Bulletin No. A1200
December 15, 2008

Fiber Glass Systems
RED THREAD® II
Piping Systems

NOV Fiber Glass Systems™

PRODUCT

Red Thread II pipe is a filament wound product using epoxy resins and continuous glass filaments with a resin rich interior surface. Its major advantages are long service life, light weight and corrosion resistance.

Pipe and fittings are available in **2" through 16"** diameters with pressure ratings up to 450 psig static at a maximum operating temperature of 210ºF. RED THREAD II pipe is available in 18"-24" diameters and varying pressure ratings up to 450 psig static.

RED THREAD II *Performance Plus*™ piping is available in 8" through 24" sizes with a 300 psig cyclic pressure rating per API 15LR. Refer to Bulletin No. A1225.

FITTINGS

Compatible epoxy 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.

Fittings Bulletins:
A1350-Standard 1"-24"
A1355-Performance Plus 8"-24"

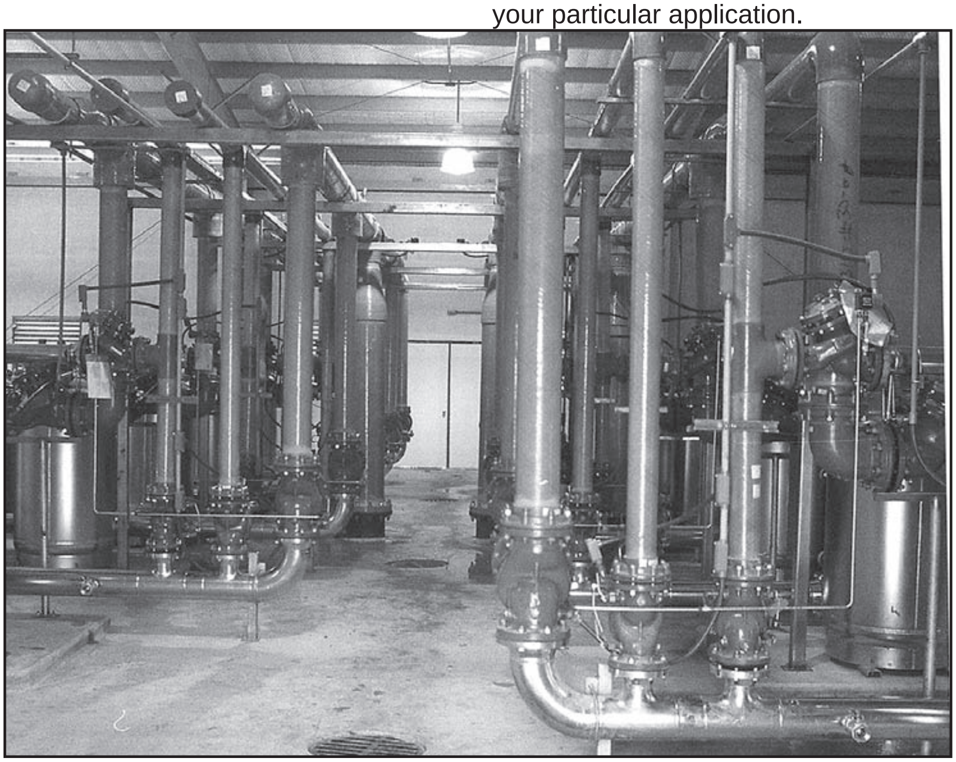
JOINING METHODS

T.A.B.™ (Threaded and Bonded) is the primary joining method for 2" through 6" diameter pipe. Factory supplied ends have special profile, double-lead threads for quick, reliable assembly. Combined with specially-formulated epoxy adhesive, T.A.B. joints promote positive make-up and prevent backout during cure.

For 8" through 24" sizes, the matched tapered joining method is used. Pipe is supplied with one end belled (integral bell or factory-bonded coupling) and one end tapered. Epoxy adhesive is used to secure the joint.

