Bulletin No. A1380
September 15, 2005

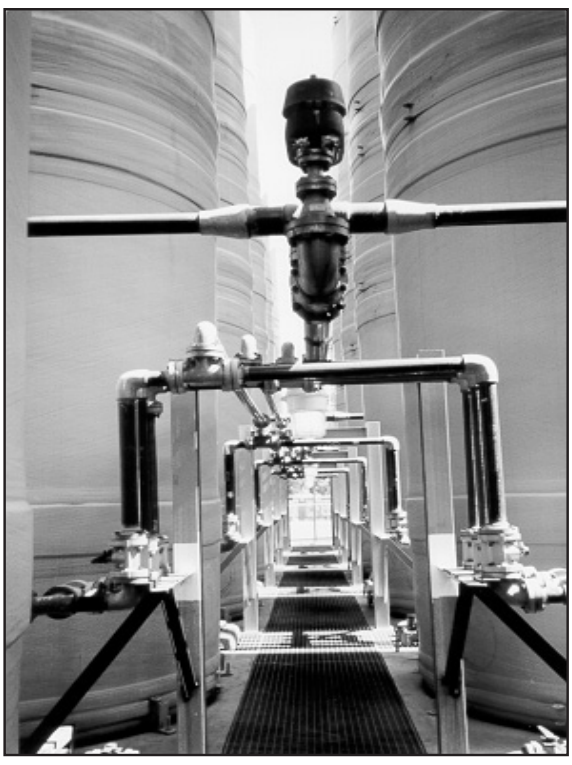
# Smith Fibercast
# CENTRICAST PLUS® RB-2530
# Piping Systems

## PRODUCT

CENTRICAST PLUS RB-2530 pipe is manufactured with high strength glass fabrics and our 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 250ºF. 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. RB-2530 also contains a UV inhibitor for protection against "fiber blooming" caused by UV radiation. Smith Fibercast warrants CENTRICAST PLUS RB-2530 pipe and fittings against UV degradation of physical properties and chemical resistance for 15 years.



## FITTINGS

RB-2530 epoxy fittings are manufactured with the same chemical resistance, temperature rating and performance 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 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 PLUS 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 RB-2530 piping system provides longer service life than traditional piping materials. RB-2530's performance conveying chemical mixtures and hot caustics is particularly exceptional resulting in a reduction in maintenance and replacement costs.

RB-2530 piping systems are light weight and easily installed. Reductions in labor costs and heavy handling equipment due to the ease of installation result in lower total installed costs.

RB-2530 pipe typically weighs less than ¼ that of comparable Schedule 40 Stainless Steel. A 20' length of 4" RB-2530 weighs 47 lbs. while the same length of stainless steel weighs 216 lbs.

## DISTRIBUTION

FGS Smith Fibercast has a network of stocking distributors throughout the United States as well as representatives and distributors throughout the world. These distributors are supported by a staff of experienced application engineers and highly trained field service technicians strategically located around the world.

# PIPE PROPERTIES

## General Specifications and Dimensional Data*

| Nominal Pipe Size (In.) | Nominal I.D. (In.) | Nominal I.D. (mm) | Nominal O.D. (In.) | Nominal O.D. (mm) | Nominal Wall Thickness (In.) | Nominal Wall Thickness (mm) | Reinforcement Thickness (In.) | Reinforcement Thickness (mm) | Nominal Weight (Lbs./Ft.) | Nominal Weight (kg/m) | Capacity (Gal./Ft.) | Capacity (Cu. Ft./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 |
| 1 1/2 | 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 Smith Fibercast.

## ASTM D2997 Designation Codes†:

| | |
|---|---|
| 1” | RTRP-21CW-4356 |
| 1 1/2" - 4" | RTRP-21CW-4456 |
| 6"- 8" | RTRP-21CW-4455 |
| 10" - 12" | RTRP-21CW-4454 |
| 14" | RTRP-21CW-4453 |

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

## Pipe Lengths Available

| Size (In.) | Length (Ft.) |
|---|---|
| 1 - 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)

| Nominal Pipe Size (In.) | Max. Internal Pressure @ 225°F (psig) Socket Pressure Fittings(3) | Flanged Pressure Fittings(4) | Other Pressure Fittings(5) | Maximum External Pressure(6) @ 75°F | @150°F | @ 250°F |
|---|---|---|---|---|---|---|
| 1 | 300 | 300 | NA | 2,125 | 1,849 | 1,381 |
| 1 1/2 | 300 | 300 | NA | 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 | NA | 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, saddles and grooved nipples.

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

NA = Not available at time of printing.

