

Fiber Glass Systems **CENTRICAST® CL-1520** **Piping Systems**



CENTRICAST CL-1520 Pipe

PRODUCT

CENTRICAST CL-1520 pipe is manufactured with high strength glass fabrics and a highly resilient formulation of corrosion-resistant vinyl ester resin. A 50 mil integral corrosion barrier of pure resin provides excellent corrosion resistance. It is recommended for highly chlorinated or acidic mixtures up to 175°F and many other chemicals up to 200°F. Pipe and fittings are available in 1½"-14" diameters with static pressure ratings up to 150 psig, with higher pressure ratings in smaller sizes. CENTRICAST CL-1520 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. CL-1520 pipe also contains a UV inhibitor for protection against "fiber blooming" caused by UV radiation. Fiber Glass Systems warrants CENTRICAST CL-1520 pipe and fittings against UV degradation of physical properties and chemical resistance for 15 years.

FITTINGS

Compatible vinyl 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 CL-1520 vinyl resin pipe is excellent for many chemical and slurry applications including strong acids, chlorine and oxidizing agents that corrode traditional metal pipe. Refer to Manual No. E5615 "*Chemical Resistance Guide*" for proper application.

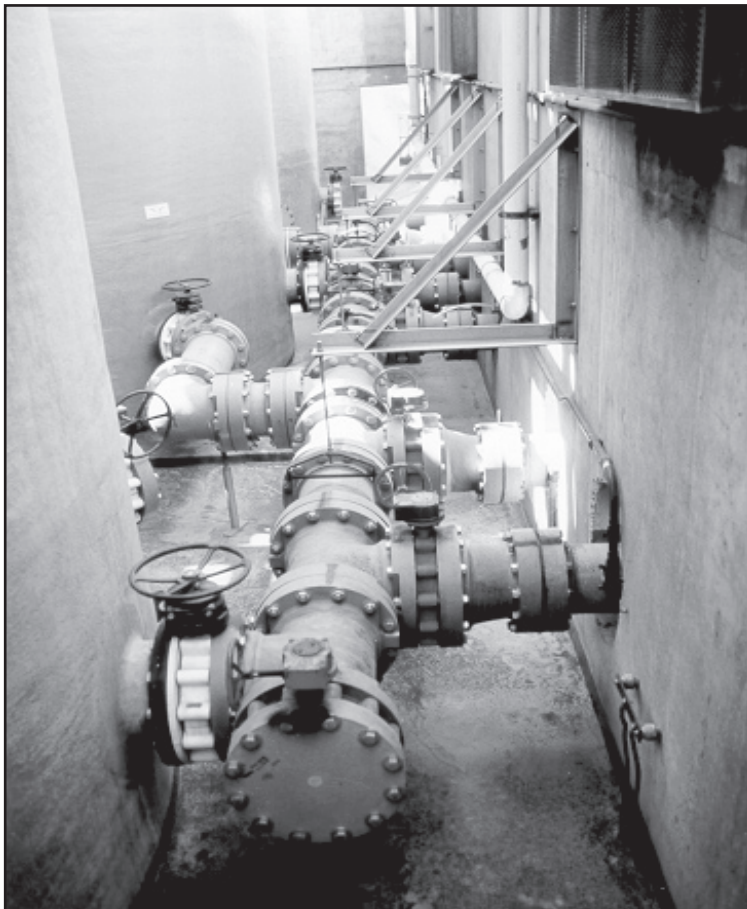
BENEFITS

The excellent chemical resistance of the CL-1520 piping system provides longer service life than traditional piping materials. CL-1520 pipe performance conveying chemical mixtures and hot acids is particularly exceptional resulting in a reduction in maintenance and replacement costs.

CL-1520 piping systems are light weight, easily installed, and typically weighs less than 1/6 that of comparable Schedule 40 Stainless Steel. A 20' length of 4" CL-1520 weighs 34 lbs while the same length of stainless steel weighs 216 lbs.

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.



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 1/2	1.52	38.6	1.90	48.3	0.19	4.8	0.13	3.3	0.67	1.00	0.09	0.013
2	2.00	50.7	2.38	60.3	0.19	4.8	0.13	3.3	0.86	1.28	0.16	0.022
3	3.12	79.2	3.50	88.9	0.19	4.8	0.13	3.3	1.30	1.94	0.40	0.053
4	4.12	105.0	4.50	114.0	0.19	4.8	0.13	3.3	1.70	2.53	0.69	0.093
6	6.21	158.0	6.63	168.0	0.21	5.3	0.15	3.8	2.79	4.16	1.57	0.210
8	8.15	207.0	8.63	219.0	0.24	6.1	0.18	4.6	4.17	6.21	2.71	0.362
10	10.30	261.0	10.75	273.0	0.24	6.1	0.18	4.6	5.23	7.78	4.30	0.575
12	12.30	312.0	12.75	324.0	0.24	6.1	0.18	4.6	6.23	9.26	6.14	0.821
14	13.50	343.0	14.00	356.0	0.24	6.1	0.18	4.6	6.85	10.19	7.46	0.997

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

ASTM D2997 Designation Codes*:

1 1/2"-4"	RTRP-22BT-4556
6"	RTRP-22BT-4555
8"	RTRP-22BT-4554
10"-12"	RTRP-22BT-4553
14"	RTRP-22BT-4552

*Mechanical properties cell classifications shown are minimum. Actual classifications may be higher for some sizes.

