

Red Thread™ IIA

(Product Data)



Applications

- Service Station
- Vent/Vapor Recovery
- Bulk Plant Terminals
- Fueling Terminals
- Central Fuel Oil Systems
- Marinas Terminals
- Ethanol Fuel Blends
- Biodiesel Fuel
- Diesel Exhaust Fluid
- UL/ULC Systems that require MV, HB, CT, A&M Fuels

Materials and Construction

All pipe is manufactured by filament winding process using amine-cured epoxy thermosetting resin to impregnate strands of continuous glass filaments with a resin-rich interior surface. The operating pressure of the pipe is up to 250 psig (17.2 bar) with continuous operating temperature to 150°F (66°C).

Red Thread IIA is Listed with Underwriters Laboratories Standard 971-2004 for non-metallic underground piping for motor vehicle (MV), high blend (HB), concentrated (CT) and aviation and marine (A&M) fuels. The pipe and fittings are also Listed with Underwriters Laboratories of Canada with both Listings under File MH9162.

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 and are described in FH1250.

Testing

Installed pipe systems should be tested prior to use to assure soundness of all joints and connections. Locate pressure gauge in close proximity to the pressurizing equipment, not directly on the piping system. A pressure gauge with the test pressure at mid-scale is recommended.

Joining System

- **T.A.B.™** - The primary joining method for pipe joints promoting fast, positive make-up and prevents "backout" during curing.
- **Bell & Spigot** - The primary joining method for fitting joints.

These joints assist the installer and assures a fast trouble-free installation. Adhesive for this system is Series 8000. T.A.B. spigots can be bonded into tapered bells and tapered spigots can be Bonded into T.A.B. bells using standard bonding procedures for tapered joints.

ASTM D2996 Designation Code -
RTRP-11AW13110

Nominal Dimensional Data

Pipe Size		Inside Diameter		Outside Diameter		Wall Thickness		Weight		Pressure/ Temperature Max. Rating at 150°F (66°C)		Mill Test Pressure		Minimum Bending Radius	
in	mm	in	mm	in	mm	in	mm	lbs/ft	kg/m	psig	MPa	psig	MPa	ft	m
2	50	2.238	57	2.372	60	0.067	1.70	0.42	0.63	250	1.72	375	2.59	102	31.0
3	80	3.363	85	3.559	90	0.098	2.49	0.92	1.37	175	1.21	300	2.07	153	46.5
4	100	4.364	111	4.554	116	0.095	2.41	1.15	1.71	125	0.86	265	1.83	195	59.5
6	150	6.408	163	6.686	170	0.139	3.53	2.47	3.68	20	0.14	265	1.83	287	87.4

View of Joint Illustrations



T.A.B.



Bell & Spigot

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	-	18,203 - 14,689	125.5 - 101.3	ASTM D2992 - Procedure B
Static 50 Year Life	LTHS - 95% LCL	-	16,788 - 13,142	115.7 - 90.6	ASTM D2992 - Procedure B
Parallel Plate					
Hoop Modulus of Elasticity	3.02×10^5	20,822	-	-	ASTM D2412
Shear Modulus	1.76×10^5	12,135	1.63×10^6	11,250	-

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	10.7×10^{-6} in/in °F	19.3×10^{-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	150°F	24°C	66°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

Pipe Length

Size		Standard		Random	
in	mm	ft	m	ft	m
2-6	50-150	15	4.57	22-25	6.7-7.62

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UL/ULC Listed Red Thread® II A Piping System

SPECIFICATION GUIDE

Primary Piping

SECTION 1 - Scope

This section covers the use of fiberglass reinforced plastic (FRP) pipe for single wall fuel handling and fuel handling vent and vapor applications including gasoline, unleaded gasoline, gasoline/alcohol mixtures, bio-diesel, DEF and diesel up to 150°F and 250 psig cyclic pressure.

SECTION 2 - General Conditions

2.01 Coordination - Material furnished and work performed under this section shall be coordinated with the related work and equipment specified under other sections, i.e. Valves, Flexible Connectors, Equipment.

2.02 Governing Standards - Except as modified or supplemented herein, all materials and construction methods shall comply with and be tested in accordance with the following standards and test methods:

Standards and Test Methods:

UL971 2004	Standard for Nonmetallic Underground Piping for Flammable Liquids
ASTM D2310	Standard Classification for Machine-Made "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Pipe
ASTM D2992	Standard practice for obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Pipe and Fittings

2.03 Operating Conditions - In addition to the above listed minimum design requirements, the system shall meet the following minimum operating conditions:

- a. Operating Pressure _____
- b. Fluid Conveyed _____
- c. Test Pressure _____

2.04 Quality Assurance - Pipe manufacturer's quality program shall be in compliance with ISO 9001 and/or API Q1.

2.05 Delivery, Storage, and Handling - Pipe and fittings shall be protected from damage due to impact and point loading. Pipe shall be properly supported to avoid damage due to flexural strain. The contractor shall not allow dirt, debris or other extraneous materials to get into pipe and fittings. All factory machined areas shall be protected from sunlight until installed.

