Red Thread™ HP16

(Product Data)

OIL & GAS

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

Red Thread HP16 pipe is manufactured by the filament winding process using aromatic amine-cured epoxy thermosetting resin to impregnate strands of continuous glass filaments. The standard pressure design basis for Red Thread HP pipe is in accordance with API 15LR, 20-year design life at 200° F. Pipe is available in pressure ratings from 232 psi to 435 psi, and serviceable to 210° F by applying a system derating factor of 0.92. Refer to brochures CI1220/CI1265/CI1235 for 20/25/35 bar pressure classes.

ASTM D-2996-17 Classification: RTRP-11AW1-3110 for static design basis.

Fittings

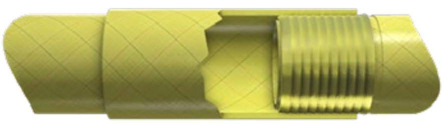
Fittings are manufactured with the same chemical and temperature capabilities as the pipe. Depending on the configurations and size, the fittings construction method will be compression molded, contact molded, fabricated or filament wound. Fittings details are in two documents. Use CI1350 for sizes 2"-16" (50-400 mm) and CI1351 for 18"-42" (450-1050 mm). All fittings may not have the same pressure rating as the pipe. System rating is governed by the lowest rated component used.

Joining System

- **T.A.B.™** - In sizes 2"-6", pipe and couplings are supplied with a threaded and bonded (T. A. B.) joining system. Double-lead threads provide quick secure adhesive connections during installation.
- **Bell & Spigot** - The pipe and fittings are joined using the bell and spigot connection. Pipe is supplied with one end belled (integral bell or factory-bonded coupling) and one end tapered in sizes 8"-42". For 8"-42" sizes, the matched tapered joining method is used and the pipe is available in random 12 meter (40 feet) lengths.

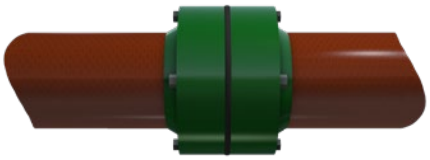
  Epoxy adhesive available from NOV Fiber Glass Systems is used to secure the joint.
- **Flanged** - Flanged connections are available for all components and diameters.

View of Joint Illustrations



T.A.B.

Bell & Spigot



Flanged

Dimensions, Ratings, Weights and Capacities

Nominal Pipe Size		Pressure Rating		Inside Diameter		Outside Diameter[2]		Minimum Reinforced Wall Thickness		Weight		Capacity	
in	mm	psi	bar	in	mm	in	mm	in	mm	lbs/ft	kg/m	gal/ft	l/m
2	50	435	30	2.24	57	2.35	60	0.058	1.47	0.4	0.54	0.20	2.5
3	80	435	30	3.36	85	3.54	90	0.086	2.18	0.8	1.20	0.46	5.7
4	100	362	25	4.36	111	4.53	115	0.083	2.11	1.0	1.52	0.78	9.7
6	150	362	25	6.41	163	6.65	169	0.122	3.10	2.2	3.21	1.68	20.9
8	200	232	16	8.36	212	8.61	219	0.127	3.23	2.9	4.35	2.85	35.4
10	250	232	16	10.36	263	10.67	271	0.156	3.96	4.5	6.62	4.38	54.4
12	300	232	16	12.28	312	12.65	321	0.185	4.70	6.3	9.31	6.16	76.4
14	350	232	16	14.03	356	14.51	369	0.238	6.05	9.2	13.70	8.03	99.7
16	400	232	16	16.03	407	16.57	421	0.272	6.91	12.0	17.90	10.50	130.0
18	450	232	16	17.82	453	18.38	467	0.277	7.04	13.6	20.20	13.00	161.0
20	500	232	16	19.83	504	20.40	518	0.286	7.26	15.6	23.30	16.00	199.0
24	600	232	16	23.83	605	24.50	622	0.334	8.48	21.9	32.60	23.20	288.0
30[1]	750	232	16	30.03	763	30.89	785	0.430	10.92	35.6	52.90	36.80	457.0
36[1]	900	232	16	36.03	915	37.05	941	0.510	12.95	50.6	75.30	53.00	658.0
42[1]	1050	232	16	42.03	1068	43.23	1098	0.600	15.24	69.4	103.00	72.10	895.0

[1] Pipe qualified for 232 psig, see fittings ratings in CI1351 for exceptions.

[2] Outer diameter based on minimum reinforced wall thickness.

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.

