CENTRICAST® CL-2030 PIPING SYSTEM

One Company | Unlimited Solutions

NOV Fiber Glass Systems

NOV Fiber Glass Systems is the combination of the **Star® Fiberglass** product line and the **Smith Fibercast®** product lines bringing over 60 years of "Time-Tested" composite pipe experience to the Oilfield, Chemical/Industrial, Petroleum Marketing, Marine and Offshore markets.

PRODUCT

Centricast CL-2030 pipe is manufactured with high strength glass fabrics and a highly resilient formulation of corrosion resistant vinyl ester resin. A 100 mil integral corrosion barrier of pure resin provides excellent corrosion resistance. It is recommended for most highly chlorinated or acidic mixtures up to 175°F and many other chemicals up to 200°F. **Centricast CL-2030** proprietary resin formulation also provides 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. The pipe 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. **Centricast CL-2030** pipe also contains a UV inhibitor for protection against "fiber blooming" caused by UV radiation. NOV Fiber Glass Systems warrants the pipe and fittings against UV degradation of physical properties and chemical resistance for 15 years.

FITTINGS

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

- Fittings Literature:
  A1390-Standard 1"-14"

JOINING METHODS

An adhesive bonded socket connection with positive stops in the fittings is standard and 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 bond the pipe and fittings. See **Manual No. F6080** ***"Pipe Installation Handbook"*** for detailed installation instructions and fabrication techniques.

RECOMMENDED SERVICES

Centricast CL-2030 vinyl ester resin pipe is excellent for many chemical applications including strong acids, chlorine, salts 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 **Centricast CL-2030** piping system provides longer service life than traditional piping materials. The pipe performance conveying chemical mixtures and hot acids is particularly exceptional resulting in a reduction in maintenance and replacement costs.

Centricast CL-2030 pipe typically weighs less than one-fourth that of comparable Schedule 40 Stainless Steel. A 20' length of 4" pipe weighs 58 lbs. while the same length of stainless steel weighs 216 lbs.

DISTRIBUTION

NOV 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, strategically located field personnel.

PRODUCT DATA

Nominal Dimensional Data

Pipe Size (In)	I.D.		O.D.		Wall Thickness		Reinforcement Thickness		Weight		Capacity	
	(In)	(mm)	(In)	(mm)	(In)	(mm)	(In)	(mm)	(Lbs/Ft)	(kg/m)	(Gal/Ft)	(CuFt/Ft)
1	0.94	23.7	1.32	33.4	0.19	4.8	0.080	2.0	0.45	0.68	0.04	0.005
1½	1.42	36.1	1.90	48.3	0.24	6.1	0.130	3.8	0.84	1.26	0.08	0.011
2	1.86	47.1	2.38	60.3	0.26	6.6	0.150	3.8	1.16	1.74	0.14	0.019
3	2.92	74.2	3.50	88.9	0.29	7.4	0.180	4.6	1.97	2.94	0.35	0.047
4	3.84	97.5	4.50	114.3	0.33	8.4	0.220	5.6	2.91	4.35	0.60	0.080
6	5.97	152.0	6.63	168.4	0.33	8.4	0.220	5.6	4.39	6.57	1.45	0.194
8	7.97	202.0	8.63	219.2	0.33	8.4	0.220	5.6	5.78	8.65	2.59	0.348
10	10.10	256.0	10.75	273.1	0.33	8.4	0.220	5.6	7.26	10.90	4.15	0.555
12	12.10	307.0	12.75	323.9	0.33	8.4	0.220	5.6	8.65	13.00	5.96	0.797
14	13.30	339.0	14.00	355.6	0.33	8.4	0.220	5.6	9.52	14.30	7.26	0.971

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

ASTM D2997 Designation Codes

1" - 1½"	RTRP-22BS-3446
2" - 6"	RTRP-22BS-4446
8"	RTRP-22BS-4445
10" - 12"	RTRP-22BS-4444
14"	RTRP-22BS-4443

Pipe Lengths Available*

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

*Pipe comes in random or exact lengths from 18.0 - 20.4 feet long.

Pressure Ratings[1][2]

Nominal Pipe Size (In)	Maximum Internal Pressure @ 175°F (psig)			Maximum External Pressure (psig)[6]		
	Socket Pressure Fittings [3]	Flg'd Pressure Fittings [4]	Other Pressure Fittings [5]	75ºF	150ºF	175°F
1	300	300	N/A	1,975	1,679	1,383
1½	300	300	N/A	1,034	878	775
2	275	200	125	1,013	861	759
3	200	150	125	467	397	350
4	150	150	100	425	361	319
6	150	150	100	218	185	163
8	150	150	100	69	59	52
10	150	150	75	34	29	26
12	150	150	75	43	36	32
14	125	150	75	16	14	12

[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. For insulated and/or heat traced temperatures, reduce pressure ratings by 30% for 175°F to 200°F operating temperatures. For compressible gases, consult the factory for pressure ratings. Centricast **CL-2030** pipe and vinyl ester fittings can be used in insulated drainage and vent systems up to 200°F operating temperatures. Heat cured 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 and crosses.