2.06 Acceptable Manufacturers - NOV Fiber Glass Systems, 501-568-4010, or approved equal.

Section 3 - Material and Construction

3.01 2"-4" Pipe - The pipe shall be manufactured by the filament winding process using an amine cured epoxy thermosetting resin to impregnate strands of continuous glass filaments, which are wound around a mandrel at a 54^{3/4}" winding angle under controlled tension. The pipe shall be heat cured and the cure shall be confirmed using a Differential Scanning Calorimeter.

Pipe shall be supplied with a T.A.B.™ (Threaded and Bonded) ends.

Pipe shall have a minimum continuous cyclic pressure rating of 125 psig at 150°F in accordance with ASTM D2992, Procedure A or UL 971 pressure rating.

All pipe shall be 100% hydrotested at the factory before shipment at a minimum pressure of 265 psig and shall be UL971-2004 Listed and labeled.

3.02 ASTM D2310 Classifications (at 73.4°F)

2" - 3"	RTRP-11AF
4"	RTRP-11AH

(Mechanical properties cell classifications shown are minimums.)

3.03 Fittings - All fittings shall be manufactured using the same type of material as the pipe. Fittings may be manufactured either by compression molding, filament winding, resin transfer molding or contact molding methods. All fittings, adapter, and sump penetrations shall be UL971-2004 Listed.

Fittings shall be adhesive bonded matched tapered bell and spigot.

3.04 Connections - Connections to flex connectors or other piping materials shall be made by the use of NPT (National Pipe Thread) threaded adapters or flanges bonded to the FRP piping system.

3.05 Sump Penetrations - Sump penetrations shall be made by means of a permanently bonded FRP coupling. The coupling shall be capable of adjusting for the slope of the piping system entering or exiting the sump wall.

3.06 Adhesives - Adhesives shall be manufacturer's standard for the piping system specified.

3.07 Acceptable Products - RED THREAD IIA Piping System as manufactured by NOV Fiber Glass Systems or engineered approved equal.

SECTION 4 - Installation and Testing

4.01 Training and Certification - All joints installed or constructed in the field shall be assembled by employees of the contractor who have been trained by the pipe manufacturer. The pipe manufacturer or their authorized representative shall train the contractor's employees in the proper joining and assembling procedures required for the project, including hands-on participation by the contractor's employees. Each bonder shall fabricate one pipe-to-pipe and one pipe-to-fitting joint that shall pass the minimum pressure test for the application as stated in Section 2.03 without leaking.

Only bonders that have successfully completed the pressure test shall bond pipe and fittings. Each bonder shall carry a current manufacturer's proof of training card.

4.02 Pipe Installation - Pipe shall be installed as specified and indicated on the drawings.

The piping system shall be installed in accordance with the manufacturer's current published installation procedures.

4.03 Testing - A hydrostatic pressure test shall be conducted on the completed piping system. The piping system shall be subjected to 10 pressurization cycles from 0 psig to 1.5 times the design operating pressure as stated in Section 2.03.c. After the 10 cycles, the pressure shall be held on the system for a minimum of 1 hour and the line inspected for leaks.

Test pressures shall not exceed 1.5 times the maximum rated pressure of the lowest rated element in the system.

All pipe joints shall be water tight. All joints that are found to leak, by observation or during testing, shall be replaced by the contractor and retested.

Should hydrostatic testing be impractical, testing with low pressure air or inert gas may be acceptable. Extreme caution should be used when testing with air. Follow all safety precautions and testing recommendations of the pipe manufacturer.

Secondary Containment Piping

SECTION 1 - Scope

This section covers the use of fiberglass reinforced plastic (FRP) pipe for fuel handling and fuel handling vent and vapor applications including gasoline, unleaded gasoline, gasoline/alcohol mixtures, bio-diesel and diesel that require secondary containment.

SECTION 2 - General Conditions

2.01 Coordination - Material furnished and work performed under this section shall be coordinated with the related work and equipment specified under other sections, i.e. Valves, Flexible Connectors, Equipment.

