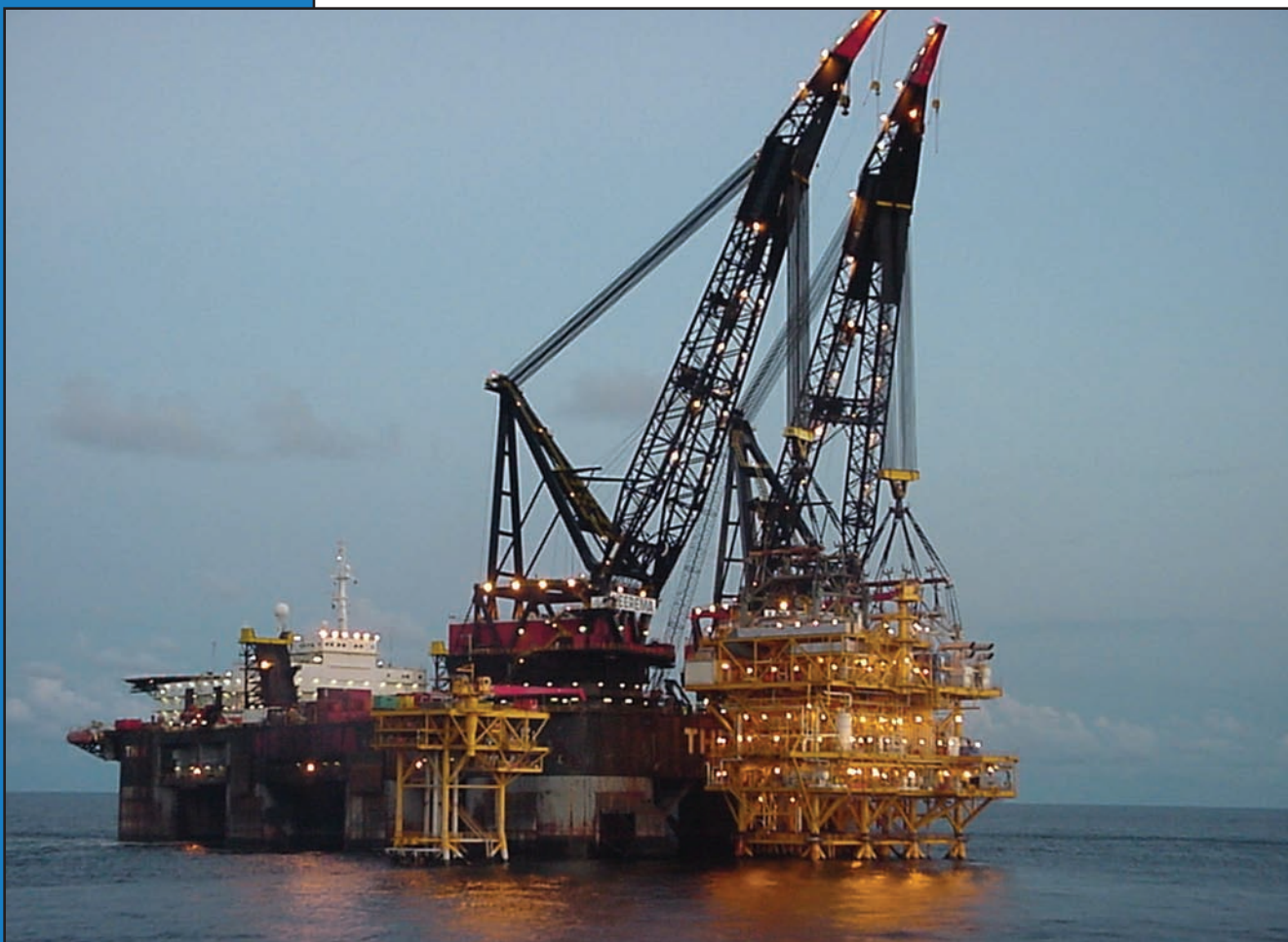


# GREEN THREAD Marine-Offshore Piping Systems



Fiber Glass Systems (FGS) combines the resources of Star Fiberglass and Smith Fibercast with five manufacturing facilities in North America and two in the Far East. We offer a real choice in high-performance fiberglass piping for offshore applications.