FIELD TAPERING & JOINING

Pipe can be cut and easily retapered for installation in the field using Fiber Glass Systems tapering tools. Power or manual tools are available for smaller diameter pipe. Both manual and power operated tools are available for larger diameter pipe. Power-driven tools are recommended for larger pipe sizes and where many tapers are required. See **Manual No. F6000, *Pipe Installation Handbook for Matched Tapered Bell & Spigot Joints,*** for installation instructions and recommendations on the proper tool for your particular application.



RECOMMENDED SERVICES

RED THREAD II epoxy resin pipe is excellent for **light chemical services in salts, solvents, and pH 2 to 13 solutions** that corrode traditional Metallic pipe. It has been used extensively with great success for petroleum production applications such as produced water. CO_2, crude oil and gas, and flow lines; and also in food processing services, water and wastewater facilities, and chemical processing services. All RED THREAD II pipe and fittings carry the ANSI/NSF 61 Listing for handling potable water. **Refer to Bulletin E5615 "*Chemical Resistance Guide*" for proper application.**

BENEFITS

There are many advantages to choosing RED THREAD II pipe. For example, when considering total installed cost, RED THREAD II piping provides significant savings due to its light weight and easy installation features. No heavy handling equipment is required, and the load RED THREAD II pipe adds to a structure is minimal compared to steel, black iron, copper, and stainless steel. For example, 4" RED THREAD II pipe weighs only 1.0 lbs. per foot compared to 5.6 lbs. for Schedule 10 stainless.

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, strategically located field personnel.

PRODUCT DATA

General Specifications and Dimensional Data

Nominal Pipe Size (In)	Nominal I.D.		Nominal O.D.		Nominal Wall Thickness		Nominal Weight		Capacity	
	(In)	(mm)	(In)	(mm)	(In)	(mm)	(Lbs/Ft)	(kg/m)	(Gal/Ft)	(CuFt/Ft)
2	2.238	57	2.395	61	.079	2.01	0.4	0.60	0.20	.03
3	3.363	85	3.520	90	.079	2.01	0.7	1.04	0.46	.06
4	4.364	111	4.562	115	.099	2.51	1.2	1.79	0.78	.10
6	6.408	163	6.678	170	.135	3.43	2.4	3.51	1.68	.22
8	8.356	212	8.642	219	.143	3.63	3.3	4.91	2.85	.38
10	10.357	263	10.731	273	.187	4.75	5.3	7.89	4.38	.59
12	12.278	312	12.710	323	.216	5.49	7.2	10.71	6.15	.82
14	14.029	356	14.567	370	.269	6.83	10.1	15.33	8.03	1.07
16	16.031	407	16.637	423	.303	7.70	13.2	19.79	10.49	1.40
18	17.820	453	18.460	469	.320	8.13	15.5	23.07	12.96	1.73
20	19.830	504	20.480	520	.325	8.25	17.5	26.04	16.04	2.15
24	23.830	605	24.580	624	.375	9.53	24.3	36.16	23.17	3.10

Tolerances or maximum/minimum limits are available.

ASTM D2996 Designation Codes

2”-3”	RTRP-11AF1-2111
4”	RTRP-11AH1-2111
6”-8”	RTRP-11AH1-2112
10”	RTRP-11AH1-2114
12”	RTRP-11AH1-2115
14”-16”	RTRP-11AH1-2116
18”-24”	RTRP-11AH1-2110

Pipe Lengths Available

Size (In)	Random Length (Ft)
2-6	30
8-24	40

Pressure Ratings

Size (In)	Maximum Internal Pressure (psig)	Maximum External Pressure (psig)[1]		
	Static Max. Temp. 210ºF	75ºF	150ºF	Max. Rated Temp.
2	450	85	80	75
3	450	36	34	32
4	450	34	30	27
6	450	22	20	19
8	225	17	13	11
10	225	17	13	11
12	225	17	13	11
14	225	17	13	11
16	225	17	13	11
18	225	9.9	7.5	6.5
20	225	7.8	6.0	5.2
24	225	6.9	5.3	3.5

[1]Vacuum Service: A full vacuum within the pipe is equivalent to 14.7 psig external pressure at sea level. Maximum external pressure ratings are based on test data obtained using ASTM D2924. Contact Fiber Glass Systems if higher external pressure ratings are required.

