Green Thread™ HP 32
(Product Data)

CHEMICAL & INDUSTRIAL

Applications

- Chemical Processing Liquids
- Food Processing Liquids
- Potable Water
- Cooling Water
- Condensate Return
- Industrial Wastewater
- Mildly Corrosive Liquids
- Crude Oil & Gas
- Produced Water
- Saltwater
- CO_2

Materials and Construction

All pipe manufactured by filament winding process using amine-cured epoxy thermosetting resin to impregnate strands of continuous glass filaments. Pipe wall includes a minimum 0.020” (0.50 mm) resin-rich corrosion barrier (liner).

Pipe is available in 2”-16” (50-400 mm) diameters with static pressure ratings of 464 psig (32 bar). The pipe and fittings are designed for continuous operation at 200°F (93°C) serviceable up to 230°F (110°C) by applying a derating factor of 0.76 to all component ratings. Pipe diameters of 1”-6” (25-150 mm) are available in 20’ (6 m) random lengths and the 8”-16” (200- 400 mm) diameters are in 19’ or 39’ (6 or 12 m) random lengths.

ASTM D-2996 Classification: RTRP - 11FX1-3110 for static design basis.

Fittings

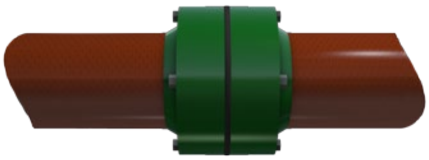
Fittings are filament wound with the same chemical, temperature and pressure capabilities as the pipe. Reference document CI1370 for fitting dimensions. 2”-12” (50-300 mm) fittings use HP 40 dimensions. 14” and 16” (350-400 mm) fittings use HP 32 dimensions.

Joining System

- **Bell & Spigot** - Matched-taper joint secured with epoxy adhesive. Self-locking feature resists movement, facilitating joining runs of pipe without waiting for adhesive to cure.
- **Flanged** - Available for all piping systems and diameters; factory assembled or shipped loose for assembly in the field.

View of Joint Illustrations

Bell & Spigot



Flanged

Nominal Dimensional Data

Pipe Size		Inside Diameter		Outside Diameter		Minimum Reinforced Wall Thickness		Weight[2]	
in	mm	in	mm	in	mm	in	mm	lbs/ft	kg/m
2	50	2.15	55	2.34	59	0.075	1.91	0.60	0.89
3	80	3.28	83	3.49	87	0.084	2.13	0.91	1.35
4	100	4.28	109	4.54	115	0.109	2.77	1.50	2.23
6	150	6.35	161	6.71	170	0.161	4.09	3.10	4.61
8	200	8.36	212	8.83	224	0.212	5.39	5.60	8.33
10	250	10.36	263	10.93	277	0.262	6.66	8.4	12.50
12	300	12.29	312	12.95	329	0.311	7.90	12.3	18.30
14	350	14.04	356	14.79	377	0.355	9.02	15.2	22.62
16	400	16.04	407	16.90	429	0.405	10.29	20.1	29.91

[2] Based on the minimum wall.

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 following tables were developed to ensure a design that limits beam mid-span deflection to ½ inch to ensure good appearance and adequate drainage. 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.

Support Spacing vs. Specific Gravity

Specific Gravity	2.00	1.50	1.25	1.00	0.75
Multiplier	0.86	0.92	0.96	1.00	1.06

Example: 8” pipe @ 75°F (23.9°C) with 1.5 specific gravity fluid, maximum support spacing = 26.9 x 0.92 = 24.7 ft.

Maximum Support Spacing for Uninsulated Pipe[1]

Size		Continuous Spans of Pipe[2]			
		feet		meters	
in	mm	75°F	200°F	24°C	93°C
2	50	14.7	10.6	4.48	3.23
3	80	16.9	12.2	5.15	3.72
4	100	19.3	14.0	5.88	4.27
6	150	23.5	17.0	7.16	5.18
8	200	26.9	19.5	8.20	5.94
10	250	30.0	21.7	9.14	6.62
12	300	32.5	23.7	9.92	7.19
14	350	34.9	25.3	10.64	7.71
16	400	37.4	27.1	11.40	8.26

[1] For Sg=1.0, consult manufacturer for heavier insulated pipe support spans. Span recommendations include no provision for weight of (fittings, valves, etc.) or thrusts at branches and turns. Heavy valves and other appurtenances must be supported separately.

[2] Calculated spans are based on ½” mid-span deflections to ensure good appearance and adequate drainage. Total system stresses should always be taken into account by the system design engineer when determining support spans.

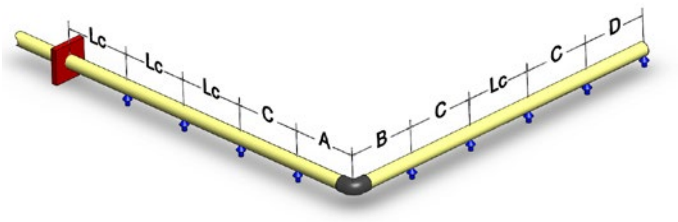
There are seven basic guidelines to follow when designing an above ground piping system:

1. Do not exceed the recommended support span.
2. Support heavy valves and in-line equipment independently.
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 loading to minimize bending stresses on pipe and fittings.
7. Provide adequate axial and lateral restraint to ensure line stability during rapid changes in flow (water hammer).

