Z-Core™
(Product Data)

CHEMICAL & INDUSTRIAL

Applications

- Sulfuric Acid
- Hydrochloric Acid
- Solvents
- Caustics
- Process Drain

Materials and Construction

Z-Core pipe is a centrifugally cast fiberglass pipe with a 100 mil resin-rich liner and is available in 1" through 14" diameters. The pipe is rated for temperatures to 275°F and for pressures to 150 psig (higher pressures available on request).

Z-Core has a resin-rich 10 mil reinforced corrosion barrier on the outside surface which provides superior resistance to exterior corrosion. The resin-rich exterior also offers protection against "fiber blooming" caused by ultraviolet radiation. Pipe and fittings are warranted against reduction of physical and corrosion ratings due to ultraviolet exposure for a period of 15 years.

Fittings

Fittings are manufactured with the same chemical/temperature capabilities as the pipe. Depending on the particular part and size, fittings will be compression molded, contact molded, hand fabricated or filament wound.

Joining System

- **Socket Joint** - Adhesive bonded straight socket joint with positive stops.

  This is the standard for Centricast piping systems.

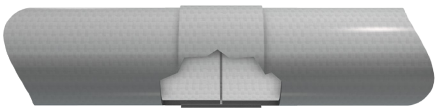
ASTM D2997 Designation Codes	
1"- 2"	RTRP-21CW-4446
3"- 4"	RTRP-21CW-4556
6"- 8"	RTRP-21CW-4555
10"- 12"	RTRP-21CW-4554
14"	RTRP-21CW-4553

Nominal Dimensional Data

Pipe Size		Inside Diameter		Outside Diameter		Wall Thickness		Reinforcement Thickness		Weight		Capacity	
in	mm	in	mm	in	mm	in	mm	in	mm	lbs/ft	kg/m	gal/ft	ft³/ft
1	25	0.92	23.2	1.315	33.4	0.20	5.1	0.09	2.3	0.45	0.67	0.03	0.005
1½	40	1.40	35.6	1.900	48.3	0.25	6.4	0.14	3.6	0.80	1.20	0.08	0.011
2	50	1.88	47.6	2.375	60.3	0.25	6.4	0.14	3.6	1.09	1.63	0.14	0.019
3	80	3.00	76.2	3.500	88.9	0.25	6.4	0.14	3.6	1.74	2.59	0.37	0.049
4	100	3.94	100.1	4.500	114.3	0.28	7.1	0.17	4.3	2.74	4.07	0.63	0.085
6	150	5.88	149.2	6.625	168.3	0.28	7.1	0.17	4.3	4.03	6.00	1.50	0.201
8	200	7.79	197.7	8.625	219.1	0.30	7.6	0.19	4.8	5.27	7.85	2.59	0.347
10	250	10.10	256.5	10.750	273.1	0.33	8.4	0.22	5.6	7.41	11.03	4.16	0.557
12	300	12.10	307.3	12.750	323.9	0.33	8.4	0.22	5.6	8.55	12.72	5.97	0.799
14	350	13.30	337.8	14.000	355.6	0.33	8.4	0.22	5.6	10.11	15.05	7.22	0.965

Tolerances or maximum/minimum limits can be obtained from NOV Fiber Glass Systems.

View of Joint Illustrations



Socket

Supports

Proper pipe support spacing depends on the temperature and weight of the fluid in the pipe. The support spacing table is based on unrestrained continuous beam theory using the pipe bending modulus derived from long-term beam bending tests. The maximum spans lengths were developed to ensure a design that limits mid-span deflection to ½ inch and dead weight bending to 1/8 of the ultimate bending stress. Any additional loads on the piping system such as insulation, wind, seismic, etc. requires further consideration. Restrained (anchored) piping systems operating at elevated temperatures may result in guide spacing requirements that are shorter than unrestrained piping systems. In this case, the maximum guide spacing governs the support span requirements for the system. Pipe spans near elbows require special attention. Both supported and unsupported elbows 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:

1. Do not exceed the recommended support span.
2. Support heavy valves and in-line equipment independently.
3. Protect pipe from external abrasion at supports.
4. Avoid point contact loads.
5. Avoid excessive bending. This applies to handling, transporting, initial layout, and final installed position.
6. Avoid excessive vertical loading to minimize bending stresses on pipe and fittings.
7. Provide adequate axial and lateral restraint to ensure line stability during rapid changes in flow.

