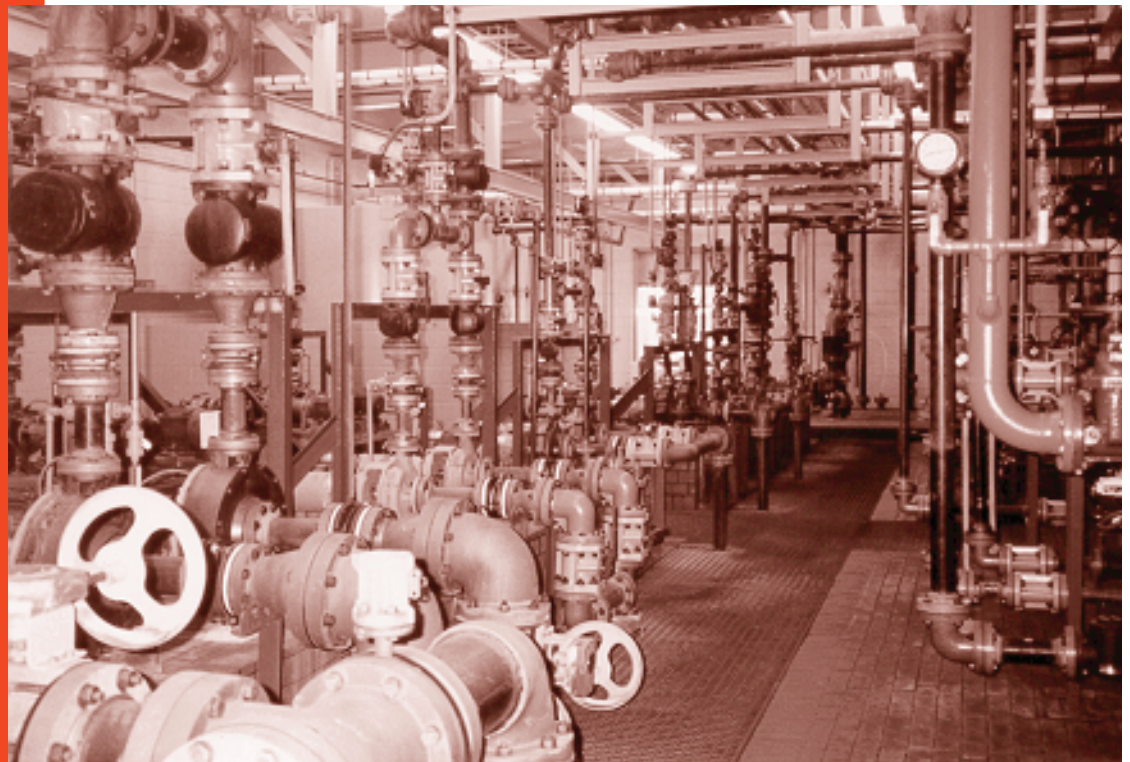


Fiber Glass Systems
CENTRICAST Plus® RB-2530
Piping Systems



CENTRICAST PLUS RB-2530 Pipe

PRODUCT

CENTRICAST PLUS RB-2530 pipe is manufactured with high strength glass fabrics and a highly resilient formulation of aromatic amine cured epoxy resin. A 100 mil integral corrosion barrier of pure resin provides excellent corrosion resistance. It is recommended for most caustics, salts, solvents, many acids and chemical process solutions up to 250°F. CENTRICAST PLUS RB-2530 proprietary resin formulation also provides the toughness for many corrosive slurries. Pipe and fittings are available in 1"-14" with static pressure ratings up to 150 psig, with higher pressure ratings in smaller sizes. CENTRICAST PLUS RB-2530 comes in 20' nominal or exact lengths.

EXTERNAL BARRIER

A 10 mil resin-rich reinforced external corrosion barrier provides excellent corrosion resistance and protection from ultraviolet (UV) radiation. Fiber Glass Systems warrants CENTRICAST PLUS RB-2530 pipe and fittings against UV degradation of physical properties and chemical resistance for 15 years.