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

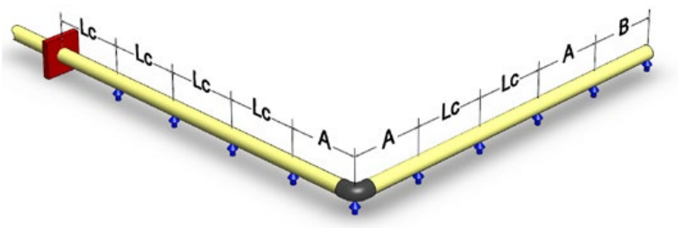
	Span Type	Factor
Lc	Continuous interior or fixed end spans	1.00
C	Second span from supported end or unsupported fitting	0.80
A+B	Sum of unsupported spans at fitting	≤0.75*
D	Simple supported end span	0.67

*For example: If continuous support is 10 ft. (3.04 m), A+B must not exceed 7.5 ft.(2.28 m) (A=3 ft. (0.91 m) and B=4.5 ft. (1.37 m)) would satisfy this condition.



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

	Span Type	Factor
Lc	Continuous interior or fixed end spans	1.00
A	Second span from simple supported end or unsupported fitting	0.80
B	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 NOV Fiber Glass Systems' Engineering and Piping Design Guide, Section 3.

Change in Temperature		Pipe Change in Length	
°F	°C	in/100 ft	cm/100 m
25	13.9	0.41	3.45
50	27.8	0.83	6.90
75	41.7	1.24	10.35
100	55.6	1.66	13.80

Testing

Hydrostatic testing is recommended to evaluate the integrity of all new piping installations. For systems operating below the system rating, a test pressure of 1.5 times the system operating pressure is recommended; however, the maximum test pressure must not exceed 1.3 times the lowest pressure rated fiberglass component in the piping system.

The hydro test pressure should be repeated up to ten cycles from 0 psig to the test pressure to provide a high degree of confidence in the piping system. The final pressurization cycle should be allowed to stabilize for 15-30 minutes, then inspected for leaks. Do not attempt to repair leaks while system is pressurized. The hydro test should be repeated after any re-work is performed.

When hydro testing, open high-point vents (if used) to prevent entrapment of air in the lines as the system is slowly filled with water, then close the vents and slowly pressurize to the test pressure. 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.

Water Hammer

Piping systems may be damaged by pressure surges due to water hammer. The use of soft start pumps and slow actuating valves will reduce the magnitude of surge pressures during operation and are highly recommended.

Typical Mechanical Properties

Pipe Property		75°F	24°C	200°F	93°C	Method
		psi	MPa	psi	MPa	
Axial Tensile						
Ultimate Stress		9,530	65.7	6,585	45.4	ASTM D2105
Modulus of Elasticity		1.68×10^6	11,584	1.42×10^6	9,791	ASTM D2105
Poisson's Ratio, ν_{ah} (ν_{ha})[1]		0.35 (0.61)				
Axial Compression						
Ultimate Stress		12,510	86.3	8,560	59.0	ASTM D695
Modulus of Elasticity		0.677×10^6	4,668	0.379×10^6	2,613	ASTM D695
Beam Bending						
Modulus of Elasticity (Long Term)		2.6×10^6	17,927	0.718×10^6	4.951	ASTM D2925
Hydrostatic Burst						
Ultimate Hoop Tensile Stress		40,150	277	36,480	252	ASTM D1599
Hydrostatic Hoop Design Stress						
Static 20 Year Life	LTHS - 95% LCL	-	-	20,787 - 17,155	143.3 - 118.3	ASTM D2992 - Procedure B
Static 50 Year Life	LTHS - 95% LCL	-	-	19,057 - 15,302	131.4 - 105.5	ASTM D2992 - Procedure B
Parallel Plate						
Hoop Modulus of Elasticity		3.02×10^6	20,822	-	-	ASTM D2412
Shear Modulus		1.76×10^6	12,135	1.63×10^6	11,240	-

Typical Physical Properties

Pipe Property	Value	Value	Method
Thermal Conductivity	0.23 BTU/hr•ft•°F	0.4 W/m°C	ASTM D177
Thermal Expansion	13.8×10^{-6} in/in °F	24.8×10^{-6} mm/mm °C	ASTM D696
Absolute Roughness	0.00021 in	0.00053 mm	
Specific Gravity	1.8		ASTM D792

[1] ν_{ha} = The ratio of axial strain to hoop strain resulting from stress in the hoop direction.
ν_{ah} = The ratio of hoop strain to axial strain resulting from stress in the axial direction.

[2] The differential pressure between internal and external pressure which causes collapse.

[3] A 0.67 design factor is recommended for short duration vacuum service. A full vacuum is equal to 14.7 psig (0.101 MPa) differential pressure at sea level.

[4] A 0.33 design factor is recommended for sustained (long-term) differential collapse pressure design and operation.

Ultimate Collapse Pressure

Size		Collapse Pressure[2,3,4]			
		psig		MPa	
in	mm	75°F	200°F	24°C	93°C
2	50	330	250	2.28	1.72
3	80	160	120	1.10	0.83
4	100	160	120	1.10	0.83
6	150	160	120	1.10	0.83
8	200	160	120	1.10	0.83
10	250	160	120	1.10	0.83
12	300	160	120	1.10	0.83
14	350	160	120	1.10	0.83
16	400	160	120	1.10	0.83

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