Maximum Support Spacing for Uninsulated Pipe[1]

Size		Continuous Spans of Pipe[2]			
		75°F (24°C)		200°F (93°C)	
in	mm	ft	m	ft	m
1	25	15.0	4.58	14.5	4.44
1½	40	18.4	5.63	17.9	5.46
2	50	18.1	5.52	17.6	5.35
3	80	20.5	6.26	19.9	6.06
4	100	23.0	7.01	22.3	6.80
6	150	25.8	7.89	25.1	7.65
8	200	28.7	8.75	27.8	8.48
10	250	31.5	9.60	30.5	9.31
12	300	33.0	10.07	32.0	9.76
14	350	33.7	10.30	32.7	9.98

[1] For Sg=1.0, consult manufacturer for heavier insulated pipe support spans. Span recommendations include no provision for weight of fittings, valves, etc. or thrusts at branches and turns. Heavy valves and other appurtenances must be supported separately.

[2] Calculated spans are based on ½" mid-span deflections to ensure good appearance and adequate drainage. Total system stresses should always be taken into account by the system design engineer when determining support spans.

Support Spacing vs. Specific Gravity

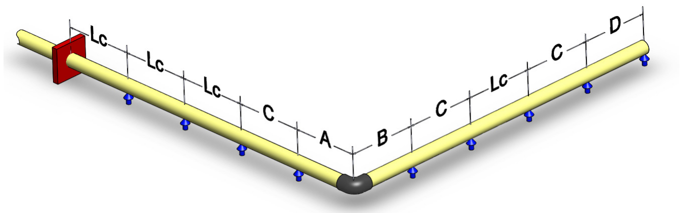
Specific Gravity	3.00	2.00	1.50	1.25	1.00	0.75	Gas/Air
Multiplier	0.81	0.88	0.93	0.96	1.00	1.05	1.32

Example: 6" pipe @ 200°F with 1.5 specific gravity fluid, maximum support spacing = 25.1 x 0.93 = 23.3 ft.

Adjustment Factors for Various Spans With Unsupported Fitting at Change in Direction

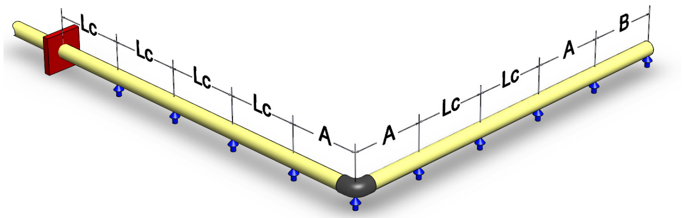
	Span Type	Factor
Lc	Continuous interior or fixed end spans	1.00
C	Second span from supported end or unsupported fitting	0.80
A+B	Sum of unsupported spans at fitting	≤0.75*
D	Simple supported end span	0.67

*For example: If continuous support is 10 ft. (3.04 m), A+B must not exceed 7.5 ft.(2.28 m) (A=3 ft. (0.91 m) and B=4.5 ft. (1.37 m)) would satisfy this condition.



Adjustment Factors for Various Spans With Supported Fitting at Change in Direction

	Span Type	Factor
Lc	Continuous interior or fixed end spans	1.00
A	Second span from simple supported end or unsupported fitting	0.80
B	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 NOV Fiber Glass Systems' Engineering and Piping Design Guide, Section 3.

Testing

See Fiber Glass Systems' Socket Joint Installation Handbook.

When possible, the piping system should be hydrostatically tested prior to beginning service. Care should be taken when testing 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.

Water Hammer

Care should be taken when designing an FRP piping system to eliminate sudden surges. Soft start pumps and slow actuating valves should be considered.