Pipe Lengths Available

Size (In)	Random Length (Ft)
1 1/2"-14"	20*

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

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

Nom. Pipe Size (In)	Maximum Internal Pressure @ 175°F (psig)			Maximum External Pressure ⁽⁶⁾		
	Socket Pressure Fittings ⁽³⁾	Flanged Pressure Fittings ⁽⁴⁾	Other Pressure Fittings ⁽⁵⁾	75°F	150°F	175°F
1 1/2	300	300	-	650	579	491
2	275	200	125	380	268	227
3	200	150	125	130	74	63
4	150	150	100	50	33	28
6	150	150	100	30	21	17
8	150	150	100	25	17	14
10	150	150	75	16	13	11
12	150	150	75	10	8	7
14	125	150	-	7	5	4

(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) Reduce pressure ratings by 30% for 175°F to 200°F operating temperatures. For compressible gases, insulated and/or heat traced piping systems, consult the factory for pressure ratings. CENTRICAST CL-1520 pipe and vinyl ester fittings can be used in drainage and vent systems up to 200°F. 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 CL-200 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 CL-1520 Pipe

Average Physical Properties⁽¹⁾

Property	75°F psi	24°C MPa	150°F psi	66°C MPa	175°F psi	80°C MPa
Axial Tensile - ASTM D2105						
Ultimate Stress	30,000	210	26,000	180	25,000	170
Design Stress	7,500	52	6,500	45	6,250	43
Modulus of Elasticity	2.6E+06	17,900	2.3E+06	15,900	2.2E+06	15,200
Poisson's Ratio V	0.15		0.15		0.15	
Axial Compression - ASTM D695						
Ultimate Stress	32,000	220	30,000	200	22,000	150
Design Stress	8,000	55	7,500	52	5,500	38
Modulus of Elasticity	3.1E+06	21,400	2.7E+06	18,600	2.6E+06	17,900
Beam Bending - ASTM D2925						
Ultimate Stress	40,000	280	35,000	240	33,000	230
Design Stress ⁽¹⁾	5,000	34	4,375	30	4,125	28
Modulus of Elasticity (Long Term)	3.3E+06	22,800	2.9E+06	20,000	2.8E+06	19,300
Hydrostatic Burst - ASTM D1599						
Ultimate Hoop Tensile Stress	30,000	200	26,000	180	25,000	170
Hoop Tensile Modulus of Elasticity	2.4E+06	17,000	2.1E+06	14,500	2.0E+06	13,800
Hydrostatic Design - ASTM D2992, Procedure B - Hoop Tensile Stress Static 50 Year @ 175°F	-	-	-	-	11,690	81

Coefficient of Linear Thermal Expansion - ASTM D696	Non-Insulated Pipe: 8.4×10^{-6} in/in/°F • 15.2×10^{-6} mm/mm/°C Insulated Pipe: 9.2×10^{-6} in/in/°F • 16.6×10^{-6} mm/mm/°C
Thermal Conductivity	0.07 BTU/(ft)(hr)(°F) • 0.04 W/(m)(°C)
Specific Gravity - ASTM D792	152 (0.055 Lb/in ³ • (1.52 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)
1½	0.72	0.29	0.30	1.02
2	0.92	0.58	0.49	1.30
3	1.38	1.96	1.12	1.98
4	1.79	4.26	1.90	2.57
6	3.05	16.00	4.83	4.23
8	4.78	42.60	9.88	6.32
10	5.98	83.50	15.50	7.92
12	7.11	140.00	22.00	9.43
14	7.82	187.00	26.70	10.40

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	@ 175°F	@ 75°F	@ 175°F			Stiffness Factor In ³ Lbs/In ²	Pipe Stiffness (psi)	Hoop Modulus x10 ⁶ (psi)
1 1/2	5,400	4,500	5,800	4,000	52	125	366	3,545	2.0
2	6,900	5,700	7,300	5,000	65	203	366	1,738	2.0
3	10,300	8,600	11,000	7,600	96	466	458	642	2.5
4	13,400	11,200	14,300	9,800	124	790	458	294	2.5
6	22,900	19,100	24,400	16,800	182	2,013	788	156	2.8
8	35,800	29,800	38,200	26,300	237	4,115	1,264	113	2.6
10	44,800	37,400	47,800	32,900	296	6,473	1,458	66	3.0
12	53,300	44,400	56,900	39,100	351	9,178	1,652	45	3.4
14	58,600	48,800	62,500	43,000	385	11,108	1,652	34	3.4

⁽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	150°F	175°F
1 1/2	16.4	15.8	15.7
2	17.6	17.0	16.9
3	19.9	19.2	19.1
4	21.4	20.7	20.5
6	24.7	23.9	23.7
8	27.7	26.8	26.5
10	29.4	28.5	28.2
12	30.8	29.8	29.5
14	31.6	30.6	30.3

*Consult factory for spans above 175°F or for insulated pipe support spacing.