#### GREEN THREAD® Marine-Offshore Piping Systems

##### GREEN THREAD 175

- Rated to 175 psig/12 bar
- Temperatures up to 230°F/110°C
- Cost-effective, low pressure services

##### GREEN THREAD 250

- Rated to 250 psig/18 bar
- Temperatures up to 230°F/110°C
- Extra safety factor for critical services

##### • FIRE RESISTANT PIPING SYSTEMS

##### • CONDUCTIVE PIPING SYSTEMS

- 1" - 24" Sizes  
(25mm-600mm)



#### Product

GREEN THREAD® Offshore piping systems are available in two pressure classes.

**GREEN THREAD 175** is rated to 175 psig/12 bar at temperatures up to 230°F/110°C. This system is available with a molded fittings option that provides a cost-effective alternative to filament wound fittings for low pressure service such as drain lines, sewer lines, vent lines and similar applications.

**GREEN THREAD 250** is rated to 250 psig/18 bar at temperatures up to 230°F/110°C. This design provides the end user with an extra safety factor for critical services such as offshore fire protection systems and ballast piping applications.

All GREEN THREAD Marine and Offshore pipe products are manufactured with an inner corrosion and erosion barrier that is reinforced to provide maximum resistance to the harsh marine environment. GREEN THREAD Offshore systems are available in sizes from 1" through 24" diameter, with a complete range of filament wound fittings for all sizes and pressure classes. See page 7 for available pipe lengths.

#### FIRE RESISTANCE

GREEN THREAD 250 and GREEN THREAD 175 systems are fully qualified for IMO Level-3 fire resistance without any passive fire protection required in 2"-24" sizes. In applications such as dry deluge fire protection piping where a higher degree of fire resistance is necessary, GREEN THREAD 250-F is supplied with a unique reinforced "Fire Jacket" that has been fully qualified for modified Level-3 (L-WD) fire resistance in accordance with U. S. Coast Guard PFM 1-98. Pipe protected by the Fiber Glass Systems "Fire Jacket" exhibits zero heat release when tested in accordance with IMO A.653(16). Flammability of the product is so low that it has been exempted from smoke and toxicity test requirements.

#### CONDUCTIVE PIPING SYSTEMS

GREEN THREAD 250-C and GREEN THREAD 175-C are supplied with conductive carbon fibers as an integral part of the pipe wall in order to provide a uniformly conductive piping system for use in hazardous areas. A specially formulated conductive adhesive ensures conductivity across the joints. Pipe and fittings are also manufactured with a 0.020" (0.5mm)

conductive nexus reinforced liner so there is no compromise in performance when choosing the conductive option. Conductive piping is available in all sizes and pressure ratings.

## **FITTINGS**

All GREEN THREAD 250 and 175 fittings are manufactured with the same pressure, temperature, and chemical capabilities as the pipe. GREEN THREAD 175 fittings are available as molded or filament wound in 2" to 6" diameter, filament wound in larger sizes. GREEN THREAD 250 fittings are filament wound in all sizes. All standard fittings are supplied with the conductive option and are also available with the "fire jacket" as required. Filament wound fittings come in long radius (1.5 D) in 1"-6" and standard radius for 8"-24" to accommodate the tight space requirements on most jobs. Long radius 8"-24" fittings are available upon request.

## **JOINING METHODS**

GREEN THREAD 250 and GREEN THREAD 175 use an easily installed socket joint with positive stop up through 12" diameter. Larger diameter pipe and fittings use the tapered joint for optimum pressure and mechanical performance.

This combination of joining systems enables the end user to take advantage of the positive stop feature of the socket joining system in the smaller sizes, while providing maximum joint efficiency and the extra reliability of the tapered joint in the larger sizes.

## **LIGHT WEIGHT**

GREEN THREAD 250 and GREEN THREAD 175 offer considerable weight savings in original design and construction of floating offshore structures or vessels. GREEN THREAD 250 is 1/4 or less the weight of steel. The GREEN THREAD 250-F pipe is 1/2 or less the weight of carbon steel and CuNi piping.