FITTINGS

Compatible epoxy fittings are manufactured with the same chemical/temperature capabilities as the pipe. The fabrication process is dependent on the fitting type and size. Fittings are manufactured by compression molding, contact molding or filament winding.

JOINING METHODS

An adhesive bonded socket connection with positive stops in the fittings is standard. The use of positive stops in the fittings is standard. The use of positive stops simplifies close tolerance piping installation. This joining system is easy to install and no special tools are required for field assembly. The joint is prepared for bonding by lightly sanding the pipe O.D. and the mating fitting's socket. A high strength adhesive with the same chemical resistance and temperature capabilities is used to bind the pipe and fittings. See Manual No. F6080 "Pipe Installation Handbook" for detailed installation instructions and fabrication techniques.

RECOMMENDED SERVICES

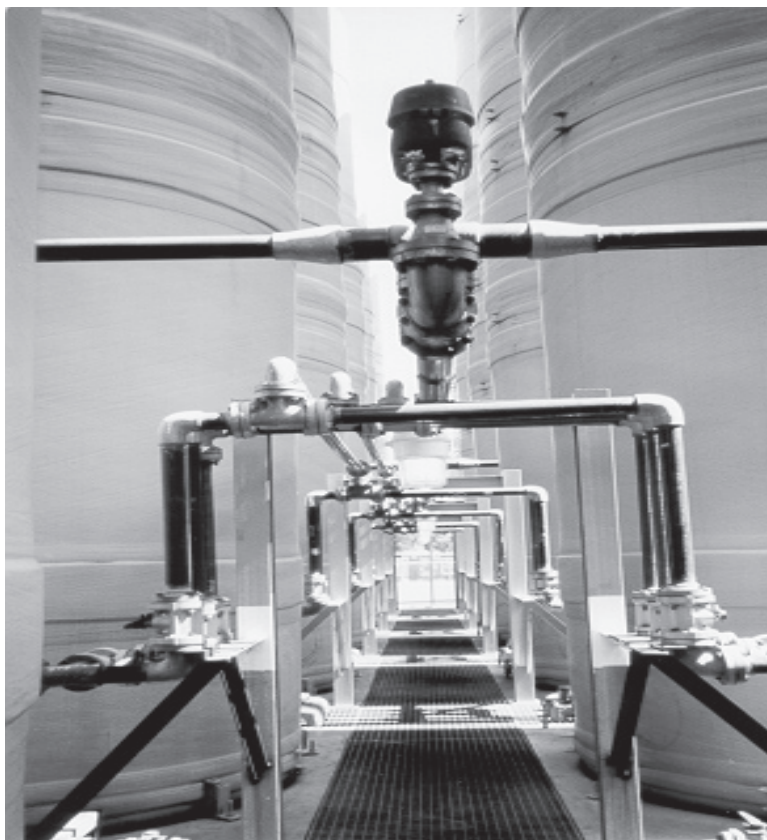
CENTRICAST RB-2530 epoxy resin pipe is excellent for many chemical and slurry applications including caustics, acids, salts, solvents and process solutions that corrode traditional metal pipe. Refer to Manual No. E5615 "*Chemical Resistance Guide*" for proper application.

BENEFITS

The excellent chemical resistance of the RB-2530 piping system provides longer service life than traditional piping materials. RB-2530 pipe performance conveying chemical mixtures and hot caustics is particularly exceptional resulting in a reduction in maintenance and replacement costs.

DISTRIBUTION

Fiber Glass Systems has a network of stocking distributors across the U.S. as well as representatives and distributors in many other parts of the world. These distributors are supported by a staff of experienced technical personnel at the home office and by highly trained field, strategically located field personnel.



