral pipe stop in bell for predictable, precise laying lengths

### 2 to 24-inch (50 to 600 mm)

Van Stone type flanges with movable flange rings for easy bolt alignment

### 1 to 40-inch (25 to 1000 mm)

One-piece flanges in standard hubbed or heavy-duty hubless configuration

### 2 to 40-inch (50 to 1000 mm)

Viking-Johnson or Dresser type mechanical couplings for installations requiring up to 2° angular deflection

Standard Bondstrand Series 2000M pipe is shipped in the configurations shown below. Pipe in 10-inch (250 mm) sizes and larger is shipped with plain spigot end to facilitate the use of mechanical couplings.

Nominal Pipe Size		Standard End Configuration
(in)	(mm)	
1 - 1½	25 - 40	Quick-Lock bell x plain end
2 - 8	50 - 200	Quick-Lock bell x shaved spigot
10 - 16	250 - 400	Quick-Lock bell x plain end
18 - 40	450 - 1000	plain end x plain end

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## Pipe lengths

Bondstrand marine pipe is produced in different lengths depending on pipe diameter and the location of manufacture. Pipe can be cut to specified lengths at the factory. Consult your Ameron representative.

Nominal Pipe Size		Length	
(in)	(mm)	(ft)	(m)
1 - 1½	25 - 40	10*	3.0
2 - 8	50 - 200	30*	9.1
10 - 16	250 - 400	20*	6.1
18 - 40	450 - 1000	40	12.2

\* In U.S. Other lengths may be available outside of U.S.

## Fittings and flanges

See Bondstrand Product Data, SERIES 2000M AND 7000M FITTINGS, FP169, for dimensions, shipping weights and pressure ratings.

### Fittings

90° and 45° elbows	Reducers
Tees and reducing tees	Reducing saddles furnished with
45° laterals	<ul style="list-style-type: none"> <li>• Quick-Lock socket outlet</li> </ul>
Crosses	<ul style="list-style-type: none"> <li>• flanged outlet</li> </ul>
Couplings and nipples	<ul style="list-style-type: none"> <li>• metallic bushing outlet</li> </ul>

### Flanges

Series 2000M flanges are offered in three configurations

- one-piece hubbed (standard)
- one-piece hubless (heavy-duty)
- loose ring (van Stone)

Bondstrand marine flanges are produced with the following drillings for easy connection to piping systems currently in common use; other drillings, as well as undrilled flanges, are available:

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| • ANSI B16.1 CI 125 (26 to 40 in) | • ISO 2084 NP-10                  |
| • ANSI B16.5 CI 150 (1 to 24 in)  | • ISO 2084 NP-16                  |
| • ANSI B16.5 CI 300 (1 to 24 in)  | • JIS B2211 5 kg/cm <sup>2</sup>  |
| • API 605 CI 150                  | • JIS B2212 10 kg/cm <sup>2</sup> |
| • API 605 CI 300                  | • JIS B2213 16 kg/cm <sup>2</sup> |

See Bondstrand Product Data, SERIES 2000M AND 7000M FLANGES, FP168, for dimensions and weights for the drillings given above.

## Typical pipe dimensions

Series 2000M pipe dimensions conform to Iron Pipe Size (IPS\*) ODs in 1 to 36-inch sizes and Marine Cast Iron (MCI\*\*) ODs in 14 to 40-inch sizes.

Nominal Pipe Size		Pipe Inside Diameter		Nominal Wall Thickness		Shipping Weight (approx)	
(in)	(mm)	(in)	(mm)	(in)	(mm)	(lb/ft)	(kg/m)
1	25	1.07	27	.15	3.8	0.5	0.7
1½	40	1.67	42	.15	3.8	0.9	1.3
2	50	2.10	53	.16	4.1	0.8	1.2
3	80	3.22	82	.16	4.1	1.2	1.8
4	100	4.14	105	.21	5.2	2.0	3.0
6	150	6.26	159	.22	5.4	3.1	4.6
8	200	8.22	209	.28	7.0	5.2	7.7
10	250	10.35	263	.34	8.6	8.1	12
12	300	12.35	314	.40	10.2	11	17
14	350	13.29	338	.43	11.0	13	19
		14.12**	359	.46	11.6	15	22
16	400	15.19	386	.49	12.5	17	25
		16.03**	407	.51	13.1	19	28
18	450	17.08	434	.55	13.9	21	32
		17.94**	456	.57	14.5	23	35
20	500	18.98	482	.60	15.4	26	39
		19.88**	505	.63	16.0	29	43
22	550	21.78**	553	.69	17.5	33	49
24	600	22.78	579	.72	18.3	37	56
		23.73**	603	.75	19.2	40	60
26	650	25.59**	650	.81	20.6	44	66
28	700	27.57**	700	.87	22.1	51	75
30	750	28.47	723	.89	22.6	58	86
		29.53**	750	.93	23.5	62	93
32	800	31.46**	799	.99	25.1	68	102
36	900	34.17	868	1.07	27.3	83	123
		35.31**	897	1.10	28.2	88	132
40	1000	39.37**	1000	1.17	29.7	110	165