## **ENGINEERING & DESIGN**

Fiber Glass Systems offers complete design and installation assistance for the engineer, the shipbuilder or offshore platform constructor. A complete Engineering and Piping Design Guide, Manual No. E5000, is available upon request. The easy-to-use Success by Design engineering software is available at [www.smithfibercast.com](http://www.smithfibercast.com). FGS Application Engineers can provide up-front layout and system design advice, as well as comprehensive flexibility and stress analyses of piping layouts. FGS pipe and fittings are available in PDMS format.

## **INSTALLATION**

Fiber Glass Systems can provide turnkey solutions worldwide through our certified fabrication network. Local factory support enhances the installation's success. Piping spools can be prefabricated and tested in our factory or at a local fabrication site to minimize on-site installation time, and reduce overall installed costs. When Green Thread Marine-Offshore products are fabricated and installed by FGS or our certified installation contractors, additional warranty terms are available. Consult Manual No. F6300 for proper installation procedures.

## **MARINE/OFFSHORE Applications**

**Firewater Systems**

**Salt Water Supply Lines**

**Cooling Water**

**Waste Lines**

**Potable Water**

**Process Lines**

**Ballast Piping**

**Cargo Lines**

**Bilge Piping**

**Sprinkler Systems**

**Fresh Water Lines**

**Sanitary Lines**

**Scuppers**

**Sounding Tubes**

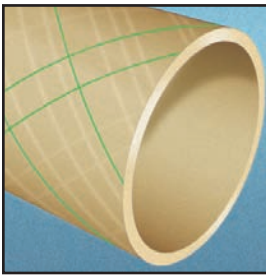
**Vent Lines**

**Drains**

**Conduit**

# MARINE-OFFSHORE Piping Systems

## PIPE PROPERTIES



### General Specifications and Dimensional Data\*

#### GREEN THREAD 175

Nominal Pipe Size (In)	Nominal I.D.		Nominal O.D.		Nominal Wall Thickness		Nominal Liner Thickness		Nominal Weight		Capacity	
	(In)	(mm)	(In)	(mm)	(In)	(mm)	(In)	(mm)	(Lbs/Ft)	(kg/m)	(Ft³/Ft)	(L/m)
2	2.15	54.6	2.51	63.7	0.19	4.7	0.02	0.5	0.9	1.34	0.03	2.3
3	3.28	83.3	3.66	93.0	0.19	4.8	0.02	0.5	1.4	2.08	0.06	5.5
4	4.28	108.7	4.66	118.4	0.19	4.8	0.02	0.5	1.8	2.68	0.10	9.3
6	6.35	161.3	6.80	172.7	0.23	5.8	0.02	0.5	3.1	4.61	0.22	20.4
8	8.36	212.3	8.84	224.5	0.24	6.1	0.02	0.5	4.3	6.40	0.38	35.4
10	10.36	263.1	10.93	277.6	0.28	7.1	0.02	0.5	6.0	8.93	0.59	54.4
12	12.28	311.9	12.92	328.2	0.32	8.0	0.02	0.5	8.3	12.35	0.82	76.5
14	14.04	356.6	14.74	374.4	0.35	8.9	0.02	0.5	10.5	15.63	1.08	99.9
16	16.04	407.4	16.82	427.2	0.39	9.9	0.02	0.5	13.3	19.79	1.40	130.3
18	17.83	452.8	18.68	474.5	0.43	10.9	0.02	0.5	16.1	23.96	1.73	161.1
20	19.83	503.6	20.77	527.6	0.47	11.9	0.02	0.5	19.6	29.17	2.15	199.4
24	23.84	605.5	24.94	633.5	0.55	14.0	0.02	0.5	27.9	41.52	3.10	288.0