Average Physical Properties

Property	75ºF psi	24ºC MPa	210ºF psi	99ºC MPa
Axial Tensile - ASTM D2105				
Ultimate Stress	10,300	71	7,700	53
Design Stress	2,575	17.8	1,925	13.3
Modulus of Elasticity	1.82×10^6	12,548	1.18×10^6	8,136
Poisson's Ratio $V_{a/h}$ ($V_{h/a}$)	0.35 (0.64)			
Axial Compression - ASTM D695				
Ultimate Stress	33,000	230	19,400	134
Design Stress	8,325	57.4	4,850	33.4
Modulus of Elasticity	1.26×10^6	8,687	0.6×10^6	4,137
Beam Bending - ASTM D2925				
Ultimate Stress	23,000	158.6	16,000	110
Design Stress[1]	2,875	19.8	2,000	13.8
Modulus of Elasticity (Long Term)	1.46×10^6	10,000	0.96×10^6	6,630
Hydrostatic Burst - ASTM D1599				
Ultimate Hoop Tensile Stress	34,000	234	43,500	300
Hydrostatic Design - ASTM D2992, Procedure A - Hoop Tensile Stress	Sizes			
Cyclic 150 x 10^6 Cycles	2"- 3" 9,410	64.9	5,790	39.9
	4"-24" 13,073[2]	90.1[2]	8,447[2]	58.2[2]

Coefficient of Linear Thermal Expansion - ASTM D696	0.88×10^{-5} in/in/ºF	1.58×10^{-5} mm/mm/ºC
Thermal Conductivity	0.23 BTU/hr-ft-ºF	0.4 W/m-ºC
Specific Gravity - ASTM D792	1.8	
Flow Factor - SF / Hazen-Williams Coefficient	150	
Surface Roughness	1.7×10^{-5} Feet	0.00021 Inch
Manning's "n"	0.009 Inch	

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)
2	0.50	0.33	0.28	0.58
3	0.74	1.09	0.62	0.85
4	1.21	3.00	1.32	1.39
6	2.42	12.90	3.86	2.77
8	3.33	30.00	6.94	3.82
10	5.41	74.80	13.94	6.19
12	7.40	143.90	22.64	8.48
14	10.55	268.00	36.80	12.08
16	13.60	450.00	54.10	15.55
18	15.92	652.00	70.64	18.24
20	18.00	909.00	88.77	20.58
24	24.90	1817.00	147.84	28.52

[1]Beam bending design stress is 1/8 of ultimate to account for combined stress (i.e., bending and pressure).

[2]The hydrostatic design stress cyclic at 150ºF is 10,503 psi per ASTM D2992, Procedure A. Based on complete data sets obtained at 150ºF and 200ºF, the extrapolated value at 75ºF and 210ºF is 13,073 and 8,447 psig, respectively.

