Green Thread™ HP 25

(Product Data)

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

Pipe manufactured by filament winding process using amine-cured epoxy thermosetting resin to impregnate strands of continuous glass filaments. The pipe wall includes an internal resin-rich corrosion barrier.

Pipe is available in 1”-24” (25-600 mm) diameters with pressure ratings up to 362 psig (25 bar). The pipe and fittings have an operating temperature of 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”-24” (150 -600 mm) diameters are in 19’ or 39’ (6 or 12 m) random lengths.

ASTM D-2996 Classification:
RTRP - 11FW1-3110 for static design basis.

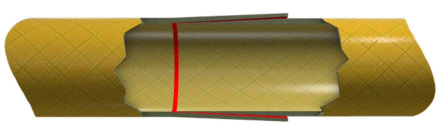
Fittings

Fittings are manufactured with the same chemical and temperature capabilities as the pipe. Depending on the particular part and size, fittings will be compression molded, contact molded, hand fabricated or filament wound. Fitting details are in document CI1360.

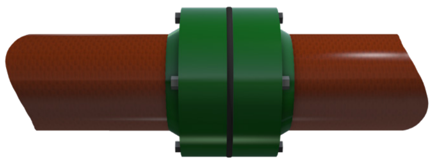
Joining System

- **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		Liner Thickness		Weight [2]	
in	mm	in	mm	in	mm	in	mm	in	mm	lbs/ft	kg/m
1[1]	25	1.19	30.2	1.34	34.0	0.057	1.45	0.015	0.38	0.3	0.4
1½[1]	40	1.76	44.7	1.91	49.0	0.062	1.57	0.015	0.38	0.4	0.6
2[1]	50	2.15	54.0	2.34	59.5	0.075	1.91	0.020	0.51	0.6	0.8
3[1]	80	3.28	83.0	3.47	88.1	0.075	1.91	0.020	0.51	0.8	1.2
4	100	4.28	109.0	4.49	114.0	0.085	2.16	0.020	0.51	1.2	1.8
6	150	6.35	161.0	6.64	169.0	0.125	3.18	0.020	0.51	2.5	3.7
8	200	8.36	212.0	8.73	222.0	0.164	4.17	0.020	0.51	4.2	6.3
10	250	10.36	263.0	10.81	275.0	0.203	5.16	0.020	0.51	6.3	9.4
12	300	12.29	312.0	12.89	327.0	0.240	6.10	0.020	0.51	8.7	13.0
14	350	14.04	367.0	14.63	372.0	0.274	6.96	0.020	0.51	11.3	16.8
16	400	16.04	407.0	16.71	424.0	0.313	7.95	0.020	0.51	14.6	21.7
18	450	17.82	453.0	18.55	471.0	0.347	8.81	0.020	0.51	17.9	26.6
20	500	19.83	504.0	20.64	524.0	0.386	9.80	0.020	0.51	22.1	32.9
24	600	23.83	605.0	24.80	630.0	0.464	11.80	0.020	0.51	32.0	47.6

[1] Minimum reinforced wall thickness exceeds the requirement for the 25 Bar class and may be operated up to 30 Bar (435 psi).
[2] Based on the minimum wall.
NOTE: System rating is determined by pressure ratings of fittings used in the piping system. See document CI1360 for individual fitting pressure ratings.

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	1.07

Example: 18” (450 mm) pipe @ 70°F (24°C) with 1.5 specific gravity fluid, maximum support spacing = 35.7 ft. x 0.91 = 32.5 ft.

Maximum Support Spacing for Pipe[1]

Size		Continuous Spans of Pipe[2]			
		feet		meters	
in	mm	70°F	200°F	21.1°C	93.3°C
1	25	11.3	10.1	3.44	3.07
1 ½	40	12.8	11.4	3.92	3.50
2	50	14.1	12.6	4.32	3.86
3	80	15.9	14.2	4.85	4.33
4	100	17.6	15.7	5.37	4.79
6	150	21.4	19.1	6.53	5.83
8	200	24.5	21.9	7.48	6.68
10	250	27.3	24.3	8.32	7.43
12	300	29.7	26.5	9.06	8.09
14	350	31.7	28.3	9.68	8.64
16	400	33.9	30.3	10.3	9.24
18	450	35.7	31.9	10.9	9.73
20	500	37.7	33.6	11.5	10.2
24	600	41.3	36.9	12.6	11.2

[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.