#### GREEN THREAD 250

Nominal Pipe Size (In)	Nominal I.D.		Nominal O.D.		Nominal Wall Thickness		Nominal Liner Thickness		Nominal Weight		Capacity	
	(In)	(mm)	(In)	(mm)	(In)	(mm)	(In)	(mm)	(Lbs/Ft)	(kg/m)	(Ft³/Ft)	(L/m)
1	1.00	25.0	1.33	34.0	0.16	4.2	0.02	0.5	0.4	0.59	0.005	0.51
1 ½	1.50	38.1	1.96	49.8	0.21	5.4	0.02	0.5	0.8	1.19	0.012	1.14
2	2.15	54.6	2.51	63.7	0.19	4.7	0.02	0.5	0.9	1.34	0.03	2.3
3	3.28	83.3	3.66	93.0	0.19	4.8	0.02	0.5	1.4	2.08	0.06	5.5
4	4.28	108.7	4.66	118.4	0.19	4.8	0.02	0.5	1.8	2.68	0.10	9.3
6	6.35	161.3	6.80	172.7	0.23	5.8	0.02	0.5	3.1	4.61	0.22	20.4
8	8.36	212.3	8.95	227.3	0.30	7.6	0.02	0.5	5.3	7.89	0.38	35.4
10	10.36	263.1	11.06	280.9	0.35	8.9	0.02	0.5	7.8	11.61	0.59	54.4
12	12.28	311.9	13.09	332.5	0.41	10.4	0.02	0.5	10.7	15.92	0.82	76.5
14	14.04	356.6	14.94	379.5	0.46	11.7	0.02	0.5	13.7	20.39	1.08	99.9
16	16.04	407.4	17.07	433.6	0.52	13.2	0.02	0.5	17.6	26.19	1.40	130.3
18	17.83	452.8	18.96	481.6	0.57	14.5	0.02	0.5	21.5	32.00	1.73	161.1
20	19.83	503.6	21.08	535.4	0.62	15.7	0.02	0.5	26.3	39.14	2.15	199.4
24	23.84	605.5	25.31	642.9	0.74	18.8	0.02	0.5	37.5	55.81	3.10	288.0

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

## ENGINEERING DATA

### GREEN THREAD 175, 175-C

Nominal Pipe Size		Fiber Glass Systems Pressure Rating		UKOAA/DEP Nom. Pressure Rating <sup>(1)</sup>		Vacuum/External Pressure @ Ambient Temperature <sup>(2)</sup>			
						Ultimate Collapse Pressure		Rated Pressure	
(In)	(mm)	(psig)	(bar)	(psig)	(bar)	(psig)	(bar)	(psig)	(bar)
2	50	175	12	1180	81	>1700	>117	>563	>38.8
3	80	175	12	851	59	855	59.0	210	14.5
4	100	175	12	660	45	305	21.0	96	6.6
6	150	175	12	550	38	175	12.1	55	3.8
8	200	175	12	435	30	85	5.9	28	1.9
10	250	175	12	426	29	80	5.5	26	1.8
12	300	175	12	400	28	75	5.2	24	1.7
14	350	175	12	400	28	75	5.2	23	1.6
16	400	175	12	400	28	70	4.8	23	1.6
18	450	175	12	400	28	70	4.8	22	1.5
20	500	175	12	400	28	70	4.8	22	1.5
24	600	175	12	400	28	70	4.8	22	1.5

### GREEN THREAD 250, 250-C, 250-F, 250-CF

Nominal Pipe Size		Fiber Glass Systems Pressure Rating		UKOAA/DEP Nom. Pressure Rating <sup>(1)</sup>		Vacuum/External Pressure @ Ambient Temperature <sup>(2)</sup>			
						Ultimate Collapse Pressure		Rated Pressure	
(In)	(mm)	(psig)	(bar)	(psig)	(bar)	(psig)	(bar)	(psig)	(bar)
1	25	250	18	2400	167	>3000	>210	>1000	>70
1½	40	250	18	1960	135	>3000	>210	>1000	>70
2	50	250	18	1180	81	>1700	>117	>563	>38.8
3	80	250	18	851	59	855	59.0	210	14.5
4	100	250	18	660	45	305	21.0	96	6.6
6	150	250	18	550	38	175	12.1	55	3.8
8	200	250	18	550	38	175	12.1	55	3.8
10	250	250	18	550	38	175	12.1	55	3.8
12	300	250	18	550	38	175	12.1	55	3.8
14	350	250	18	550	38	175	12.1	55	3.8
16	400	250	18	550	38	175	12.1	55	3.8
18	450	250	18	550	38	175	12.1	55	3.8
20	500	250	18	550	38	175	12.1	55	3.8
24	600	250	18	550	38	175	12.1	55	3.8

(1) Piping Design per DEP13.40.10.19-Dec. 1998/UKOAA Calculated at 200°F for a 25 year design live.