\* Outside diameters of Series 2000M pipe in 250 and 300 mm sizes exceed iron pipe dimensions of ISO 559-1977 (273 and 324 mm, respectively) and cast iron pipe dimensions of ISO 13-1978 (274 and 326 mm, respectively).

## Typical physical properties

Pipe Property	Units	Value	Method
Thermal conductivity Pipe wall	Btu•in/(hr•ft <sup>2</sup> •°F)	2.3	Ameron
	W/m•°C	0.33	
Thermal expansion Linear	10 <sup>-6</sup> in/in/°F	10	Ameron
	10 <sup>-6</sup> mm/mm°C	18	
Flow coefficient	Hazen-Williams	150	—
Absolute roughness	10 <sup>-6</sup> ft	17.4	—
	10 <sup>-6</sup> m	5.3	
Specific gravity	—	1.79	—
Density	lb/in <sup>3</sup>	0.065	

## Typical mechanical properties

Pipe Property	Units	70°F (21°C)	200°F (93°C)	Method
Circumferential				
Tensile stress at weeping	10 <sup>3</sup> psi	24.0	18.5	ASTM D1599
	MPa	165	128	
Tensile modulus	10 <sup>6</sup> psi	3.65	3.20	Ameron
	GPa	25.2	22.1	
Poisson's ratio		0.56	0.70	Ameron
Longitudinal				
Tensile strength	10 <sup>3</sup> psi	8.50	6.90	ASTM D2105
	MPa	59.0	44.6	
Tensile modulus	10 <sup>6</sup> psi	1.60	1.24	ASTM D2105
	GPa	11.1	8.50	
Poisson's ratio		0.37	0.41	ASTM D2105
Beam apparent				
Elastic modulus	10 <sup>6</sup> psi	1.70	1.00	ASTM D2925
	GPa	11.7	6.90	
Hydrostatic design basis (cyclic) <sup>1</sup>	10 <sup>3</sup> psi	6.0	—	ASTM D2992A
	MPa	41.4	—	

1) At 150°F (66°C).

## Support spacing

Recommended maximum support spacing for Bondstrand Series 2000M pipe when carrying liquid with a specific gravity of 1.0.

Nominal Pipe Size	Temperature (°F/°C)								
	(100/38)		(150/66)		(200/93)		(250/121)		
	(in)	(mm)	(ft)	(m)	(ft)	(m)	(ft)	(m)	
1	25	9.2	2.80	8.7	2.65	8.1	2.45	7.3	2.20
1½	50	10.3	3.15	9.8	3.00	9.1	2.75	8.2	2.50
2	50	11.8	3.60	11.2	3.40	10.4	3.15	9.4	2.85
3	80	13.4	4.10	12.7	3.85	11.8	3.60	10.7	3.25
4	100	15.2	4.65	14.4	4.40	13.4	4.10	12.1	3.70
6	150	17.4	5.30	16.5	5.05	15.3	4.65	13.9	4.25
8	200	19.6	5.95	18.6	5.65	17.3	5.25	15.6	4.75
10	250	22.1	6.75	20.9	6.35	19.4	5.90	17.5	5.35
12	300	24.1	7.35	22.8	6.95	21.2	6.45	19.1	5.80
14	350	24.9	7.60	23.6	7.20	23.2	7.05	19.8	6.05
16	400	26.8	8.15	25.3	7.70	23.6	7.20	21.3	6.50
18	450	28.3	8.65	26.7	8.15	24.9	7.60	22.5	6.85
20	500	29.8	9.10	28.2	8.60	26.2	8.00	23.7	7.20
22	550	31.7	9.65	30.0	9.15	27.9	8.50	25.2	7.70
24	600	32.5	9.90	30.7	9.35	28.6	8.70	25.8	7.85
26	650	34.4	10.50	32.6	9.95	30.3	9.25	27.4	8.35
28	700	35.8	10.90	33.8	10.30	31.5	9.60	28.4	8.65
30	750	36.2	11.05	34.3	10.45	31.9	9.70	28.8	8.80
32	800	37.5	11.45	35.0	10.65	32.6	9.95	30.1	9.15
36	900	37.8	11.50	35.8	10.90	33.3	10.15	31.0	9.45
40	1000	40.0	12.20	38.1	11.60	35.4	10.80	32.0	9.75

