

Series 5000C Fiberglass Pipe and Fittings

for several corrosive marine and industrial services

Uses and applications

Acid drains	Chlorine	Organic chemicals
Bleach processing	Sodium Hypochlorite	Oxidizing chemicals and acids
Chemical process piping	Corrosive slurries	Phosphoric acid
Chlorinated water	Food processing plant	General industrial service for severely corrosive liquids

Performance

Bondstrand Series S5000C fiberglass pipe, fittings and flanges incorporate high strength conductive filaments to prevent accumulation of potentially dangerous levels of static electrical charges by the flow of liquids. Series 5000 C piping systems are made electrically conductive by using a conductive NOV Fiber Glass Systems adhesive in the adhesive-bonded joint and for mounting flanges. Accumulated charges are harmlessly drained from the fiberglass pipe system into the metallic structure by means of stainless steel cables embedded in fiberglass grounding saddles. The saddles are adhesive bonded in the field by the installer to the external wall of the pipe.

Working Pressure from 150 to 232 psig (1 to 1.6 Mpa) depending on pipe size. Operating temperatures to 200°F (93°C). 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. Low thermal conductivity 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.

Composition

Pipe

Filament-wound fiberglass-reinforced vinyl ester pipe with conductive filaments in pipe wall and integral 0.050-inch (1.3 mm) resin-rich reinforced conductive liner.

Nominal Pipe Size		ASTM Designation
(inch)	(mm)	(D2996)
2-6	50-150	RTRP 12ED-1012
8-16	200-400	RTRP 12ED-1013

Filament-wound fittings

Wide range of lined filament-wound vinyl ester fittings with fiberglass strands and conductive veils

- Tees
- 90° and 45° elbows
- Crosses
- Nipples and couplings 45° laterals
- Tapered body reducers

Flanges

Filament-wound vinyl ester reinforced by fiberglass strands and conductive
Filament-wound or molded flanges with ANSI B16.1 and ANSI B16.5 drilling,
Molded reducing and blind flanges.

Thermosetting adhesives

RP106 two-part vinyl ester

Quick-Lock® straight/taper adhesive-bonded joint featuring integral pipe stop in bell
for predictable, precise laying lengths. Flanges and flanged fittings.

Joining systems

Nominal Pipe Size		Random Lengths	
(inch)	(mm)	(ft)	(m)
2-8	50-200	30	9
10-16	250-400	20	6

Pipe lengths

Elbows
Tees
Flanges, blind flanges and reducing flanges
Plugs and end-caps
Crosses
Nipples and couplings
45° laterals
Tapered body reducers

Tapered body reducers, tees and 90° and 45° elbows are available with any combination of Quick-Lock female and filament-wound or fittings.

Laying lengths of filament-wound fittings with Quick-Lock ends match those of ANSI B16.9 steel butt welding fittings. Flanged ends match ANSI B16.1 and B16.5 center-to-face and face-to-face dimensions.

Typical pipe dimensions and weights

Nominal Pipe Size		Pipe ID		Nominal Wall Thickness ²		Average Sectional Area ³		Pipe Weight	
(inch)	(mm)	(inch)	(mm)	(inch)	(mm)	(inch ²)	(mm ²)	(lb/ft)	(kg/m)
2	50	2.1	53	0.157	4	1.13	730	1	1.5
3	80	3.22	82	0.157	4	1.7	1100	1.5	2.3
4	100	4.14	105	0.203	5.2	2.73	1760	2.4	3.5
6	150	6.2	159	0.203	5.2	4.06	2620	3.5	5.2
8	200	8.22	209	0.226	5.7	5.83	3760	5	7.4
10	250	10.35	263	0.226	5.7	7.31	4710	6.2	9.3
12	300	12.35	314	0.226	5.7	8.69	5600	7.4	11
14	350	13.56	344	0.25	6.4	10.85	7000	8.7	14.7
16	400	15.5	394	0.286	7.3	14.18	9150	11.2	19

1) For availability of 1, 1½, 14 and 16-inch (25, 40, 350 and 400 mm) sizes, consult your NOV Fiber Glass Systems representative.

2) Minimum wall thickness shall not be less than 87.5% of nominal wall thickness in accordance with ASTM D2996.

3) Use these values for calculating longitudinal thrust.