(2) Long term rating incorporating the DEP Safety Factor of 3.0

For properties of products larger than 24", contact the manufacturer.

# MARINE-OFFSHORE Piping Systems

## Typical Physical Properties

Property	Value (psi)		Value (MPa)	
	@ 75°F	@ 200°F	@ 24°C	@ 93°C
Axial Tensile - ASTM D2105				
Ultimate Stress	10,550	7,680	71	52.9
Design Stress	2,637	1,920	17.8	13.2
Modulus of Elasticity	1.61 x 10 <sup>6</sup>	1.16 x 10 <sup>6</sup>	12411	7997
Poisson's Ratio	0.38		0.38	
Axial Compression - ASTM D695				
Ultimate Stress	33,300	20,383	230.0	140.5
Design Stress	8,300	5,090	57.4	35.1
Modulus of Elasticity	1.26 x 10 <sup>6</sup>	0.66 x 10 <sup>6</sup>	8687	4550
Beam Bending - ASTM D2925				
Ultimate Stress	23,000	17,166	159	118.3
Design Stress <sup>(1)</sup>	2,900	2,145	20.0	14.8
Modulus of Elasticity (long-term)	2.18 x 10 <sup>6</sup>	1.29 x 10 <sup>6</sup>	15031	8894
Hydrostatic Burst - ASTM D1599				
Ultimate Hoop Tensile Stress	46,300	47,990	319	330
Hydrostatic Design - ASTM D2992				
Procedure A - Hoop Tensile Stress Cyclic 150 x 10 <sup>6</sup> Cycles LTHS	8,850	6,090	61.0	41.9
Procedure B - Hoop Tensile Stress LTHS Static 20 Year Life at 200°F LCL		16,945 14,654		116.8 101.0
Coefficient of Linear Thermal Expansion ASTM D696	1.26 x 10 <sup>-5</sup> in/in/°F		2.27 x 10 <sup>-5</sup> mm/mm/°C	
Thermal Conductivity	0.23 BTU/(ft)(hr)(°F)		0.4 W/(m)(°C)	
Specific Gravity - ASTM D792	1.8		1.8	
Flow Factor - SF Hazen-Williams Coefficient	150		150	