## Average Physical Properties(1)

| Property | Size @ 75° F/ @ 24° C | | | | Size @ 225° F/ @ 107° C | | | | Size @ 250° F/ @ 121° C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1" | | 1½" - 14" | | 1" | | 1½" - 14" | | 1" | | 1½" - 14" | |
| | psi | MPa | psi | MPa | psi | MPa | psi | MPa | psi | MPa | psi | MPa |
| 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 | 17000 | – | – | 2.1E+06 | 14000 | – | – | 1.9E+06 | 13000 |
| Poisson's Ratio | 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 | 9000 | 2.5E+06 | 17000 | 1.1E+06 | 8000 | 2.1E+06 | 14000 | 1.0E+06 | 7000 | 1.9E+06 | 13000 |
| 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 | 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 | 4000 | 3.7E+06 | 26000 | 4.7E+05 | 3200 | 3.1E+06 | 21000 | 4.4E+05 | 3000 | 2.9E+06 | 20000 |
| 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 | 19000 | – | – | 2.3E+06 | 16000 | – | – | 2.2E+06 | 15000 |
| Hydrostatic Design – ASTM D2992, Procedure B – Hoop Tensile Stress(1) | | | | | | | | | | | | |
| Static 50 Year @ 75°F | 16,090 | 110 | 16,090 | 110 | – | – | – | – | – | – | – | – |
| Coefficient of Linear Thermal Expansion – ASTM D696 | Non-Insulated Pipe: 11.0 x $10^{-6}$ in./in./°F • 19.9x$10^{-6}$ mm/mm°C<br>Insulated Pipe: 12.0 x $10^{-6}$ in./in./°F • 21.7x$10^{-6}$ mm/mm°C | | | | | | | | | | | |
| Thermal Conductivity | 0.07 BTU/(ft)(hr)(°F) • 0.04 W/(m)(°C) | | | | | | | | | | | |
| Specific Gravity (Density) | 1.47 (0.053 Lb/in.$^3$) • (1.47 g/cm$^3$) | | | | | | | | | | | |
| Hazen-Williams Flow Factor | C-150 | | | | | | | | | | | |
| Surface Roughness | 1.7 x $10^{-5}$ 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.$^3$) | Total Wall End Area (In.$^2$) |
|---|---|---|---|---|
| 1 | 0.35 | 0.07 | 0.10 | 0.70 |
| 1½ | 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 |

## Recommended Operating Ratings

| Size (In.) | Axial Tensile Loads Max. (Lbs.) @ 75° F | Axial Tensile Loads Max. (Lbs.) @ 250°F | Axial Compressive Loads Max. (Lbs.) @ 75° F | Axial Compressive Loads Max. (Lbs.) @ 250°F(1) | Bending Radius Min. (Ft.) Entire Temp. Range | Torque Max. (Ft.•Lbs.) Entire Temp. Range | Parallel Plate Loading(2) @ 5% Deflection & 75°F ASTM D2412 Stiffness Factor $In.^3$•Lbs./$In.^2$ | Pipe Stiffness (psi) | Hoop Modulus x $10^6$ (psi) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,560 | 1,200 | 1,700 | 600 | 9 | 41 | 164 | 4791 | 2.7 |
| 1½ | 4,260 | 3,300 | 6,770 | 2,500 | 56 | 132 | 617 | 6080 | 2.7 |
| 2 | 5,410 | 4,200 | 8,600 | 3,200 | 70 | 216 | 617 | 2969 | 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 | 1000 | 1105 | 731 | 2.7 |
| 6 | 18,960 | 14,700 | 30,160 | 11,200 | 195 | 2260 | 1228 | 245 | 3.0 |
| 8 | 27,690 | 21,400 | 44,060 | 16,400 | 253 | 4330 | 1715 | 153 | 3.0 |
| 10 | 40,030 | 30,900 | 63,680 | 23,700 | 316 | 7820 | 3106 | 143 | 3.5 |
| 12 | 47,630 | 36,800 | 75,780 | 28,100 | 374 | 11100 | 3106 | 85 | 3.5 |
| 14 | 52,380 | 40,500 | 83,340 | 31,000 | 411 | 13500 | 3106 | 64 | 3.5 |

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

(2) Burial calculations should 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 ½ inch and bending stresses to less than or equal to ⅛ 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 six 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.) Specific Gravity=1.0, Deflection=½" Temperature 75°F | 225°F | 250°F |
|---|---|---|---|
| 1 | 8.6 | 8.3 | 8.1 |
| 1½ | 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.

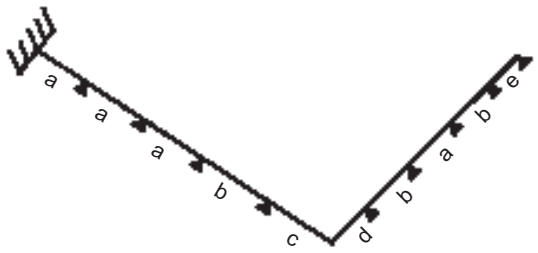
## Support Spacing vs. Specific Gravity

| 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 @ 175°F with 1.5 specific gravity fluid, maximum support spacing = 22.1x 0.9 = 19.9 ft.