2.02 Governing Standards - Except as modified or supplemented herein, all materials and construction methods shall comply with and be tested in accordance with the following standards and test methods:

Standards and Test Methods:

UL971 2004	Standard for Nonmetallic Underground Piping for Flammable Liquids
ASTM D2310	Standard Classification for Machine-Made "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Pipe
ASTM D2992	Standard practice for obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Pipe and Fittings

2.03 Operating Conditions - In addition to the above listed minimum design requirements, the system shall meet the following minimum operating conditions:

- a. Operating Pressure _____
- b. Fluid Conveyed _____
- c. Test Pressure _____

2.04 Quality Assurance - Pipe manufacturer's quality program shall be in compliance with ISO 9001 and/or API Q1.

2.05 Delivery, Storage, and Handling - Pipe and fittings shall be protected from damage due to impact and point loading. Pipe shall be properly supported to avoid damage due to flexural strain. The contractor shall not allow dirt, debris or other extraneous materials to get into pipe and fittings. All factory machined areas shall be protected from sunlight until installed.

2.06 Acceptable Manufacturers - NOV Fiber Glass Systems, 501-568-4010, or approved equal.

Section 3 - Material and Construction

3.01 2"-4" Primary & 3"-6" Secondary Pipe - The pipe shall be manufactured by the filament winding process using an amine cured epoxy thermosetting resin to impregnate strands of continuous glass filaments, which are wound around a mandrel at a 54³/₄" winding angle under controlled tension. The pipe shall be heat cured and the cure shall be confirmed using a Differential Scanning Calorimeter.

Pipe shall be supplied with T.A.B. (Threaded and Bonded) or plain ends.

Pipe shall have a minimum continuous cyclic pressure rating of 125 psig at 150°F in accordance with ASTM D2992, Procedure A or UL 971 pressure rating.

All pipe, both primary and secondary, shall be 100% hydrotested at the factory before shipment at a minimum pressure of 265 psig and shall be UL 971-2004 Listed and Labeled.

3.02 ASTM D2310 Classifications (at 73.4°F)

<u>Primary Pipe</u>	<u>Secondary Pipe</u>
2" - 3" RTRP-11AF	3" RTRP-11AF
4" RTRP-11AH	4" - 6" RTRP-11AH

(Mechanical properties cell classifications shown are minimums.)

3.03 Fittings - All fittings shall be manufactured using the same type of material as the pipe. Fittings may be manufactured either by compression molding, filament winding, resin transfer molding or contact molding methods. All fittings, adapter, and sump penetrations shall be UL971-2004 Listed.

Primary fittings shall be adhesive bonded, matched tapered bell and spigot and rated the same as the pipe.

Secondary containment fittings shall be two-piece style to allow for 100% inspection of the primary joint pressure test and be rated to a minimum of 50 psig per UL 971-2004.

Should hydrostatic testing be impractical, testing with low pressure air or inert gas may be acceptable. Extreme caution should be used when testing with air. Follow all safety precautions and testing recommendations of the pipe manufacturer.

3.04 Connections - Connections to flex connectors or other piping materials shall be made by the use of NPT (National Pipe Thread) threaded adapters or flanges bonded to the FRP piping system.

3.05 Sump Penetrations - Sump penetrations shall be made by means of a permanently bonded FRP coupling. The coupling shall be capable of adjusting for the slope of the piping system entering or exiting the sump wall.

3.06 Adhesives - Adhesives shall be manufacturer's standard for the piping system specified.

3.07 Acceptable Products - RED THREAD IIA Piping System as manufactured by NOV Fiber Glass Systems or engineered approved equal.

SECTION 4 - Installation and Testing

4.01 Training and Certification - All joints installed or constructed in the field shall be assembled by employees of the contractor who have been trained by the pipe manufacturer. The pipe manufacturer or their authorized representative, shall train the contractor's employees in the proper joining and assembling procedures required for the project, including hands-on participation by the contractor's employees. Each bondor shall fabricate one pipe-to-pipe and one pipe-to-fitting joint that shall pass the minimum pressure test for the application as stated in Section 2.03 without leaking.

Only bondors that have successfully completed the pressure test shall bond pipe and fittings. Each bondor shall carry a current, manufacturer proof of training card.

4.02 Pipe Installation - Pipe shall be installed as specified and indicated on the drawings.

The piping system shall be installed in accordance with the manufacturer's current published installation procedures.

4.03 Testing - A hydrostatic pressure test shall be conducted on the completed piping system. The piping system shall be subjected to 10 pressurization cycles from 0 psig to 1.5 times the design operating pressure as stated in Section 2.03.c. After the 10 cycles, the pressure shall be held on the system for a minimum of 1 hour and the line inspected for leaks.


Test pressures shall not exceed 1.5 times the maximum rated pressure of the lowest rated element in the system.

All pipe joints shall be water tight. All joints that are found to leak, by observation or during testing shall be replaced by the contractor and retested.