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

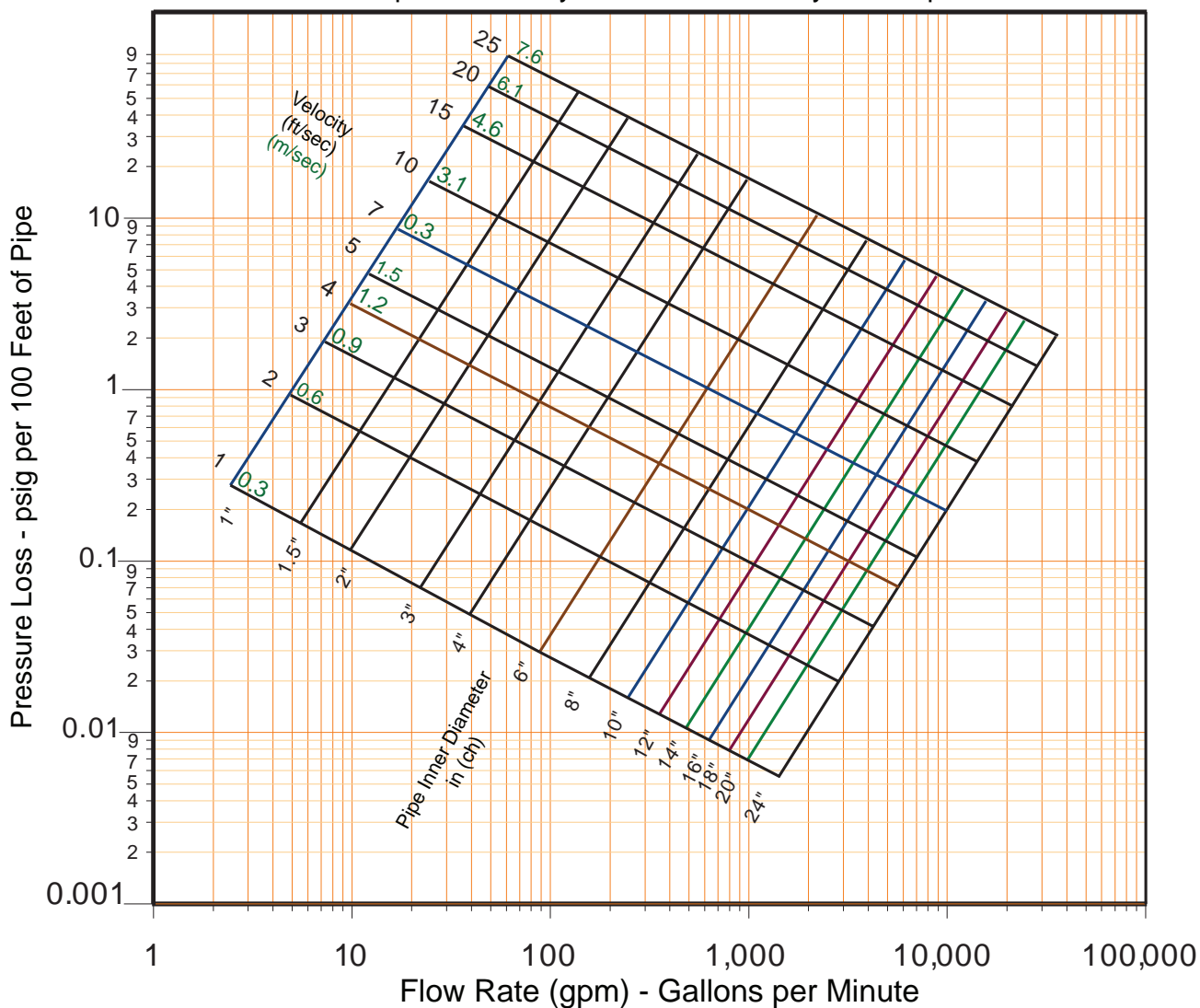
## Properties of Pipe Sections based on Minimum Reinforced Wall

Pipe Size	Minimum Cross Sectional Area (In <sup>2</sup> )				Minimum Moment of Inertia (In <sup>4</sup> )			
	GREEN THREAD 175		GREEN THREAD 250		GREEN THREAD 175		GREEN THREAD 250	
(In)	(In <sup>2</sup> )	(mm <sup>2</sup> )	(In <sup>2</sup> )	(mm <sup>2</sup> )	(In <sup>4</sup> )	(mm <sup>4</sup> x10 <sup>5</sup> )	(In <sup>4</sup> )	(mm <sup>4</sup> x10 <sup>5</sup> )
1	All 1"-6" pipe is supplied as GT250 and is utilized in all GT175 applications.		0.5	303	All 1"-6" pipe is supplied as GT250 and is utilized in all GT 175 applications.		0.08	0.34
1½			0.9	592			0.34	1.41
2			1.0	666			0.7	2.93
3			1.6	1052			2.5	10.2
4			2.1	1355			5.3	21.9
6			3.7	2387			19.9	82.8
8	5.2	3368	6.5	4168	48.2	201	60.3	251
10	7.6	4923	9.7	6258	108	449	139	577
12	10.2	6581	13.4	8645	203	845	269	1120
14	13.1	8452	17.3	11161	337	1400	452	1880
16	16.7	10774	22.4	14452	563	2340	763	3180
18	20.3	13097	27.4	17677	845	3520	1,155	4810
20	24.8	16000	33.7	21742	1,276	5310	1,755	7300
24	35.5	22903	48.2	31097	2,633	11000	3,623	15100