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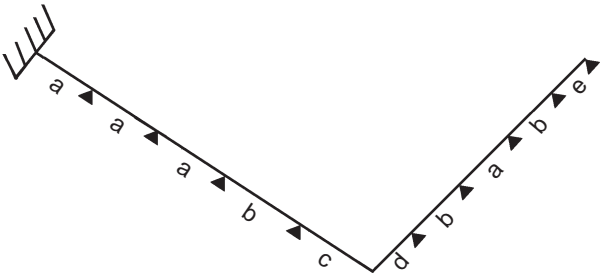
Support Spacing vs. Specific Gravity

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 @ 150°F with 1.5 specific gravity fluid,
maximum support spacing = 23.4 x 0.90 = 21.5 ft.

Piping Span Adjustment Factors With Unsupported Fitting at Change in Direction

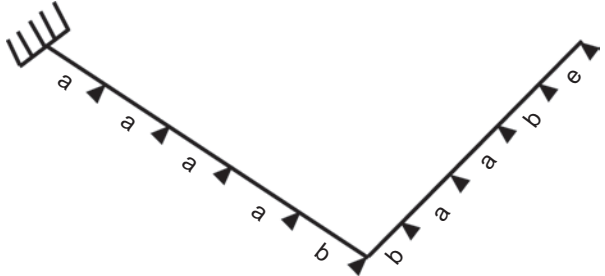
	Span Type	Factor
a	Continuous interior or fixed end spans	1.00
b	Second span from simple supported end or unsupported fitting	0.80
c + d	Sum of unsupported spans at fitting	$\leq 0.75^*$
e	Simple supported end span	0.67



* 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.

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Unrestrained Thermal Expansion Uninsulated Pipe ⁽¹⁾

Change in Temperature °F	Pipe Change In Length (In/100 Ft)
25	0.25
50	0.50
75	0.76
100	1.01
125	1.26
150	1.51
175	1.76
200	2.02

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

Nominal Pipe Size (In)	End Loads (Lbs/°F)
1 1/2	18.8
2	23.9
3	35.8
4	46.5
6	79.5
8	124.4
10	155.6
12	185.1
14	203.5

Allowable Bending Moment 90° Elbow

Nominal Pipe Size (In)	Allowable Moment (Ft•Lbs)
1 1/2	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.

Restrained Thermal End Loads and Guide Spacing

Size (In)	Operating Temperature °F (Based on installation temperature of 75°F)									
	100		125		150		175		200	
	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 Load (Lbs)
1 1/2	10.8	470	7.6	940	6.2	1,410	5.4	1,880	4.8	2,350
2	13.7	598	9.7	1,195	7.9	1,793	6.8	2,390	6.1	2,988
3	20.5	895	14.5	1,790	11.8	2,685	10.2	3,580	9.2	4,475
4	26.5	1,163	18.8	2,325	15.3	3,488	13.3	4,650	11.9	5,813
6	39.3	1,988	27.8	3,975	22.7	5,963	19.7	7,950	17.6	9,938
8	51.3	3,110	36.3	6,220	29.6	9,330	25.6	12,440	22.9	15,550
10	64.2	3,890	45.4	7,780	37.1	11,670	32.1	15,560	28.7	19,450
12	76.3	4,628	54.0	9,255	44.1	13,883	38.2	18,510	34.1	23,138
14	83.9	5,088	59.3	10,175	48.4	15,263	41.9	20,350	37.5	25,438

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 1/2	2.6	3.6	5.1	6.3	7.2	8.1	8.9	9.6	10.2	10.8	11.4
2	2.9	4.0	5.7	7.0	8.1	9.0	9.9	10.7	11.4	12.1	12.8
3	3.5	4.9	6.9	8.5	9.8	11.0	12.0	13.0	13.9	14.7	15.5
4	4.3	6.1	8.7	10.6	12.3	13.7	15.0	16.2	17.3	18.4	19.4
6	5.3	7.5	10.5	12.9	14.9	16.7	18.3	19.7	21.1	22.4	23.6
8	6.5	9.3	13.1	16.0	18.5	20.7	22.7	24.5	26.2	27.8	29.3
10	7.3	10.3	14.6	17.9	20.6	23.1	25.3	27.3	29.2	30.9	32.6
12	7.9	11.1	15.7	19.3	22.3	24.9	27.3	29.4	31.5	33.4	35.2
14	7.3	10.3	14.6	17.9	20.7	23.1	25.3	27.4	29.2	31.0	32.7

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

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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⁾
1½	40.5
2	37.2
3	31.8
4	28.5
6	25.6
8	24.6
10	22.3
12	20.6
14	19.7

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

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