CENTRICAST PLUS RB-2530 Pipe

PIPE PROPERTIES

General Specifications and Dimensional Data*

Nominal Pipe Size (In)	Nominal I.D.		Nominal O.D.		Nominal Wall Thickness		Reinforcement Thickness		Nominal Weight		Capacity	
	(In)	(mm)	(In)	(mm)	(In)	(mm)	(In)	(mm)	(Lbs/Ft)	(kg/m)	(Gal/Ft)	(CuFt/Ft)
1	0.92	23.2	1.315	33.4	0.20	5.1	0.09	2.3	0.45	0.66	0.03	0.005
1½	1.40	35.6	1.900	48.3	0.25	6.4	0.14	3.6	0.82	1.23	0.08	0.011
2	1.88	47.6	2.375	60.3	0.25	6.4	0.14	3.6	1.06	1.58	0.14	0.019
3	3.00	76.2	3.500	88.9	0.25	6.4	0.14	3.6	1.62	2.42	0.37	0.049
4	3.94	100.1	4.500	114.0	0.28	7.1	0.17	4.3	2.36	3.51	0.63	0.085
6	6.07	154.0	6.625	168.0	0.28	7.1	0.17	4.3	3.55	5.28	1.50	0.201
8	8.03	204.0	8.625	219.0	0.30	7.6	0.19	4.8	4.99	7.43	2.63	0.351
10	10.10	256.0	10.750	273.0	0.33	8.4	0.22	5.6	6.87	10.2	4.15	0.555
12	12.10	307.0	12.750	324.0	0.33	8.4	0.22	5.6	8.19	12.2	5.96	0.797
14	13.30	339.0	14.000	356.0	0.33	8.4	0.22	5.6	9.01	13.4	7.26	0.971

*All values are nominal. Tolerances or maximum/minimum limits can be obtained from Fiber Glass Systems.

Pipe Lengths Available

Size (In)	Random Length (Ft)
1"-14"	20*

*Pipe is offered in random or exact lengths. Random lengths are from 18.0 to 20.4 feet long.

ASTM D2997 Designation Codes[†]:

1"	RTRP-21CW-4356
1½"-4"	RTRP-21CW-4456
6"-8"	RTRP-21CW-4455
10"-12"	RTRP-21CW-4454
14"	RTRP-21CW-4553

[†]Mechanical properties cell classifications shown are minimum. Actual classifications may be higher for some sizes.

Pressure Ratings for Uninsulated Piping Systems ^{(1) (2)}

Nom. Pipe Size (In)	Maximum Internal Pressure @ 225°F (psig)			Maximum External Pressure ⁽⁶⁾		
	Socket Pressure Fittings ⁽³⁾	Flanged Pressure Fittings ⁽⁴⁾	Other Pressure Fittings ⁽⁵⁾	75°F	150°F	250°F
1	300	300	-	2,125	1,849	1,381
1½	300	300	-	2,065	1,797	1,342
2	300	150	125	1,170	1,014	763
3	275	150	125	335	290	219
4	150	150	100	225	195	147
6	150	150	100	62	54	40
8	150	150	100	45	39	29
10	150	150	75	35	30	23
12	150	150	75	23	20	15
14	125	150	-	16	14	10

(1) Static pressure ratings, typically created with use of a gear pump, turbine pump, centrifugal pump, or multiplex pump having 4 or more pistons or elevation head.

(2) Specially fabricated higher pressure fittings are available on request. Consult the factory for compressible gases. For insulated and/or heat traced piping systems, use 100% of the uninsulated piping recommendations up to 200°F and reduce these ratings 50% for 200°F to 250°F operating temperatures. For uninsulated piping systems, reduce these ratings 30% for 225°F to 250°F operating temperatures. Heat cured adhesive joints are highly recommended for all piping systems carrying fluids at temperatures above 120°F.

(3) Socket elbows, tees, reducers, couplings, flanges and nipples joined with WELDFAST ZC275 adhesive.

(4) Flanged elbows, tees, reducers, couplings and nipples assembled at factory.

(5) Laterals, crosses, and saddles.

(6) Ratings shown are 50% of ultimate; 14.7 psi external pressure is equal to full vacuum.