Typical pipe performance

Nominal Pipe Size		Internal Pressure Rating		Collapse Pressure Rating ¹	
(inch)	(mm)	(psig)	(MPa)	(psig)	(MPa)
2	50	232	1.6	580	4
3	80	232	1.6	160	1.1
4	100	232	1.6	225	1.55
6	150	232	1.6	65	0.45
8	200	150	1.0	45	0.31
10	250	150	1.0	22	0.15
12	300	150	1.0	13	0.09
14	350	150	1.0	11	0.08
16	400	150	1.0	11	0.08

1) At 70°F (21°C). Reduce linearly to 84% at 140°F (60°C), 76% at 170°F and 50% at 200°F (93°C).

Fittings pressure ratings

Nominal Pipe Size		Filament-wound		Molded		Reducers & Flanges		Blind Flanges & Bushed Saddles ¹	
(inch)	(mm)	(psig)	(MPa)	(psig)	(MPa)	(psig)	(MPa)	(psig)	(MPa)
2	50	232	1.6	200	1.38	232	1.6	150	1.03
3	80	232	1.6	150	1.03	232	1.6	150	1.03
4	100	200	1.38	150	1.03	232	1.6	150	1.03
6	150	175	1.21	150	1.03	232	1.6	150	1.03
8	200	150	1.03	-	-	225	1.55	150	1.03
10	250	150	1.03	-	-	175	1.21	150	1.03
12	300	150	1.03	-	-	150	1.03	150	1.03
14	350	150	1.03	-	-	150	1.03	150	1.03
16	400	150	1.03	-	-	150	1.03	150	1.03

1) Use Bondstrand Series 2000 epoxy saddles with 316 stainless steel outlet. Other outlet materials available on special order.

Nominal Pipe Size		Laterals		Crosses		Reducer Bushings	
(inch)	(mm)	(psig)	(MPa)	(psig)	(MPa)	(psig)	(MPa)
2	50	232	1.6	150	1.03	50	0.35
3	80	232	1.6	150	1.03	50	0.35
4	100	200	1.38	150	1.03	50	0.35
6	150	150	1.03	100	0.69	50	0.35
8	200	150	1.03	100	0.69	50	0.35
10	250	150	1.03	100	0.69	50	0.35
12	300	150	1.03	100	0.69	50	0.35
14	350	150	1.03	100	0.69	50	0.35
16	400	150	1.03	100	0.69	50	0.35

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

Typical physical properties

Pipe Property	Units	Value	ASTM Method
Thermal conductivity			
Pipe wall	Btu•in/(hr•ft ² •°F)	2	C177
	W/m•°C	0.28	
Thermal expansion			
Linear	10 ⁻⁶ in/in/°F	10	D696
	10 ⁻⁶ mm/mm°C	18	
Flow coefficient	Hazen-Williams	150	
Absolute roughness	10 ⁻⁶ ft	17.4	—
	10 ⁻⁶ m	5.3	
Specific gravity	-	1.8	D792
Density	lb/in ³	0.07	
Shielding capability volts		100.1	—
Grounding resistance			
@ 1500 volts	10 ⁶ ohms	1.01	—

1) Maximum value when measured in accordance with Annexes 2 and 3 of ASTM 1173

Typical mechanical properties

Pipe Property ¹	Units	70°F (21°C)	100°F (38°C)	170°F (77°C)	200°F (93°C)	ASTM Method
Circumferential	10 ³ psi	18.5	-	-	-	D1599
	MPa	128	-	-	-	
Tensile modulus	10 ⁶ psi	3.13	2.79	2.32	1.25	
	GPa	21.6	19.2	16	8.62	
Poisson's ratio		0.45	0.45	0.66	1.03	D2105
Longitudinal						
Tensile strength	10 ³ psi	7.0	6.5	5.5	4.0	D2105
	MPa	48.3	44.8	37.9	27.6	
Tensile modulus	10 ⁶ psi	1.45	1.31	1	0.52	D2105
	GPa	10.1	9.03	6.89	3.59	
Poisson's ratio		0.35	0.35	0.43	-	D2105
Beam apparent						
Elastic modulus	10 ⁶ psi	1.4	0.78	0.44	0.18	D2925
	GPa	9.65	5.4	3	1.24	
Hydrostatic design						
basis (cyclic) ²	10 ³ psi	-	6.0	-	-	D2992
	MPa	-	41.4	-	-	