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

Average Physical Properties

Property	75°F/24°C				150°F/66°C				175°F/80°C			
	1" - 1½"		2" - 14"		1" - 1½"		2" - 14"		1" - 1½"		2" - 14"	
	psi	MPa	psi	MPa	psi	MPa	psi	MPa	psi	MPa	psi	MPa
Axial Tensile - ASTM D2105												
Ultimate Stress	22,000	150	22,000	150	19,000	130	19,900	130	18,000	120	18,000	120
Design Stress	5,500	38	5,500	38	4,750	33	4,750	33	4,500	31	4,500	31
Modulus of Elasticity	2.1×10^6	14,500	2.1×10^6	14,500	1.8×10^6	12,400	1.8×10^6	12,400	1.8×10^6	12,400	1.8×10^6	12,400
Poisson's Ratio V	0.15				0.15				0.15			
Axial Compression - ASTM D695												
Ultimate Stress	26,000	180	32,000	220	24,000	170	30,000	210	18,000	120	22,000	150
Design Stress	6,500	45	8,000	55	6,000	41	7,500	52	4,500	31	5,550	38
Modulus of Elasticity	3.3×10^6	22,800	2.6×10^6	17,900	2.9×10^6	20,000	2.3×10^6	15,900	2.8×10^6	19,300	2.2×10^6	15,100
Beam Bending - ASTM D2925												
Ultimate Stress	22,000	150	40,000	280	19,000	130	35,000	240	18,000	120	33,000	230
Design Stress[1]	2.750	19	5,000	34	2.375	16	4.375	30	2.250	16	4,125	28
Modulus of Elasticity (Long Term)	3.3×10^6	22,800	3.3×10^6	22,800	2.9×10^6	20,000	2.9×10^6	20,000	2.8×10^6	19,300	2.8×10^6	19,300
Hydrostatic Burst - ASTM D1599												
Ultimate Hoop Tensile Stress	25.000	170	30,000	210	21,000	140	26,000	180	20,000	140	25,000	170
Hoop Tensile Modulus of Elasticity	3.0×10^6	20,700	3.2×10^6	22,100	2.6×10^6	17,900	2.8×10^6	19,300	2.5×10^6	17,200	2.7×10^6	18,600
Hydrostatic Design - ASTM D2992, Procedure B-Hoop Tensile Stress Static 50 Year @ 75°F	-	-	-	-	-	-	-	-	8,600	60	8,600	60

[1]Beam bending design stress is one-eighth of ultimate to allow for combined stress. Stress and modulus values can be interpolated between temperatures shown.

Coefficient of Linear Thermal Expansion - ASTM D696	Non-Insulated Pipe: 8.9×10^{-6} in/in/°F Insulated Pipe: 10.0×10^{-6} in/in/°F	16.1×10^{-6} mm/mm°C 18.1×10^{-6} mm/mm/°C
Thermal Conductivity	0.07 BTU / hr-ft-°F	0.04 W/m-°C
Specific Gravity - ASTM D792	1.56	
Flow Factor - SF / Hazen-Williams Coefficient	150	
Absolute Surface Roughness	0.00021 in	0.0053 mm
Manning's "n"	0.009	

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	0.31	0.06	0.09	0.67
1½	0.72	0.28	0.30	1.25
2	1.05	0.65	0.55	1.73
3	1.88	2.59	1.48	2.92
4	2.96	6.79	3.02	4.32
6	4.43	22.70	6.86	6.53
8	5.81	51.30	11.90	8.60
10	7.28	100.00	18.80	10.80
12	8.66	170.00	26.70	12.90
14	9.52	226.00	32.30	14.20

Recommended Operating Ratings

Size (In)	Axial Tensile Loads Max. (Lbs) Temperature 75°F	Axial Tensile Loads Max. (Lbs) Temperature 175°F	Axial Compressive Loads Max. (Lbs)[1][2] Temperature 75°F	Axial Compressive Loads Max. (Lbs)[1][2] Temperature 175°F	Bending Radius Min. (Ft) Entire Temp. Range	Torque Max. (Ft Lbs) Entire Temp. Range	Parallel Plate Loading ASTM D2412 Stiffness Factor In^3/ Lbs/In^2	Parallel Plate Loading ASTM D2412 Pipe Stiffness (psi)	Parallel Plate Loading ASTM D2412 Hoop Modulus x10^6 (psi)
1	2,000	1,600	2,400	1,600	66	43	143	4,225	2.0
1½	4,300	3,500	5,000	3,500	95	132	457	4,504	2.0
2	5,800	4,700	8,400	5,800	65	229	563	2,742	2.0
3	10,300	8,400	15,000	10,300	96	618	1,215	1,783	2.5
4	16,300	13,300	23,700	16,300	124	1,260	2,218	1,519	2.5
6	24,300	19,900	35,400	24,300	182	2,860	2,218	453	2.5
8	32,000	26,100	46,500	32,000	237	4,960	2,662	241	3.0
10	40,000	32,800	58,200	40,000	296	7,820	2,662	122	3.0
12	47,600	39,000	69,300	47,600	351	11,100	2,662	73	3.0
14	52,400	42,900	76,200	52,400	385	13,500	2,662	55	3.0

[1]Consult the factory for design recommendations above 175°F.