CENTRICAST PLUS RB-2530 Pipe

Average Physical Properties⁽¹⁾

Property	@ 75°F		@ 24°C		@ 225°F		@ 107°C		@ 250°		@ 121°C	
	1"		1 1/2"-14"		1"		1 1/2"-14"		1"		1 1/2"-14"	
	psi	MPa	psi	MPa	psi	MPa	psi	MPa	psi	MPa	psi	MP
Axial Tensile - ASTM D2105												
Ultimate Stress	18,000	120	22,000	150	15,000	100	18,000	120	14,000	100	17,000	110
Design Stress	4,500	31	5,500	38	3,750	26	4,500	31	3,500	24	4,250	29
Modulus of Elasticity	-	-	2.5E+06	17,000	-	-	2.1E+06	14,000	-	-	1.9E+06	13,000
Poisson's Ratio V	0.15				0.15				0.15			
Axial Compression - ASTM D695												
Ultimate Stress	19,600	140	35,000	240	10,000	70	19,000	130	7,000	50	13,000	90
Design Stress	4,900	34	8,750	60	2,500	17	4,750	33	1,750	12	3,250	22
Modulus of Elasticity	1.3E+06	9,000	2.5E+06	17,000	1.1E+06	8,000	2.1E+06	14,000	1.0E+06	7,000	1.9E+06	13,000
Beam Bending - ASTM D2925												
Ultimate Stress	28,000	190	42,000	290	23,000	160	35,000	240	21,000	140	32,000	220
Design Stress ⁽¹⁾	3,500	24	5,250	36	2,875	20	4,375	30	2,625	18	4,000	28
Modulus of Elasticity (Long Term)	5.6E+05	4,000	3.7E+06	26,000	4.7E+05	3,200	3.1E+06	21,000	4.4E+05	3,000	2.9E+06	20,000
Hydrostatic Burst - ASTM D1599												
Ultimate Hoop Tensile Stress	30,000	210	30,000	210	25,000	170	25,000	170	23,000	160	23,000	160
Hoop Tensile Modulus of Elasticity	-	-	2.8E+06	19,000	-	-	2.3E+06	16,000	-	-	2.2E+06	15,000
Hydrostatic Design - ASTM D2992, Procedure B-Hoop Tensile Stress Static 50 Year @ 75°F	16,090	110	16,090	110	-	-	-	-	-	-	-	-

Coefficient of Linear Thermal Expansion - ASTM D696	Non-Insulated Pipe: 11.0×10^{-6} in/in/°F • 19.9×10^{-6} mm/mm/°C Insulated Pipe: 12.0×10^{-6} in/in/°F • 21.7×10^{-6} mm/mm/°C
Thermal Conductivity	0.07 BTU/(ft)(hr)(°F) • 0.04 W/(m)(°C)
Specific Gravity - ASTM D792	1.47 (0.053 Lb/in ³ • (1.47 g/cm ³))
Flow Factor - SF / Hazen-Williams Coefficient	C-150
Surface Roughness	1.7×10^{-5} Feet
Manning's "n"	0.009

⁽¹⁾ Stress and modulus values can be interpolated between temperatures shown.

Properties of Pipe Sections Based on Minimum Reinforced Walls

Size (In)	Reinforcement End Area(In ²)	Reinforcement Moment of Inertia (In ⁴)	Reinforcement Section Modulus (In ³)	Nominal Wall End Area (In ²)
1	0.35	0.07	0.10	0.70
1 1/2	0.77	0.30	0.32	1.30
2	0.98	0.62	0.52	1.67
3	1.48	2.09	1.19	2.55
4	2.31	5.43	2.41	3.71
6	3.45	18.00	5.42	5.58
8	5.03	44.80	10.40	7.85
10	7.28	101.00	18.80	10.80
12	8.66	170.00	26.70	12.90
14	9.52	226.00	32.30	14.20