Recommended Operating Ratings

Size (In)	Axial Tensile Loads Max. (Lbs) 75ºF	Axial Tensile Loads Max. (Lbs) Max Rated Temp.	Axial Compressive Loads Max. (Lbs)(1) 75ºF	Axial Compressive Loads Max. (Lbs)(1) Max Rated Temp.	Bending Radius Min. (Ft) Entire Temp. Range	Torque Max. (Ft Lbs) Entire Temp. Range	Parallel Plate Loading(2) 5% Deflection ASTM D2412 Stiffness Factor In^3 Lbs/In^2	Pipe Stiffness (psi)	Hoop Modulus $x10^6$ (psi)
2	1,280	930	4,160	2,420	51	90	88	372	3.08
3	1,900	1,380	6,160	3,580	74	200	105	141	3.39
4	3,110	2,260	10,070	5,860	97	420	150	90	2.93
6	6,230	4,520	20,140	11,730	141	1,200	890	170	4.34
8	8,570	6,220	27,720	16,150	183	2,200	760	60	3.32
10	13,930	10,110	45,030	26,230	227	4,450	1,620	75	3.22
12	19,050	13,820	61,600	35,890	269	7,250	1,940	50	2.91
14	27,160	19,710	87,830	51,160	308	11,800	4,400	80	2.60
16	35,020	25,410	113,220	65,960	352	17,400	6,520	80	3.11
18	40,990	29,750	132,530	77,210	391	22,700	-	-	-
20	46,350	33,630	149,850	87,300	433	28,500	-	-	-
24	64,110	46,530	207,290	120,760	520	47,400	-	-	-

(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.

Maximum Support Spacing for Uninsulated Pipe*

Nom. Pipe Size (In.)	Continuous Spans of Pipe (Ft.) Deflection=1/2" Specific Gravity=1.0 75ºF	150F	210F	Gas 75ºF
2	12.6	12.0	11.4	19.1
3	14.0	13.3	12.6	22.1
4	15.9	15.1	14.3	25.2
6	18.9	18.0	17.0	30.7
8	20.6	19.5	18.6	34.8
10	23.2	22.0	20.9	38.9
12	25.1	23.9	22.6	42.4
14	27.4	26.0	24.7	45.3
16	29.2	27.7	26.3	48.4
18	30.4	28.9	27.4	51.1
20	31.4	29.8	28.3	53.9
24	34.1	32.4	30.7	59.0

*Consult factory for insulated pipe support spacing.

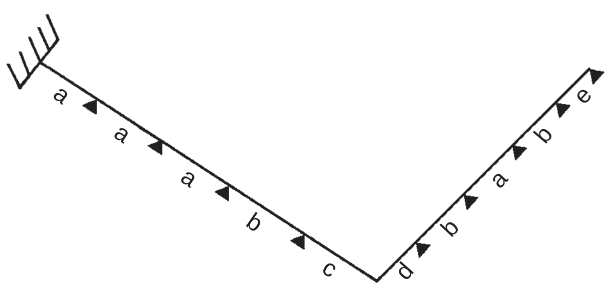
Support Spacing vs. Specific Gravity

Specific Gravity	2.00	1.50	1.25	1.00	0.75
Multiplier	0.84	0.90	0.95	1.00	1.07

Example: 6” pipe @ 150°F with 1.5 specific gravity fluid, maximum support spacing = 17.9 x 0.90 = 16.1 ft.

Piping Span Adjustment Factors With Unsupported Fitting at Change in Direction

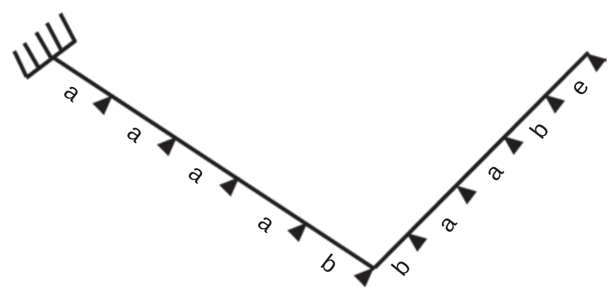
	Span Type	Factor
a	Continuous interior or fixed end spans	1.00
b	Second span from simple supported end or unsupported fitting	0.80
c + d	Sum of unsupported spans at fitting	≤ 0.75*
e	Simple supported end span	0.67



* 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.