## External pressure rating

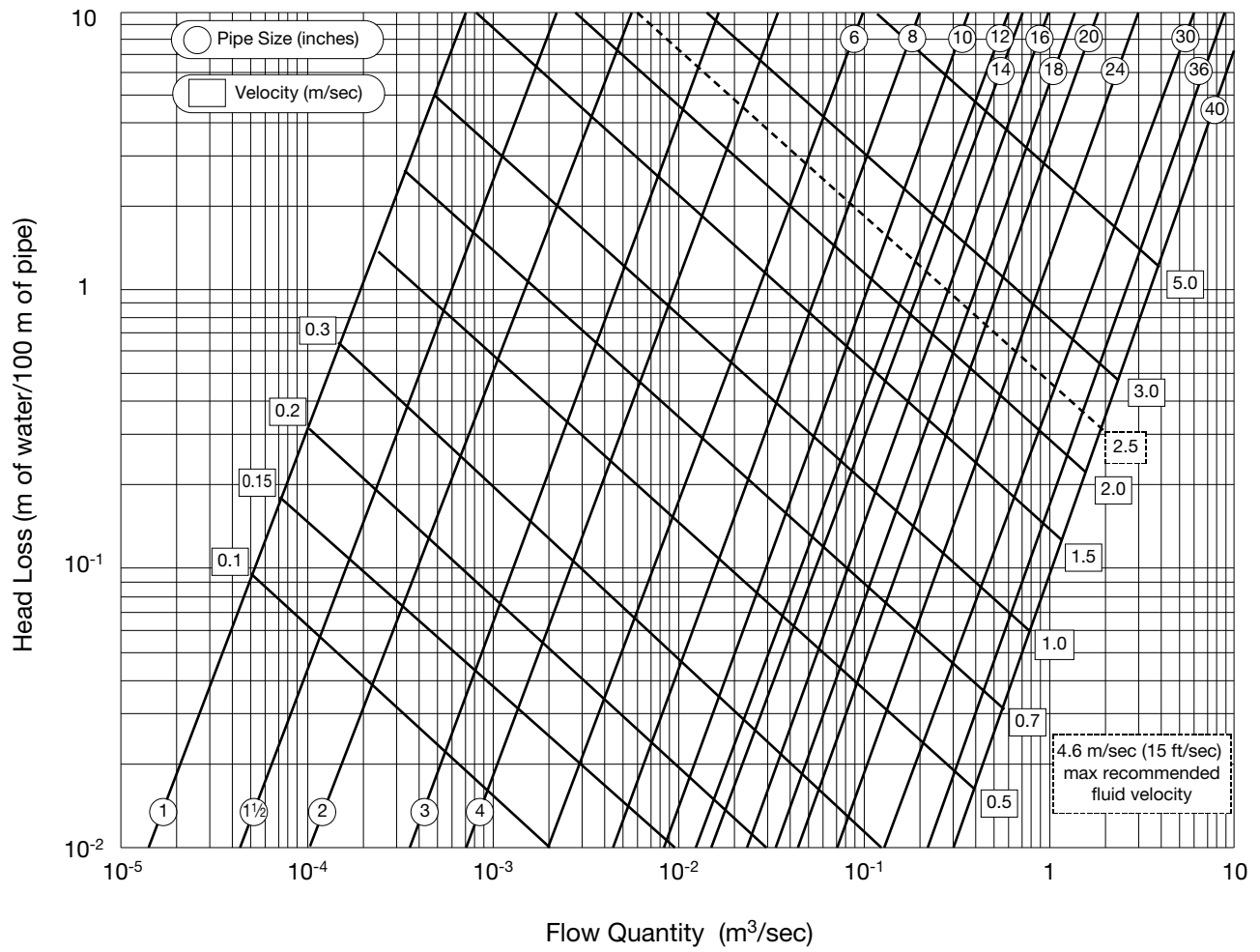
Collapse pressure calculations are based on minimum wall thicknesses (87½% of nominal wall thickness) and assume no contribution of strength by the liner. Maximum head calculations assume a 3:1 safety factor and 75% vacuum inside the pipe. For full vacuum conditions, subtract an additional 8.5 feet (2.6 m) from the tabulated values.