CENTRICAST PLUS RB-2530 Pipe

Recommended Operating Ratings

Size (In)	Axial Tensile Loads Max. (Lbs)		Axial Compressive Loads Max. (Lbs) ⁽¹⁾⁽²⁾		Bending Radius Min. (Ft) Entire Temp. Range	Torque Max. (Ft Lbs) Entire Temp. Range	Parallel Plate Loading ⁽²⁾ 5% Deflection & 75°F ASTM D2412		
	@ 75°F	@ 250°F	@ 75°F	@ 250°F			Stiffness Factor In ³ Lbs/In ²	Pipe Stiffness (psi)	Hoop Modulus x10 ⁶ (psi)
1	1,560	1,200	1,700	600	9	41	164	4,791	2.7
1 1/2	4,260	3,300	6,770	2,500	56	132	617	6,080	2.7
2	5,410	4,200	8,600	3,200	70	216	617	2,969	2.7
3	8,130	6,300	12,930	4,800	103	497	617	874	2.7
4	12,720	9,800	20,230	7,500	132	1,000	1,105	731	2.7
6	18,960	14,700	30,160	11,200	195	2,260	1,228	245	3.0
8	27,690	21,400	44,060	16,400	253	4,330	1,715	153	3.0
10	40,030	30,900	63,680	23,700	316	7,820	3,106	143	3.5
12	47,630	36,800	75,780	28,100	374	11,100	3,106	85	3.5
14	52,380	40,500	83,340	31,000	411	13,500	3,106	64	3.5

⁽¹⁾ Compressive loads are for short columns only. Buckling loads must be calculated when applicable.

⁽²⁾ Burial calculations must be based on 5% deflection as shown in table above.

SUPPORTS

The following engineering analysis must be performed to determine the maximum support spacing for the piping system. Proper pipe support spacing depends on the temperature and weight of the fluid carried in the pipe. The support spacing is calculated using continuous beam equations and the pipe bending modulus derived from long-term beam bending tests. The following tables were developed to ensure a design that limits beam mid-span deflection to 1/2 inch and bending stresses to less than or equal to 1/8 of the ultimate bending stress. Any additional weight on the piping system such as insulation or heat tracing requires further consideration. Restrained (anchored) piping systems operating at elevated temperatures often result in guide spacing requirements that are more stringent than simple unrestrained piping systems. In this case, the maximum guide spacing will dictate the support/guide spacing requirements for the system. Pipe support spans at changes in direction require special attention. Supported and unsupported fittings at changes in direction are considered in the following tables and must be followed to properly design the piping system.

There are seven basic rules to follow when designing piping system supports, anchors, and guides:

- 1 Do not exceed the recommended support span.
- 2 Support valves and heavy in-line equipment independently. This applies to both vertical and horizontal piping.
- 3 Protect pipe from external abrasion.
- 4 Avoid point contact loads.

- 5 Avoid excessive bending. This applies to handling, transporting, initial layout, and final installed position.
- 6 Avoid excessive vertical run loading. Vertical loads should be supported sufficiently to minimize bending stresses at outlets or changes in direction.
7. Provide adequate axial and lateral restraint to ensure line stability during rapid changes in flow.

Nom. Pipe Size (In.)	Continuous Spans of Pipe (Ft.) Deflection=1/2"		
	Specific Gravity=1.0		
	75°F	225°F	250°F
1	8.6	8.3	8.1
1 1/2	17.0	16.3	16.0
2	18.3	17.5	17.2
3	20.7	19.8	19.5
4	23.3	22.2	21.9
6	26.1	24.9	24.5
8	28.8	27.5	27.1
10	31.6	30.3	29.8
12	33.2	31.7	31.2
14	34.0	32.5	32.0

*Consult factory for insulated pipe support spacing.

CENTRICAST PLUS RB-2530 Pipe

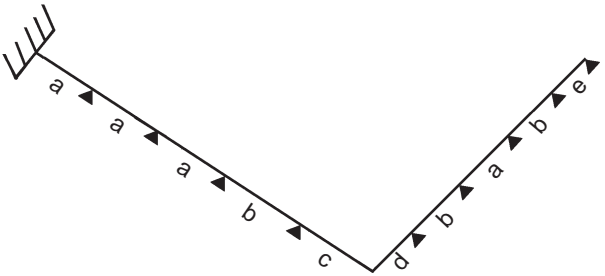
Support Spacing vs. Specific Gravity

Specific Gravity	3.00	2.00	1.50	1.25	1.00	0.75	Gas/Air
Multiplier	0.76	0.84	0.90	0.95	1.00	1.07	1.40

Example: 6" pipe @ 225°F with 1.5 specific gravity fluid, maximum support spacing = 24.9 x 0.90 = 22.4 ft.