# MARINE-OFFSHORE Piping Systems

## GREEN THREAD 175 & GREEN THREAD 250 Pipe Pressure Loss Curves for Water

Basis: Specific Gravity of 1.0 and Viscosity of 1.0 cps



### Metric Conversions

1 gal/min = 3.785412 L/min  
 1 psig/100 ft = 0.226206 bar/100m

### ASTM D2996 Designation Codes

1" - 1 1/2" RTRP-11FF1-3111  
 2" - 8" RTRP-11FF1-3112  
 10" RTRP-11FF1-3114  
 12" - 24" RTRP-11FF1-3116

Available Pipe Lengths*					
		Americas		Asia	
(in)	(mm)	(ft)	(m)	(ft)	(m)
1	25	18, 13	5.5, 4.0	13	4.0
1.5	40	18, 14	5.5, 4.3	14, 28.25	4.3, 8.6
2-12	50-300	19.25, 39.5	5.9, 12.0	28.25	8.6
14-16	350-400	19.25, 39.0	5.9, 11.9	27.5	8.4
18-24	450-600	19.25, 39.5	5.9, 12.0	24.0	7.3

\*Lengths are not necessarily exact unless specified on order.

# MARINE-OFFSHORE Piping Systems

## 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 @ 75°F & 200°F

Pipe Size		70°F				200°F			
		GREEN THREAD 175		GREEN THREAD 250/250-F		GREEN THREAD 175		GREEN THREAD 250/250-F	
(In.)	(mm)	(ft.)	(m)	(ft.)	(m)	(ft.)	(m)	(ft.)	(m)
1	25	All 1"-6" pipe is supplied as GT250 and is utilized in all GT 175 applications.		12.8	3.9	All 1"-6" pipe is supplied as GT250 and is utilized in all GT175 applications.		11.2	3.4
1½	40			15.2	4.6			13.3	4.1
2	50			16.2	5.0			14.2	4.3
3	80			18.6	5.7			16.3	5.0
4	100			20.0	6.1			17.5	5.3
6	150			23.1	7.0			20.2	6.2
8	200	25.4	7.7	26.6	8.1	22.3	6.8	23.4	7.1
10	250	28.0	8.5	29.5	9.0	24.5	7.5	25.9	7.9
12	300	30.1	9.2	32.0	9.8	26.4	8.1	28.1	8.6
14	350	32.0	9.8	34.1	10.4	28.1	8.6	29.9	9.1
16	400	34.1	10.4	36.4	11.1	29.9	9.1	31.9	9.7
18	450	35.8	10.9	38.3	11.7	31.4	9.6	33.6	10.2
20	500	37.7	11.5	40.4	12.3	33.1	10.1	35.4	10.8
24	600	41.2	12.6	44.2	13.5	36.1	11.0	38.7	11.8



# MARINE-OFFSHORE Piping Systems

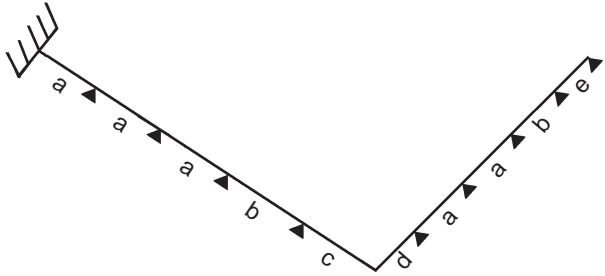
## Support Spacing vs. Specific Gravity

<b>Specific Gravity</b>	2.00	1.50	1.25	1.00	0.75
<b>Multiplier</b>	0.85	0.92	0.95	1.00	1.07

Example: 6" GREEN THREAD 175 pipe @ 200°F with 1.5 specific gravity fluid, maximum support spacing = 20.3 x 0.92 = 18.7 ft.

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

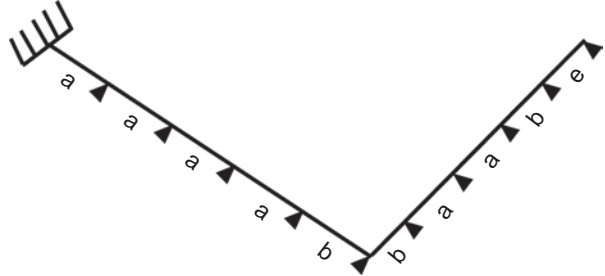
	Span Type	Factor
a	Continuous interior or fixed end spans	1.00
b	Second span from simple supported end or unsupported fitting	0.80
c + d	Sum of unsupported spans at fitting	≤ 0.75*
e	Simple supported end span	0.67



\* 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 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.