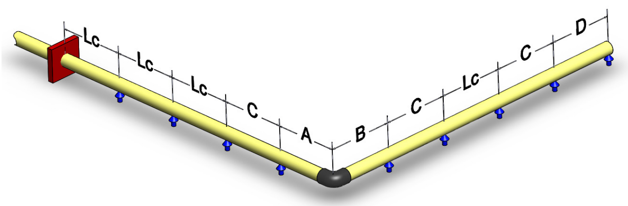
There are seven basic guidelines to follow when designing an above ground piping system:

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

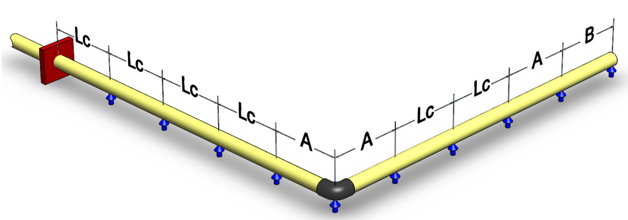
	Span Type	Factor
Lc	Continuous interior or fixed end spans	1.00
C	Second span from supported end or unsupported fitting	0.80
A+B	Sum of unsupported spans at fitting	≤0.75*
D	Simple supported end span	0.67

*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.

Temperature Change		Pipe Length Change	
°F	°C	in/100 ft	cm/100 m
25	13.9	0.36	3.0
50	27.8	0.72	6.0
75	41.7	1.08	9.0
100	55.6	1.44	12.0

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		70°F	21°C	150°F	65°C	200°F	93°C	Method
		psi	MPa	psi	MPa	psi	MPa	
Hydrostatic Design Basis	(LTHS)	23,400[1]	161[1]	23,400	161	17,500	121	ASTM D2992, Proc. B (20 yrs)
	(LCL)	20,900[1]	144[1]	20,900	144	15,800	109	
Ultimate Hoop Stress at Weeping		36,000	248	45,400	313	48,400	334	ASTM D1599

Circumferential

Hoop Tensile Modulus	3.84×10^6	26,500	2.86×10^6	19,700	2.25×10^6	15,500	NOV FGS
Poisson's Ratio ν_{ha}	0.61		0.73		0.80		NOV FGS

Longitudinal

Axial tensile strength	11,600	80	10,100	70	9,200	63.4	ASTM D2105
Axial Modulus	2.24×10^6	15,500	1.53×10^6	11,200	1.24×10^6	8,550	ASTM D2105
Poisson's Ratio ν_{ah}	0.35		0.39		0.42		ASTM D2105
Axial Bending Strength	12,300	85	-	-	-	-	NOV FGS
Axial Bending Modulus	2.25×10^6	15,500	1.75×10^6	12,100	1.43×10^6	9,900	ASTM D2925
Shear Modulus	1.76×10^6	12,100	1.65×10^6	11,400	1.58×10^6	10,900	NOV FGS

(1) Value obtained at 150°F

(2) ν_{ha} = The ration of axial strain to hoop strain resulting from stress in the hoop direction.

(3) ν_{ah} = The ration of hoop strain to axial strain resulting from stress in the axial direction.

Typical Physical Properties

Pipe Property	Value	Value	Method
Thermal Conductivity Pipe Wall	0.19 BTU/hr·ft·°F	0.33 W/m·°C	NOV FGS
Thermal Expansion - Axial	12.0×10^{-6} in/in·°F	21.6×10^{-6} mm/mm·°C	ASTM D696
Flow Coefficient, Hazen Williams	150		-
Absolute Roughness	1.7×10^{-5} ft	5.3×10^{-6} m	-
Density	121 lbs/ft^3	1940 kg/m^3	ASTM D792
Specific Gravity	1.95		ASTM D792
Specific Heat	0.22 BTU/lb·°F	910 J/kg·°C	-

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