Piping Span Adjustment Factors With Unsupported Fitting at Change in Direction

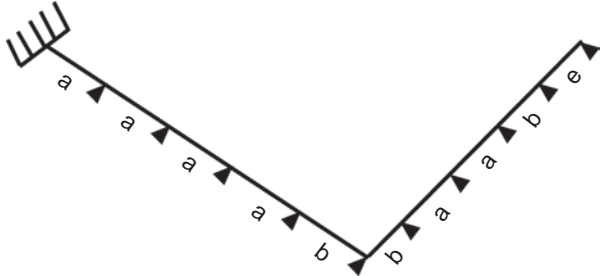
	Span Type	Factor
a	Continuous interior or fixed end spans	1.00
b	Second span from simple supported end or unsupported fitting	0.80
c + d	Sum of unsupported spans at fitting	$\leq 0.75^*$
e	Simple supported end span	0.67



* For example: If continuous support span is 10 ft., c + d must not exceed 7.5 ft. (c = 3 ft. and d = 4.5 ft. would satisfy this condition).

Piping Span Adjustment Factors With Supported Fitting at Change in Direction

	Span Type	Factor
a	Continuous interior or fixed end spans	1.00
b	Span at supported fitting or span adjacent to a simple supported end	0.80
e	Simple supported end span	0.67



THERMAL EXPANSION

The effects of thermal gradients on piping systems may be significant and should be considered in every piping system stress analysis. Pipe line movements due to thermal expansion or contraction may cause high stresses or even buckle a pipe line if improperly restrained. Several piping system designs are used to manage thermal expansion and contraction in above ground piping systems. They are listed below according to economic preference:

1. Use of inherent flexibility in directional changes
2. Restraining axial movements and guiding to prevent buckling
3. Use expansion loops to absorb thermal movements
4. Use mechanical expansion joints to absorb thermal movements

To perform a thermal analysis the following information is required:

1. Isometric layout of piping system
2. Physical and material properties of pipe
3. Design temperatures
4. Installation temperature (final tie-in temperature)
5. Terminal equipment load limits
6. Support movements

A comprehensive review of temperature effects on fiberglass pipe may be found in Fiber Glass Systems' "Engineering and Piping Design Guide", Manual No. E5000, Section 3.

CENTRICAST PLUS RB-2530 Pipe

Unrestrained Thermal Expansion Uninsulated Pipe ⁽¹⁾

Change in Temperature °F	Pipe Change In Length (In/100 Ft)
25	0.34
50	0.68
75	1.03
100	1.37
125	1.71
150	2.05
175	2.39
200	2.74

Restrained Thermal Expansion Pipe Compressive End Loads Uninsulated Pipe ⁽¹⁾

Nominal Pipe Size (In)	End Loads (Lbs/°F)
1	5.1
1½	22.1
2	28.0
3	42.1
4	65.9
6	98.3
8	143.5
10	207.4
12	246.8
14	271.4

Allowable Bending Moment 90° Elbow

Nominal Pipe Size (In)	Allowable Moment (Ft•Lbs)
1	100
1½	150
2	225
3	475
4	650
6	1,650
8	2,850
10	4,500
12	6,500
14	10,000

(1) Consult the factory for thermal expansion and compressive end loads of insulated pipe.

NOTE: The actual moments should never exceed 1/4 of the ultimate moments.