Nominal Pipe Size		100°F				150°F			
		Collapse Pressure		Maximum Head		Collapse Pressure		Maximum Head	
(in)	(mm)	(psi)	(bar)	(ft)	(m)	(psi)	(bar)	(ft)	(m)
1	25	>5000	>350	>5000	>1500	>5000	>350	>5000	>1500
1½	40	>5000	>350	>5000	>1500	>5000	>350	>5000	>1500
2	50	1457	100.5	1097	334.3	1412	97.4	1062	323.7
3	80	404	27.9	285	86.9	391	27.0	276	84.1
4	100	483	33.3	346	105.5	468	32.2	335	102.1
6	150	163	11.2	100	30.5	158	10.9	96	29.3
8	200	142	9.8	84	25.6	137	9.4	80	24.3
10	250	150	10.3	90	27.4	145	10.0	87	26.5
12	300	149	10.3	89	27.1	144	9.9	85	25.9
14	350	150	10.3	90	27.4	145	10.0	86	26.2
		155**	10.7	94	28.7	150	10.3	90	27.4
16	400	152	10.5	91	27.7	147	10.1	88	26.8
		146**	10.1	87	26.5	142	9.8	84	25.6
18	450	153	10.5	93	28.3	149	10.3	89	27.1
		148**	10.2	88	26.8	143	9.9	85	25.9
20	500	154	10.6	93	28.3	150	10.3	90	27.4
		149**	10.3	89	27.1	144	9.9	85	25.9
22	550	150**	10.3	90	27.4	145	10.0	86	26.2
24	600	150	10.3	90	27.4	145	10.0	86	26.2
		150**	10.3	90	27.4	145	10.0	87	26.5
26	650	151**	10.4	91	27.7	146	10.1	87	26.5
28	700	151**	10.4	91	27.7	147	10.1	87	26.5
30	750	147	10.1	88	26.8	143	9.9	85	25.9
		151**	10.4	91	27.7	147	10.1	87	26.5
32	800	152**	10.5	91	27.7	147	10.1	88	26.8
36	900	150	10.3	90	27.4	146	10.1	87	26.5
		152**	10.5	92	28.0	148	10.2	88	26.8
40	1000	129**	8.9	74	22.6	125	8.6	71	21.6

\*\* Data for MCI pipe.

# Head loss through Series 2000M pipe

The following chart provides head loss as a function of flow rate of water through Bondstrand Series 2000M piping. Values are based on the Hazen-Williams equation.



# Bondstrand® guide specification

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## Pipe construction

The structural wall of fiberglass pipe in 1 through 40-inch sizes shall have continuous glass fibers wound at a 54¾° helical angle 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 40-inch sizes shall be rated for a minimum of 150 psig at 200°F and shall have a full vacuum capability 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) cell limits.

Pipe and fittings shall meet the requirements of ASTM F1173 for fiberglass-reinforced epoxy pipe and fittings for shipboard applications.

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

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## Fittings construction

Fittings in 1 through 40-inch sizes shall be filament wound with a reinforced resin-rich liner of equal or greater thickness than the pipe liner and of the same glass and resin type as the pipe. Unlined fittings shall not be substituted.

When classified in accordance with ASTM D4024, filament-wound epoxy-resin flanges shall meet or surpass Type 1, Grade 1 and Class C (RTRF-113D or 113E) standards.

Compression-molding, contact-molding, spray-up or hand-layup construction shall not be allowed in standard fittings.

Pipe and fittings in 1 through 16-inch sizes 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. Pipe in 18 through 40-inch sizes shall be furnished with plain ends or with bell x plain end.

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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, D2992A or D2992B.

All fittings shall be 100% tested prior to shipping.

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

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## Technical support

Consult Ameron for further recommendations concerning the shipboard or offshore use of Bondstrand pipe system. For particular questions regarding the installation and use of Bondstrand Series 7000M antistatic pipe and fittings, refer to the Ameron Marine Engineering Manual.

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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>  
1 ft/sec = 0.304 m/sec  
1 gpm = 6.31 x 10<sup>-7</sup> m<sup>3</sup>/sec  
°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.

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Written comments regarding this document are invited. Please write Engineering Manager, Ameron Fiberglass Pipe Division.



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