Thermal Expansion

Change in Temperature ºF	Pipe Change in Length (In/100 Ft)
25	0.26
50	0.53
75	0.79
100	1.06
125	1.32
150	1.58
175	1.85

Restrained Thermal End Loads and Guide Spacing

Size (In)	Operating Temperature ºF (Based on installation temperature of 75ºF)									
	125		150		175		200		210	
	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)
2	11.4	223	9.5	294	8.5	339	8.0	356	7.8	356
3	17.0	330	14.2	436	12.7	502	11.9	528	11.7	527
4	22.0	540	18.5	713	16.5	821	15.4	863	15.1	862
6	32.3	1,081	27.1	1,426	24.2	1,642	22.6	1,727	22.2	1,724
8	42.0	1,487	35.2	1,963	31.5	2,259	29.4	2,376	28.8	2,373
10	52.0	2,417	43.6	3,189	39.0	3,671	36.4	3,861	35.7	3,856
12	61.7	3,306	51.7	4,363	46.3	5,021	43.2	5,281	42.4	5,274
14	70.5	4,714	59.1	6,220	52.9	7,158	49.3	7,530	48.4	7,520
16	80.4	6,077	67.4	8,018	60.3	9,228	56.3	9,707	55.3	9,694
18	89.5	7,113	75.0	9,386	67.1	10,802	62.6	11,363	61.5	11,347
20	99.4	8,043	83.3	10,612	74.6	12,214	69.5	12,847	68.3	12,830
24	120.0	11,126	100.0	14,681	89.6	16,896	83.6	17,773	82.1	17,748

Expansion Loop Design Minimum Leg Length (Feet)

Size (In)	Change in Length (Inches)								
	1/2	1	2	3	4	5	6	8	10
2	3.1	4.1	5.6	6.7	7.7	8.5	9.3	10.6	11.8
3	3.8	5.1	6.9	8.2	9.4	10.4	11.3	13.0	14.4
4	4.3	5.8	7.8	9.4	10.7	11.8	12.9	14.7	16.4
6	5.2	7.0	9.4	11.3	12.9	14.3	15.6	17.8	19.8
8	7.4	9.4	12.2	14.4	16.2	17.8	19.2	21.8	24.0
10	8.6	10.9	14.0	16.4	18.4	20.2	21.8	24.6	27.2
12	9.8	12.2	15.6	18.2	20.4	22.3	24.1	27.2	29.9
14	10.9	13.5	17.1	19.9	22.2	24.3	26.2	29.5	32.4
16	11.9	14.7	18.6	21.6	24.1	26.3	28.3	31.9	35.0
18	13.8	16.7	20.7	23.9	26.5	28.9	31.0	34.7	38.0
20	15.2	18.3	22.6	25.9	28.7	31.1	33.4	37.3	40.8
24	17.5	20.9	25.6	29.2	32.3	35.0	37.4	41.7	45.5

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

TESTING

See Fiber Glass Systems Manual No. F6000, Pipe Installation Handbook for Matched Tapered Bell & Spigot Joints:

The normal recommended test procedure for RED THREAD II pipe is to conduct a cyclic pressure test. A cyclic pressure test subjects the piping system to 10 pressurization cycles at 1$^1/_2$ times the anticipated or design operating pressure. The tenth pressurization is maintained on the line for 1-8 hours while the line is inspected for leaks. Lines that can be subjected to severe temperature cycles, such as steam condensate lines, hot water lines, and cold water lines, should be tested using the cyclic test procedure at 1$^1/_2$ times the system pressure rating, even if the system is to operate at relatively low pressure.

No field test pressure should exceed 1$^1/_2$ times the maximum rated cyclic pressure rating of the lowest rated element in the system. Under no circumstances should a field pressure test exceed 450 psig without consulting Fiber Glass Systems.

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.

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Fluid (Water) Hammer Constants(1)

Pipe Size (In.)	Fluid (Water) Hammer Constants(1)
2	28
3	23
4	23
6	22
8	20
10	21
12	21
14	21
16	21
18	21
20	20
24	20

(1)Constants are valid for water at 75ºF.

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

NOV Fiber Glass Systems

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