Restrained Thermal End Loads and Guide Spacing

Size (In)	Operating Temperature °F (Based on installation temperature of 75°F)									
	100		150		175		200		225	
	Guide Spacing (Ft)	Thermal End Load (Lbs)	Guide Spacing (Ft)	Thermal End Load (Lbs)	Guide Spacing (Ft)	Thermal End Load (Lbs)	Guide Spacing (Ft)	Thermal End Load (Lbs)	Guide Spacing (Ft)	Thermal End Loads (Lbs)
1	3.9	128	2.3	383	2.0	510	1.8	638	1.6	765
1½	10.4	553	6.0	1,658	5.2	2,210	4.7	2,763	4.3	3,315
2	13.2	700	7.6	2,100	6.6	2,800	5.9	3,500	5.4	4,200
3	19.9	1,053	11.5	3,158	9.9	4,210	8.9	5,263	8.1	6,315
4	25.6	1,648	14.8	4,943	12.8	6,590	11.4	8,238	10.4	9,885
6	38.1	2,458	22.0	7,373	19.1	9,830	17.1	12,288	15.6	14,745
8	49.8	3,588	28.8	10,763	24.9	14,350	22.3	17,938	20.3	21,525
10	62.2	5,185	35.9	15,555	31.1	20,740	27.8	25,925	25.4	31,110
12	74.0	6,170	42.7	18,510	37.0	24,680	33.1	30,850	30.2	37,020
14	81.4	6,785	47.0	20,355	40.7	27,140	36.4	33,925	33.2	40,710

Expansion Loop Design Minimum Leg Length (Feet)

Size (In)	Change in Length (Inches)										
	1/2	1	2	3	4	5	6	7	8	9	10
1	1.1	1.5	2.1	2.6	3.0	3.4	3.7	4.0	4.3	4.5	4.8
1½	2.7	3.8	5.4	6.6	7.6	8.5	9.3	10.0	10.7	11.4	12.0
2	3.0	4.2	6.0	7.3	8.5	9.5	10.4	11.2	12.0	12.7	13.4
3	3.8	5.3	7.5	9.2	10.6	11.9	13.0	14.1	15.0	15.9	16.8
4	5.2	7.3	10.4	12.7	14.6	16.4	17.9	19.4	20.7	22.0	23.2
6	5.9	8.4	11.8	14.5	16.7	18.7	20.5	22.1	23.7	25.1	26.4
8	7.1	10.0	14.2	17.4	20.1	22.5	24.6	26.6	28.4	30.1	31.8
10	8.5	12.0	17.0	20.8	24.0	26.8	29.4	31.8	33.9	36.0	38.0
12	9.2	13.0	18.3	22.5	25.9	29.0	31.7	34.3	36.7	38.9	41.0
14	8.5	12.1	17.0	20.9	24.1	26.9	29.5	31.9	34.1	36.2	38.1

Note: Multiply expansion loop minimum leg length by 1.414 for directional change cantilever leg length.

CENTRICAST PLUS RB-2530 Pipe

TESTING

See Section 3 of Fiber Glass Systems' Manual No. F6080, Pipe Installation Handbook: Hydrostatic Testing and System Startup.

When possible, Fiber Glass Systems' piping systems should be hydrostatically tested prior to beginning service. Care should be taken when testing, as in actual installation, to avoid water hammer. *All anchors, guides and supports must be in place prior to testing the line.*

Test pressure should not be more than 1½ times the working pressure of the piping system and never exceed 1½ times the rated operating pressure of the lowest rated component in the system.

OTHER CONSIDERATIONS

Water (Fluid) Hammer

A pressure surge will occur when fluid flow in a piping system is abruptly changed during events such as rapid pump startup or a quick closing valve. This surge can be significantly reduced by controlling pump startup and valve closure rates.

The maximum pressure surge in psi caused by water hammer can be calculated by multiplying the fluid velocity in ft/sec times the constant listed in the "Fluid (Water) Hammer Constants" Table. The peak pressure for the system will equal the water hammer surge plus the operating pressure at the time the water hammer occurred.

Fluid (Water) Hammer Constants⁽¹⁾

Pipe Size (In.)	Fluid (Water) Hammer Constants ⁽¹⁾
1	44.0
1½	44.2
2	40.7
3	35.0
4	34.0
6	28.9
8	27.0
10	26.1
12	24.2
14	23.2

⁽¹⁾Constants are valid for water at 75°F.

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