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 valves and heavy in-line equipment independently. This applies to both vertical and horizontal piping.
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 run loading. Vertical loads should be supported sufficiently to minimize bending stresses at outlets or fittings.
7. Provide adequate axial and lateral restraint to ensure line stability during rapid changes in flow.

Maximum Support Spacing for Uninsulated Pipe[1]

Pipe Size (In.)	Continuous Spans of Pipe (Ft.)[2] 75°F	150°F	175°F	Gas 75°F
1	13.5	13.1	13.0	15.5
1½	16.4	15.9	15.8	19.0
2	17.9	17.3	17.2	21.3
3	21.0	20.4	20.2	26.3
4	23.7	22.9	22.7	30.4
6	26.7	25.8	25.6	37.1
8	28.8	27.9	27.7	42.5
10	30.7	29.7	29.4	47.4
12	32.2	31.1	30.9	51.8
14	33.0	31.9	31.7	54.3

[1]Consult factory for insulated pipe support spacing and operating temperatures between 175°F and 200°F.
[2] Maximum mid-span deflection ½" with a specific gravity of 1.0

Support Spacing vs. Specific Gravity

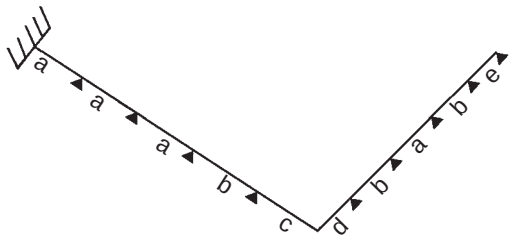
Specific Gravity	3.00	2.00	1.50	1.25	1.00	0.75	Gas/Air
Multiplier	0.76	0.84	0.90	0.95	1.00	1.07	1.40

Example: 6" pipe @ 150°F with 1.5 specific gravity fluid, maximum support spacing = 25.8 x 0.90 = 23.2

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

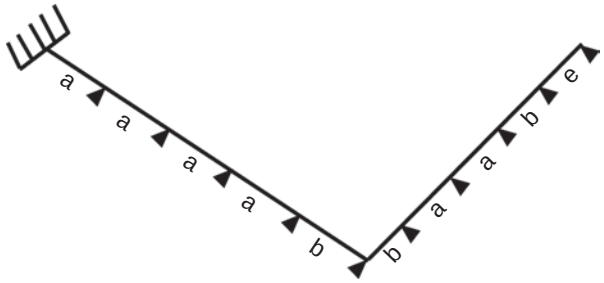
	Span Type	Factor
a	Continuous interior or fixed end spans	1.00
b	Second span from supported end or unsupported fitting	0.80
c+d	Sum of unsupported spans at fitting	≤0.75*
e	Simple supported end span	0.67

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



Adjustment Factors for Various Spans With Supported 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
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 diretional 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 movement

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"*, Manual No. E5000, Section 3.**

Unrestrained Thermal Expansion Uninsulated Pipe

Change in Temperature °F	Pipe Change in Length (In/100 Ft)
25	0.27
50	0.53
75	0.80
100	1.07
125	1.34
150	1.60
175	1.87
200	2.21

Allowable Bending Moment - 90° Elbow			
Nominal Pipe Size (In)	Allowable Movement (Ft/Lbs)	Nominal Pipe Size (In)	Allowable Movement (Ft/Lbs)
1	100	6	1,650
1½	150	8	2,850
2	225	10	4,500
3	475	12	6,500
4	650	14	10.000

Restrained Thermal End Loads and Guide Spacing

Operating Temperature °F (Based on Installation Temperature of 75°F)										
Size (In)	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	7.2	248	5.1	473	4.2	675	3.6	869	3.2	776
1½	10.4	578	7.3	1,102	6.0	1,572	5.2	2,024	4.6	1,807
2	14.7	655	10.4	1,258	8.5	1,809	7.4	2,307	6.6	2,621
3	21.9	1,173	15.5	2,253	12.7	3,239	11.0	4,130	9.8	4,694
4	28.3	1,849	20.0	3,550	16.3	5,103	14.1	6,508	12.6	7,395
6	42.3	2,767	29.9	5,312	24.4	7,636	21.1	9,739	18.9	11,067
8	55.5	3,631	39.2	6,971	32.0	10,021	27.7	12,780	24.8	14,523
10	69.5	4,549	49.1	8,733	40.1	12,554	34.7	16,011	31.1	18,195
12	82.6	5,413	58.4	10,392	47.7	14,939	41.3	19,052	37.0	21,650
14	90.9	5,953	64.3	11,429	52.5	16,429	45.4	20,953	40.6	23,810

OTHER CONSIDERATIONS

Testing:

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

When possible, NOV 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. Do not hydrotest until all support, anchors, and guides are properly installed.

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.

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