Support Spacing vs. Specific Gravity

Specific Gravity	2.00	1.50	1.25	1.00	0.75
Multiplier	0.85	0.91	0.95	1.00	1.06

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	13.5	12.0	4.11	3.68
3	80	16.4	14.7	5.02	4.50
4	100	17.5	15.7	5.34	4.79
6	150	21.2	19.0	6.48	5.81
8	200	23.0	20.0	7.00	6.10
10	250	25.5	22.2	7.80	6.77
12	300	27.8	24.1	8.49	7.37
14	350	30.6	27.2	9.33	8.31
16	400	32.7	29.1	9.98	8.88
18	450	33.8	29.5	10.30	9.00
20	500	35.0	30.1	10.68	9.18
24	600	38.1	32.58	11.63	9.93
30	800	43.0	36.9	13.12	11.26
36	900	47.0	40.2	14.34	12.27
42	1050	50.9	43.6	15.52	13.30

[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.

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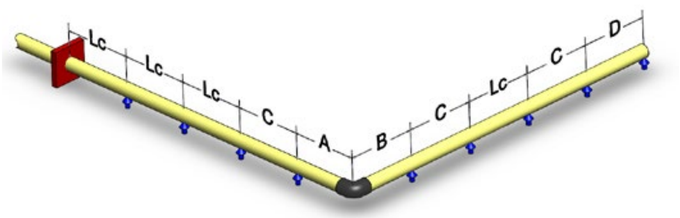
There are seven basic rules to follow when designing piping system supports, anchors, and guides:

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.

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

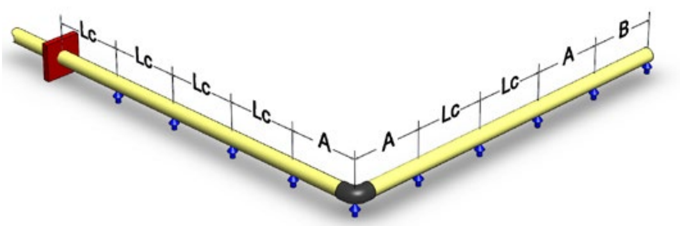
	Span Type	Factor
Lc	Continuous interior or fixed end spans	1.00
C	Second span from supported end or unsupported fitting	0.80
A+B	Sum of unsupported spans at fitting	≤0.75*
D	Simple supported end span	0.67

*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. The most common practices are listed below:

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 (ENG1000).

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,
	(LCL)	20,900[1]	144[1]	20,900	144	15,800	109	Proc. B (20 yrs)
Ultimate Hoop Stress at Weeping		36,000	248	45,000	313	48,400	334	ASTM D1599
Circumfererntial								
Hoop Tensile Modulus		3.84 x 10^6	26,500	2.86 x 10^6	19,700	2.25 x 10^6	15,500	NOV FGS
Poisson's Ratio v_{ha}		0.61		0.73		0.8		NOV FGS
Longitudinal								
Axial Tensile Strength		11,600	80	10,100	70	92,000	63.4	ASTM D2105
Axial Modulus		2.24 x 10^6	15,000	1.53 x 10^6	11,200	1.24 x 10^6	8,550	ASTM D2105
Poisson's Ratio v_{ah}		0.35		0.39		0.42		ASTM D2105
Axial Bending Strength		23,000	85	-	-	-	-	NOV FGS
Axial Bending Modulus		2.25 x 10^6	15,000	1.75 x 10^6	12,100	1.43 x 10^6	9,900	ASTM D2925
Shear Modulus		1.76 x 10^6	12,100	1.65 x 10^6	11,400	1.58 x 10^6	10,900	NOV FGS

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	12.0 x 10^{-6} in/in•°F	21.6 x 10^{-6} mm/mm•°C	ASTM D696
Flow Coefficient, Hazen Williams	150		-
Absolute Roughness	1.7 x 10^{-5} ft	5.3 x 10^{-6} m	-
Density	121 lbs/ft³	1940 kg/m³	ASTM D792

Ultimate Collapse Pressure

Size		Collapse Pressure[2,3,4]			
		psig		MPa	
In	mm	75°F	200°F	24°C	93°C
2	50	177	133	1.22	0.92
3	80	171	129	1.18	0.89
4	100	69	51	0.48	0.35
6	150	69	51	0.48	0.35
8	200	29	20	0.20	0.14
10	250	27	20	0.19	0.13
12	300	27	20	0.19	0.14
14	350	45	33	0.31	0.23
16	400	45	33	0.31	0.23
18	450	31	23	0.22	0.16
20	550	23	16	0.16	0.11
24	600	20	14	0.14	0.10
30	750	21	15	0.14	0.10
36	900	21	15	0.14	0.10
42	1050	21	15	0.14	0.10

(1) Value obtained at 150°F

(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.

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