## Piping Span Adjustment Factors With Unsupported Fitting at Change in Direction

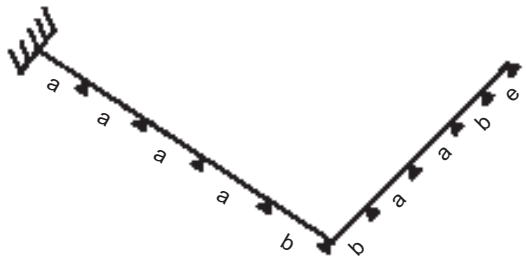
| | Span Type | Factor |
|---|---|---|
| a | Continuous interior or fixed end spans | 1.00 |
| b | Second span from simple supported end or unsupported fitting | 0.80 |
| c + d | Sum of unsupported spans at fitting | ≤ 0.75* |
| e | Simple supported end span | 0.67 |




*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

| | Type of Span | Adjustment 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 flexibilities 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 Smith Fibercast's "Engineering and Piping Design Guide", Manual No. E5000, Section 3.

## 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 |

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

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

| Nominal Pipe Size (in) | End Loads (Lbs./°F) | Nominal Pipe Size (in) | End Loads (Lbs./°F) |
|---|---|---|---|
| 1 | 5.13 | 6 | 98.25 |
| 1½ | 22.06 | 8 | 143.49 |
| 2 | 28.02 | 10 | 207.42 |
| 3 | 42.12 | 12 | 246.81 |
| 4 | 65.91 | 14 | 271.44 |

## Allowable Bending Moment 90° Elbow

| Nominal Pipe Size (in) | Allowable Moment (Ft•Lbs.) | Nominal Pipe Size (in) | Allowable Moment (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 |

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

## Maximum Guide Spacing for Restrained Thermal End Loads (Feet)

| Nominal Pipe Size (In.) | Temperature Change °F* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 25 | 50 | 75 | 100 | 125 | 150 | 175 | 200 |
| 1 | 3.9 | 2.8 | 2.3 | 2.0 | 1.8 | 1.6 | 1.5 | 1.4 |
| 1½ | 10.4 | 7.4 | 6.0 | 5.2 | 4.7 | 4.3 | 3.9 | 3.7 |
| 2 | 13.2 | 9.4 | 7.6 | 6.6 | 5.9 | 5.4 | 5.0 | 4.7 |
| 3 | 19.9 | 14.0 | 11.5 | 9.9 | 8.9 | 8.1 | 7.5 | 7.0 |
| 4 | 25.6 | 18.1 | 14.8 | 12.8 | 11.4 | 10.4 | 9.7 | 9.0 |
| 6 | 38.1 | 27.0 | 22.0 | 19.1 | 17.1 | 15.6 | 14.4 | 13.5 |
| 8 | 49.8 | 35.2 | 28.8 | 24.9 | 22.3 | 20.3 | 18.8 | 17.6 |
| 10 | 62.2 | 44.0 | 35.9 | 31.1 | 27.8 | 25.4 | 23.5 | 22.0 |
| 12 | 74.0 | 52.3 | 42.7 | 37.0 | 33.1 | 30.2 | 28.0 | 26.2 |
| 14 | 81.4 | 57.5 | 47.0 | 40.7 | 36.4 | 33.2 | 30.8 | 28.8 |

*Note: Temperature Change = Maximum Fluid Temperature - Installation Temperature.

## Expansion Loop Minimum Leg Length (Feet)

| Size (In.) | Total Deflection to be Absorbed (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 contilever leg length.

# TESTING

See Section 3 of Smith Fibercast Manual No. F6080, Pipe Installation Handbook: Hydrostatic Testing and System Start Up.

When possible, Smith Fibercast piping systems should be hydrostatically tested prior to being put into 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 high pressure surge may be created that interrupts flow in the event of a 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 psig caused by water hammer can be calculated by multiplying the fluid velocity in ft./sec. times the constant listed in this table. The instantaneous peak pressure for the system will equal the water hammer surge plus the pressure in the system at the time the water hammer occurred.

Water (Fluid) Hammer Constants(1)

| Nominal Pipe Size (in) | Constants | Nominal Pipe Size (in) | Constants |
|---|---|---|---|
| 1 | 44.0 | 6 | 28.9 |
| 1½ | 44.2 | 8 | 27.0 |
| 2 | 40.7 | 10 | 26.1 |
| 3 | 35.0 | 12 | 24.2 |
| 4 | 34.0 | 14 | 23.2 |

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



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