

Applications

- Potable Water
- Cooling Water
- Produced Water
- Drainage Systems
- Food Processing Piping
- Chemical Process Piping
- Crude Oil & Gas
- Brine Solutions
- Salt/Sea Water
- Waste Water and Sewage
- Deionized Water
- General Service for Moderately Corrosive Liquids

Materials and Characteristics

Filament wound Glassfiber Reinforced epoxy (GRE) pipe with an integral Taper female x shaved spigot adhesive bonded joint or Quick-Lock straight/taper adhesive-bonded joint.

- Laminate meets requirements of API Specification 15LR and ISO 14692.
- Pipe wall design based on hydrostatic design basis (Procedure B) with a 0.5 service factor.
- Maximum operating temperature: 200°F (93°C). Temperatures up to 250°F (121°C) are possible. Please consult NOV Fiber Glass Systems.
- Pipe sizes: 2 - 16 inch (50 - 400 mm).
- Standard pressure rating up to 175 psi (12 bar).
- ASTM D-2310 classification: RTRP-11FW.
- Pipe is non-conductive pipe.
- Pipe has a standard liner thickness of 0.5 mm.

Joining System

Fittings

Filament wound Glassfiber Reinforced epoxy (GRE) fittings with Quick-Lock straight/taper adhesive-bonded joint. Integral pipe stop in socket featured for predictable, precise laying lengths.

Flanges

Filament wound GRE heavy duty and stub end flanges with integral taper female bell end are available. Standard flange drilling pattern per ASME B16.5 and B16.47A, Class 150 are available. Other drilling patterns, such as Class 300, DIN and JIS are available.

For dimensional data and standard configurations for fittings, refer to the respective fitting guides. Optionally, the system can be supplied conductive (Bondstrand 2400C) or with fireproofing (Bondstrand 2400FP).

Pipe Lengths

Nominal Pipe Size		Random Lengths	
in	mm	ft	m
1 - 1½	25 - 40	10	3
2 - 6	50 - 150	30	9
8 - 16	200 - 400	40	12

NOTE: Overall pipe length depends on size, end configuration and production location

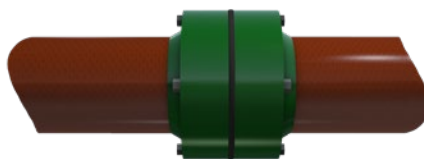
Field Testing

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

View of Joint Illustrations



Quick-Lock™ adhesive-bonded joint



Flanged

Typical Pipe Dimensions and Weights

Nominal Pipe Size		Pipe I.D.		Pipe O.D. ⁽¹⁾		Nominal Wall Thickness		Pipe Weight	
in	mm	in	mm	in	mm	in ²	mm ²	lb/ft	kg/m
1	25	1.07	27.1	1.34	34.1	0.118	3.0	0.45	0.65
1½	40	1.66	42.1	1.93	49.1	0.118	3.0	0.65	0.91
2	50	2.09	53.2	2.39	60.7	0.122	3.1	0.83	1.2
3	80	3.22	81.8	3.50	89.0	0.122	3.1	1.4	1.9
4	100	4.14	105.2	4.50	114.4	0.161	4.1	2.1	3.1
6	150	6.26	159.0	6.62	168.2	0.161	4.1	3.1	4.6
8	200	8.22	208.8	8.58	218.0	0.161	4.1	4.5	6.7
10	250	10.35	262.9	10.75	273.1	0.181	4.6	5.6	8.4
12	300	12.35	313.7	12.75	323.9	0.181	4.6	6.7	9.9
14	350	13.56	344.4	13.96	354.6	0.181	4.6	7.6	11.2
16	400	15.50	393.7	15.97	405.7	0.217	5.5	9.8	11.6

⁽¹⁾ Outer diameter is for use in flexibility analysis. Consult factory representative for the pipe and bell OD tolerances if required.

Typical Pipe Performance

Nominal Pipe Size		Internal Pressure Rating ⁽¹⁾		Collapse Pressure Rating ⁽²⁾		Stiffness Factor	
in	mm	psig	MPa	psig	MPa	lb-in	n-m
1	25	175	1.2	7023	48.4	538	60.8
1½	40	175	1.2	2160	14.9	538	60.8
2	50	175	1.2	1240	8.56	593	67.0
3	80	175	1.2	368	2.54	593	67.0
4	100	175	1.2	402	2.77	1373	155.1
6	150	175	1.2	122	0.843	1373	155.1
8	200	175	1.2	77.4	0.534	1939	219.1
10	250	175	1.2	39.4	0.272	1939	219.1
12	300	175	1.2	23.4	0.162	1939	219.1
14	350	150	1.03	19.6	0.135	2135	241.2
16	400	150	1.03	19.8	0.137	3225	364.4

⁽¹⁾ 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).

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 20 mil (0.5 mm) reinforced liner using same materials as the pipe.

Tees	45° Laterals
90° and 45° elbows	Nipples and coupling
Crosses	Tapered body reducers
Flanges*	Saddles*

* No liner.

Flanges

Filament wound GRE heavy duty and stub end flanges with integral taper female bell end are available. Standard flange drilling pattern per ASME B16.5 and B16.47A, Class 150 are available. Other drilling patterns, such as Class 300, DIN and JIS are available.