Should hydrostatic testing be impractical, testing with low pressure air or inert gas may be acceptable. Extreme caution should be used when testing with air. Follow all safety precautions and testing recommendations of the pipe manufacturer.

NOV Fiber Glass Systems**RED THREAD® IIA PIPE****MAX. OPERATION RATINGS
(PSIG) AT 150°F**

PIPE SIZE:	2"	3"	4"
PRIMARY:	250	175	125
SECONDARY:	-	50	50


 **PC, SC, NV, & VR PIPING
FOR MV FUELS, CT
FUELS, HB FUELS, A&M FUELS**
ISSUE NO. A-505 (Varies)
**UNDERGROUND USE ONLY
USE ONLY NOV FGS
PRODUCTS-FOLLOW B2160
INSTALLATION INSTRUCTIONS**

UL- 1-4

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NOV Fiber Glass Systems**RED THREAD® IIA PIPE****MAX. OPERATION RATINGS
(PSIG) AT 150°F**


PIPE SIZE:	2"	3"	4"
PRIMARY:	250	175	125

 **PC, NV & VR PIPING FOR
MV FUELS, CT FUELS,
HB FUELS, A&M FUELS**
ISSUE NO. A-487 (Varies)
**UNDERGROUND USE ONLY
USE ONLY NOV FGS
PRODUCTS-FOLLOW B2160
INSTALLATION INSTRUCTIONS**

UL- 2-3

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NOV Fiber Glass Systems**RED THREAD® IIA****Secondary Containment
Fittings & 6" PIPE****MAX. OPERATION RATINGS
PRESSURE 50 PSIG
FOR 3" & 4"
20 PSIG FOR 6" AT 150°F**

 **UGN - SC PIPING FOR
MV FUELS, CT FUELS,
HB FUELS, A&M FUELS**
ISSUE NO. A-499 (Varies)
**UNDERGROUND USE ONLY
USE ONLY NOV FGS
PRODUCTS-FOLLOW
B2160 INSTALLATION
INSTRUCTIONS**

UL- 3-3

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*The color of the representative labels
used on the products are as follows:*

*RED THREAD IIA Pipe and Primary
Fittings labels are yellow.*

*Secondary Containment Fittings / 6" SC
label is green.*

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NOV Fiber Glass Systems

NOV Fiber Glass Systems' Red Thread® IIA and Dualoy piping systems, which includes primary and secondary pipe, primary and secondary fittings, coaxial pipe and adhesives are **UL 971 Listed** for the following fuels:

Type A	Type B
100% Reference Fuel #2 (represents Diesel, per UL)	1% HCl
100% Fuel C (represents Unleaded Gasoline, per UL)	1% Nitric Acid
85% Fuel C / 15% MTBE	Sodium Bicarbonate (pH 10)
85% Fuel C / 15% Methanol	Sodium Hydroxide (pH 12)
70% Fuel C / 30% Ethanol	100% Toluene
100% Methanol	
100% Ethanol	
50% Fuel C / 50% Methanol	
50% Fuel C / 50% Ethanol	
100% Premium Leaded Gasoline	
100% Kerosene	

Fuels not specifically tested or UL971 Listed, but **compatible** with Red Thread IIA and Dualoy piping systems, which includes primary and secondary pipe, primary and secondary fittings, coaxial Dualoy and adhesives are as follows:

- E85 (although E85 is not specifically tested, UL did test E30, E50 and E100)
- Biodiesel (all blends)
- Aviation Gas

The 2005 UL 971 Standard, which became effective July 1, 2005, required testing for the following fuel groups:

MV Fuels - Motor Vehicle

Type A - 100% Ref. Fuel #2, 100% Fuel C, 85% Fuel C/15% MTBE, 85% "C"/15% Methanol, 70% "C"/30% Ethanol
 Type B - 1% HCl, 1% Nitric Acid, Sodium Bicarbonate (pH 10), Sodium Hydroxide (pH 12)

CT Fuels - Concentrated

Type A - 100% Methanol and 100% Ethanol
 Type B - None

HB Fuels - High Blend

Type A - 50% "C"/50% Methanol and 50% "C"/50% Ethanol
 Type B - 100% Toluene

AM Fuels - Aviation and Marine

Type A - 100% Premium Leaded Gas and 100% Kerosene
 Type B - None

The applications identified in the 2005 UL 971 Standard are as follows:

- PC** - Primary Carrier
- SC** - Secondary Containment
- NV** - Normal Vent
- VR** - Vapor Recovery

Red Thread IIA and Dualoy pipe, fittings and adhesives have been tested and UL Listed for all fuels and all applications identified in 2005 UL 971. This includes both the DW Bonded Sump Entry Fitting - termination style, and SW Bonded Sump Entry Fitting.

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