Pressure Ratings for Uninsulated Piping Systems[1]

Nominal Pipe Size		Maximum Internal Pressure @ 275°F (135°C)					
		Socket Fittings[2]		Flanged Fittings[3]		Other Fittings[4]	
in	mm	psig	MPa	psig	MPa	psig	MPa
1	25	275	1.90	275	1.90	-	-
1½	40	275	1.90	275	1.90	125	0.86
2	50	275	1.90	275	1.90	125	0.86
3	80	175	1.21	175	1.21	100	0.69
4	100	150	1.03	150	1.03	100	0.69
6	150	150	1.03	150	1.03	100	0.69
8	200	150	1.03	150	1.03	100	0.69
10	250	150	1.03	150	1.03	75	0.52
12	300	150	1.03	150	1.03	75	0.52
14	350	125	0.86	125	0.86	-	-

(1) Specially fabricated higher pressure fittings are available on request. Consult the factory for compressible gases. Heat cured joints are recommended for all piping systems carrying fluids at temperatures above 120°F (50°C).

(2) Socket elbows, tees reducers, couplings, flanges and nipples joined with WELDFAST ZC-275 adhesive.

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

(4) Laterals and crosses.

Elbow Strength - Allowable Bending Moment - 90º Elbow

Nominal Pipe Size		Allowable Moment	
in	mm	lb-ft	N-m
1	25	100	136
1½	40	150	203
2	50	225	305
3	80	475	644
4	100	650	881
6	150	1,650	2,237
8	200	2,850	3,864
10	250	4,500	6,101
12	300	6,500	8,813
14	350	10,000	13,558

Change in Temperature		Pipe Change in Length	
°F	°C	in/100 ft	cm/100 m
25	13.9	0.34	2.85
50	27.8	0.68	5.70
75	41.7	1.03	8.55
100	55.6	1.38	11.4

Typical Mechanical Properties

Pipe Property		75°F	24°C	200°F	93°C	275°F	135°C
		psi	MPa	psi	MPa	psi	MPa
Axial Tensile - ASTM D2105							
Ultimate Stress	2"-14"	28,000	193.1	22,400	154.4	16,800	115.8
	1"-1 ½"	22,000	151.7	17,600	121.4	13,200	91.0
Modulus of Elasticity	2"-14"	2.5 x 10^6	17,240	2.0 x 10^6	13,790	1.5 x 10^6	10,340
	1"-1 ½"	2.25 x 10^6	15,500	1.8 x 10^6	12,410	1.35 x 10^6	9,300
Poisson's Ratio, ν_{ah} (ν_{ha})[(1)]	0.15 (0.15)						
Beam Bending - ASTM D2925							
Modulus of Elasticity (Long Term)	2"-14"	3.7 x 10^6	25,500	3.27 x 10^6	22,550	1.50 x 10^6	10,340
	1"-1 ½"	5.6 x 10^6	38,600	4.95 x 10^6	34,130	2.47 x 10^6	17,030
Hydrostatic Burst - ASTM D1599							
Ultimate Hoop Tensile Stress	2"-14"	30,000	207	-	-	-	-
	1"-1 ½"	30,000	207	-	-	-	-
Hydrostatic Hoop Design Stress - ASTM D2992 - Procedure B							
Static 20 Year Life	LTHS	17,490	120.6	6,973	48.1	-	-
	95% LCL	14,400	99.3	6,060	41.8	-	-
Static 50 Year Life	LTHS	16,100	111.0	5,889	40.6	-	-
	95% LCL	12,870	88.7	5,008	34.5	-	-
Parallel Plate - ASTM D2412							
Hoop Modulus of Elasticity		5.0 x 10^6	34,470		-	-	-

Typical Physical Properties

Pipe Property	Value	Value	Method
Thermal Expansion Coefficient	11.4 x 10^{-6} in/in/°F	20.5 x 10^{-6} mm/mm/°C	ASTM D696
Thermal Conductivity	0.23 BTU/hr•ft•°F	0.4 W/m°C	ASTM D177
Absolute Roughness	0.00021 in	0.00053 mm	
Specific Gravity	1.6		ASTM D792

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

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CLASSIFIED UL WATER QUALITY
ANSI/NSF 61
Drinking Water System
Components 35GH
Water Contact Temp: 23C

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