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

Fittings Pressure Rating

Nominal Pipe Size		Elbows & Tees		Tapered Body Reducers & Flanges		Blind Flanges & Bushed Saddles ⁽¹⁾		Laterals		Crosses		Reducers, Bushings ⁽²⁾	
		Filament Wound											
in	mm	psig	MPa	psig	MPa	psig	MPa	psig	MPa	psig	MPa	psig	MPa
1	25	300	2.07	600	4.14	150	1.03	-	-	-	-	50	0.35
1½	40	300	2.07	550	3.79	150	1.03	-	-	-	-	50	0.35
2	50	375	2.59	450	3.10	150	1.03	275	1.90	150	1.03	50	0.35
3	80	325	2.24	350	2.41	150	1.03	250	1.72	150	1.03	50	0.35
4	100	300	2.07	350	2.41	150	1.03	200	1.38	150	1.03	50	0.35
6	150	225	1.55	250	1.72	150	1.03	150	1.03	100	0.69	50	0.35
8	200	225	1.55	225	1.55	150	1.03	150	1.03	100	0.69	50	0.35
10	250	200	1.38	175	1.21	150	1.03	150	1.03	100	0.69	50	0.35
12	300	175	1.21	150	1.03	150	1.03	150	1.03	100	0.69	50	0.35
14	350	150	1.03	150	1.03	-	-	150	1.03	100	0.69	50	0.35
16	400	150	1.03	150	1.03	-	-	150	1.03	100	0.69	50	0.35

⁽¹⁾ With 316 stainless steel outlet. Other outlet materials available on special order.

⁽²⁾ Reducer bushings bonded into flanges will have the same rating as the flange. Otherwise, rated as shown.

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 ^(1,2,3)			
		70°F (21°C)		200°F (93°C)	
in	mm	ft	m	ft	m
1	25	12.7	3.87	11.4	3.46
1 ½	40	14.5	4.41	12.9	3.94
2	50	15.6	4.76	14.0	4.25
3	80	17.7	5.38	15.8	4.81
4	100	20.1	6.14	18.0	5.49
6	150	22.6	6.89	20.2	6.16
8	200	25.0	7.62	22.3	6.81
10	250	26.6	8.10	23.8	7.25
12	300	27.9	8.50	24.9	7.60
14	350	28.8	8.77	25.7	7.84
16	400	30.8	9.39	27.5	8.39

⁽¹⁾ For Sg = 1.0, consult the manufacturer for other fluid densities and insulated pipe support spans. Span recommendations include no provision for weight of (fittings, valves, flanges, etc.) or thrusts (branches, turns, etc.). Heavy valves and other appurtenances must be supported separately.

⁽²⁾ Calculated spans are based on 1/2" (12.7 mm) maximum mid-span deflections to ensure good appearance and adequate drainage. Total system stresses should always be taken into account by the system design engineer.

⁽³⁾ Continuous spans are defined as interior (not end) spans that are uniform in length and free from structural rotation at the supports.

Guide Specification

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.

Pipe in 1 through 16-inch sizes shall be rated for a minimum of 175 psig at 200°F. In 1 through 8-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-11FW) cell limits in 1 through 16-inch nominal pipe sizes

Standard Fittings Construction

Fittings in 1 through 16-inch sizes shall be filament wound with a reinforced resin-rich liner of 20 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.

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, and D2925.

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

Typical Mechanical Properties

Pipe Properties	Units	70°F	21°C	200°F	93°C	Method
Hydrostatic Design Basis	N/mm ²	23,351	161 ⁽¹⁾	17,549	121	ASTM D2992, Proc. B (20 yrs)
Ultimate Hoop Stress at Weeping	N/mm ²	40,610	280	48,442	334	ASTM D1599
Circumferential						
Hoop tensile strength	N/mm ²	55,114	380	-	-	ASTM D2290
Hoop tensile modulus	N/mm ²	3.87 x 10 ⁶	26,700	2.36 x 10 ⁶	16,300	ASTM D2290
Poisson's Ratio ν_{ah} ⁽²⁾	-	0.61		0.80		NOV FGS
Longitudinal						
Axial tensile strength	N/mm ²	11,603	80	9,427	65	ASTM D2105
Axial strength modulus	N/mm ²	2.24 x 10 ⁶	15,500	1.24 x 10 ⁶	8,550	ASTM D2105
Poisson's Ratio ν_{ha} ⁽³⁾	-	0.35		0.42		ASTM D2105
Axial bending strength	N/mm ²	12,328	85	-	-	NOV FGS
Axial bending modulus	N/mm ²	2.24 x 10 ⁶	15,500	1.43 x 10 ⁶	9,900	ASTM D2925
Shear Modulus	N/mm ²	1.75 x 10 ⁶	12,100	1.66 x 10 ⁶	11,500	NOV FGS

Typical Physical Properties

Pipe Properties	Units	Value	Method
Thermal Conductivity Pipe Wall	W/m°C	0.33	NOV FGS
Thermal Expansion @ 21°C	mm/mm °C	18 x 10 ⁻⁶	ASTM D696
Thermal Expansion @ 93°C	mm/mm °C	24 x 10 ⁻⁶	ASTM D696
Flow Efficient, Hazen-Williams	-	150	-
Absolute Roughness⁽⁴⁾	m	5.3 x 10 ⁻⁶	-
Density	kg/m ³	1,800	-
Specific Gravity	-	1.8	ASTM D792
Specific Heat	J/kg °C	910	-
Grounding Resistance @ 500 volts - pipe	Ohm/m	<1 x 10 ⁻⁶	ASTM D257
Grounding Resistance @ 500 volts - fitting	Ohm/pc	<1 x 10 ⁻⁶	ASTM D257
Shielding Capacity	Volt	100	-

⁽¹⁾ Value obtained at 65°C

⁽²⁾ ν_{ha} = The ratio of axial strain to hoop strain resulting from stress in the hoop direction.

⁽³⁾ ν_{ah} = The ratio of hoop strain to axial strain resulting from stress in the axial direction.

⁽⁴⁾ Although friction loss is lower, maximum velocity is recommended no more than 4.6 m/s (15 ft/s) to avoid excess axial load on pipe support.

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