Nominal Pipe Size		Stiffness Factor ³		Pipe Stiffness ³		Beam Moment of Inertia ⁴	
(inch)	(mm)	(lb•in)	(N•m)	(psi)	(MPa)	(in ⁴)	(10 ⁶ mm ⁴)
2	50	340	38.4	1540	10.6	0.48	0.2
3	80	340	38.4	460	3.2	1.61	0.67
4	100	820	92.6	530	3.7	4.7	1.96
6	150	820	92.6	160	1.1	15.5	6.40
8	200	1180	133.3	105	0.72	39	16.3
10	250	1180	133.3	53	0.37	77	32
12	300	1180	133.3	31	0.23	129	54
14	350	1330	150.2	36	0.25	209	88
16	400	2190	247.4	38	0.26	368	154

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. S		Turning Angle (~)
(inch)	(mm)	(ft)	(m)	(ft)	(m)	(deg)
2	50	69.4	21	17.5	5.3	84
3	80	101.1	31	12.1	3.7	57
4	100	129.9	40	9.5	2.9	44
6	150	191.8	58	6.5	1.9	30
8	200	250	76	5.0	1.5	23
10	250	312	95	4.0	1.2	18
12	300	370	113	3.4	1.0	15
14	350	410	125	3.2	0.9	14
16	400	410	143	2.7	0.8	12

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

Buried installations

Live loads

Bondstrand 5000C 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.

Thrust blocks

Most properly bedded installations do not require thrust blocks. Consult Ameron for recommendations for systems operating at elevated temperatures.

Earth loads on buried pipe

Maximum Earth Cover¹

Nominal Pipe Size		Maximum Earth Cover ¹					
(inch)	(mm)	100 psi	0.69 MPa	125 psi	0.86 MPa	150 psi	1.03 MPa
(inch)	(mm)	(ft)	(m)	(ft)	(m)	(ft)	(m)
2	50	30	9.14	30	9.14	30	9.14
3	80	30	9.14	30	9.14	30	9.14
4	100	30	9.14	30	9.14	30	9.14
6	150	30	9.14	24	7.32	23	7.01
8	200	23	7.01	22	6.71	21	6.4
10	250	23	7.01	21	6.4	19	5.79
12	300	23	7.01	21	6.4	18	5.49
14	350	23	7.01	21	6.4	17	5.18
16	400	23	7.01	20	6.1	16	4.88

1) Based on a 120 lb/ft³ (1925 kg/m³) soil density and 1000 psi (6.9 MPa) modulus of soil reaction.

Span lengths

Recommended maximum support spacings for Bondstrand 5000C, conductive vinyl ester pipe at various operating temperatures. Values based on 0.5-inch (12 mm) deflection at midspan for fluid specific gravity = 1.0. For fully continuous spans, values may be increased up to 20%. Decrease values by 20% for single spans.

Nominal Pipe Size		Span (ft)			
(inch)	(mm)	100°F	140°F	170°F	200°F
2	50	12.1	10.8	9.4	7.5
3	80	13.7	12.3	10.7	8.6
4	100	16.1	14.5	12.6	10
6	150	18.1	16.1	14.2	11.2
8	200	20.1	18.1	15.5	12.6
10	250	21.4	19.2	16.6	13.5
12	300	22.3	20.2	17.5	13.9
14	350	23.1	20.7	18.1	14.4
16	400	24.3	21.6	18.9	15

1) Span recommendations are intended for normal horizontal piping support arrangements (a compromise between continuous spans and simple spans), but 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) Fully continuous spans may be used with support spacing up to 20% greater for this deflection: in simple spans, support spacing should be 20% less.

Field testing

Bondstrand 5000C, conductive piping systems are designed for hydrostatic field testing at 150% of rated operating pressure. Pneumatic testing is *not* recommended.

Bondstrand® Guide Specification

Pipe construction

The structural wall of fiberglass pipe in 2 through 16-inch sizes shall have continuous glassfibers wound at a 54¾ helical angle in a matrix of premium vinyl ester resin.

The integral, reinforced resin-rich liner shall consist of Conductive Carbon veil 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 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 2 and Class E (RTRP-12ED) cell limits in 2 through 16-inch nominal pipe sizes.

Filament-wound vinyl ester fiberglass pipe shall be gray.

Pipe in 2 through 8-inch sizes shall be furnished in 30-ft length 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 Conductive reinforced resin-rich liner of equal or greater thickness than the pipe liner and of the same glass and resin type as the pipe.

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.

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 of 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 inch = 25.4 mm
1 ft = 0.3048 m
1 lb•in = 0.113 N•m
1 in⁴ = 4.162 x 10⁻⁷m⁴
°C = ⁵/₉ (°F - 32)

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The logo for NOV Fiber Glass Systems, featuring the letters 'NOV' in a stylized font with a red circle, followed by the text 'Fiber Glass Systems' in a bold, blue, sans-serif font.

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