Bondstrand™ 4000 Product Data
(Corrosive Industrial Service)

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 PSX™ •34 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 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.

Composition

Pipe

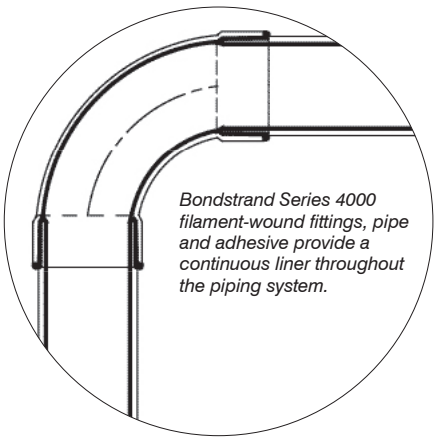
Filament-wound fiberglass reinforced epoxy pipe with nominal 0.050-inch (1.3 mm) resin-rich reinforced liner.

Nominal Pipe Size		ASTM Designation
in	mm	D2996
2-3	20-75	RTRP 11FE-2111
4-6	100-150	RTRP 11FE-2112
8-16	200-400	RTRP 11FE-2113

Joining Systems

Quick-Lock® straight/taper adhesive-bonded joint. Integral pipe stop in socket featured for predictable, precise laying length.

Flanges and flanged fittings.



Bondstrand Series 4000 filament-wound fittings, pipe and adhesive provide a continuous liner throughout the piping system.

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 Cl 150 lb flanges.

Other flange drilling patterns such as DIN, ISO, JIS, ANSI B16.5 Cl 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 30	6 or 9
8	200	20 or 30	6 or 9
10-16	250-400	20, 30 or 40	6, 9 or 12

Typical Pipe Dimensions and Weights

Nominal Pipe Size		Pipe I.D.		Nominal Wall Thickness[1]		Average[2] Sectional Area		Pipe Weight	
in	mm	in	mm	in	mm	in	mm	lb/ft	kg/m
2	50	2.10	53	.15	3.9	0.52	335	0.8	1.2
3	80	3.21	82	.16	4.0	0.81	525	1.1	1.7
4	100	4.14	105	.20	5.4	1.38	890	1.9	2.8
6	150	6.19	157	.20	5.4	2.63	1700	2.8	4.2
8	200	8.22	209	.23	5.7	5.83	3760	4.1	6.1
10	250	10.35	263	.23	5.7	7.31	4720	5.1	7.7
12	300	12.35	314	.23	5.7	8.69	5610	6.1	9.1
14	350	13.56	344	.25	6.4	10.40	6710	7.4	11.0
16	400	15.50	394	.29	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.

Pressure Ratings

Nominal Pipe Size		Internal Pressure Rating[1]		Ultimate Collapse Pressure[2]	
in	mm	psig	MPa	psig	MPa
2	50	450	3.10	212	1.46
3	80	320	2.21	68	0.47
4	100	350	2.41	82	0.56
6	150	249	1.72	74	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 FGS 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

Typical Physical Properties			
Pipe Property	Units	Value 2 ”-16”	ASTM
Thermal conductivity	Btu-in/(h•ft²•°F) W/m•°C	2.23 0.33	C177
Coefficient of thermal expansion (linear) (2 -16 inch) 77°F to 150°F (25°C to 65°C)	10^{-6} in/in/°F 10^{-6} cm/cm/°C	10.00 18.00	D696
Flow coefficient	Hazen-Williams	150.00	—
Absolute roughness	10^{-6} ft 10^{-6} m	17.40 5.30	—
Specific gravity	—	1.80	D792
Density	lb/in³	0.07	

Typical Mechanical Properties

Typical Mechanical Properties			
Pipe Property[1]	Units	Value 2" - 16"	ASTM
Tensile strength			
Longitudinal	10^3 psi	20.0	D2105
	MPa	138.0	
Circumferential	10^3 psi	40.0	D1599
	MPa	275.0	
Tensile modulus			
Longitudinal	10^6 psi	1.5	D2105
	GPa	10.3	
Circumferential	10^6 psi	2.3	—
	GPa	15.9	
Compressive strength			
Longitudinal	10^3 psi	20.0	—
	MPa	138.0	
Compressive modulus			
Longitudinal	10^6 psi	1.5	—
	GPa	10.3	
Long-term hydrostatic[3]			
Design basis			
Static, Hoop Stress	10^3 psi	18.9	D2992(B)
LCL 20 Year Life @150°F (65°C)	MPa	130.3	
Cyclic, Hoop Stress	10^3 psi	—	D2992(A)
LCL 20 Year Life @150°F (65°C)	MPa	—	
Poisson's Ratio[2]			
ν_{yx}	—	0.19	—
ν_{xy}	—	0.11	—

(1) Based on structural wall thickness, at room temperature unless noted.

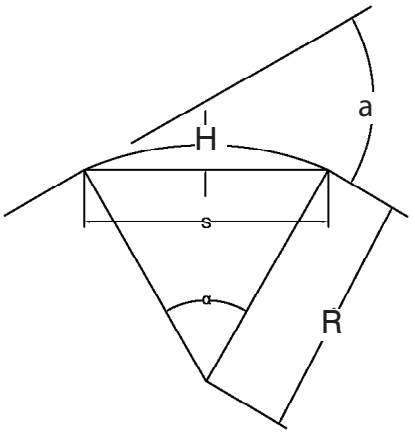
(2) The first subscript denotes the direction of applied stress and the second that of measured contraction
x denotes longitudinal direction.
y denotes circumferential direction.

(3) Test fixtures were end type (full end thrust on samples).

Nominal Pipe Size		Stiffness Factor[1]		Pipe Stiffness[1]		Beam Moment of Inertia[2]	
in	mm	lb•in	N•m	psi	MPa	in^4	$10^6\ mm^4$
2	50	371	42	1677	11.6	0.49	0.20
3	80	371	42	602	3.5	1.68	0.69
4	100	894	101	676	4.6	4.84	2.01
6	150	894	101	176	1.2	15.9	6.61
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) Per ASTM D2412.
2) Use these values to calculate permissible spans.

Bending Radius



Nominal Pipe Size		Bending Radius[1] (R)		Maximum Allowable Deflection, H*		Turning Angle (a)
in	mm	ft	m	ft	m	deg
2	50	83	25	14.1	4.5	69
3	80	123	37	10.1	3.1	47
4	100	158	48	7.9	2.4	36
6	150	233	71	5.4	1.6	25
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

* For 100-ft (30m) Bending Length.

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 FGS 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 H20 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 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. 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.

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