# MARINE-OFFSHORE Piping Systems

## BRANCHING TABLES

### GREEN THREAD 175

#### Main Line

Branch Diameter	Main Line													
	2	3	4	6	8	10	12	14	16	18	20	24	30	36
2	T	RT	RT	ORT	ORT	O	O	O	O	O	O	O	O	O
3		T	RT	RT	ORT	O	O	O	O	O	O	O	O	O
4			T	RT	RT	ORT	O	O	O	O	O	O	O	O
6				T	RT	RT	ORT	O	O	O	O	O	O	O
8					T	RT	RT	RT	RT	RT	RT	RT	RT	RT
10						T	RT	RT	RT	RT	RT	RT	RT	RT
12							T	RT	RT	RT	RT	RT	RT	RT
14								T	RT	RT	RT	RT	RT	RT
16									T	RT	RT	RT	RT	RT
18										T	RT	RT	RT	RT
20											T	RT	RT	RT
24												T	RT	RT

### GREEN THREAD 250

#### Main Line

Branch Diameter	Main Line													
	2	3	4	6	8	10	12	14	16	18	20	24	30	36
1	RT	ORT	ORT	ORT	ORT	O	O	O	O	O	O	O	O	O
1 1/2	RT	RT	ORT	ORT	ORT	O	O	O	O	O	O	O	O	O
2	T	RT	RT	ORT	ORT	O	O	O	O	O	O	O	O	O
3		T	RT	RT	ORT	O	O	O	O	O	O	O	O	O
4			T	RT	RT	ORT	ORT	ORT	ORT	ORT	ORT	ORT	ORT	ORT
6				T	RT	RT	RT	RT	RT	RT	RT	RT	RT	RT
8					T	RT	RT	RT	RT	RT	RT	RT	RT	RT
10						T	RT	RT	RT	RT	RT	RT	RT	RT
12							T	RT	RT	RT	RT	RT	RT	RT
14								T	RT	RT	RT	RT	RT	RT
16									T	RT	RT	RT	RT	RT
18										T	RT	RT	RT	RT
20											T	RT	RT	RT
24												T	RT	RT

T - Equal Tee

RT - Reducing Tee

O - Outlet Saddle

ORT - Outlet Saddle or Reducing Tee

## TESTING

Hydrostatic testing should be performed to evaluate the structural integrity of a new piping system installation. Experience has shown that testing to 1.5 times the anticipated maximum operating pressure of a system provides a high degree of confidence in the piping system. In no case should the test pressure exceed 1.5 times the maximum pressure rating of any component in the piping system.

Testing should not be undertaken until all permanent supports, anchors and guides are properly installed according to the engineering design specifications. Do not attempt to pressure test a system supported by ropes, wooden blocks or other temporary support apparatus.

When hydro testing open vents to prevent entrapment

of air in lines as the system is slowly filled with water. Then the vents should be closed and the system slowly pressurized to the test pressure. Allow the system to stabilize for 15-30 minutes, then, inspect the system for leaks. Upon completion of hydro test, relieve the pressure on the system slowly, open vents and any drains to allow for complete drainage of the system. If a flange connection leak occurs do not attempt to re-torque bolts while the system is pressurized. The hydro test should be repeated after any re-work is performed.

Examples of other test procedures are discussed in the Fiber Glass Systems Marine-Offshore Pipe Installation Handbook, Manual No. F6300.

## 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<sup>(1)</sup>**

Nominal Pipe Size (In)	Constants	
	GREEN THREAD 175	GREEN THREAD 250
1	-	45
1½	-	44
2	37	37
3	33	33
4	29	29
6	27	27
8	25	27
10	24	27
12	24	27
14	24	27
16	23	27
18	23	27
20	24	27
24	23	27

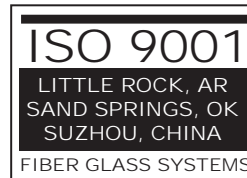
<sup>(1)</sup>Constants are valid for water at 75°F.



# MARINE-OFFSHORE Piping Systems



Germanischer Lloyd



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