Dualoy® 3000/LCX Product Data

Applications

Rigid fiberglass coaxial fuel handling systems requiring Underwriters Laboratories Listing for integral primary and containment piping conveying the following fuels:

- Motor Vehicle (MV)
- Aviation and Marine A&M)
- High Blend (HB)
- Bio-Diesel
- Concentrated (CT)
- Diesel Exhaust Fluid

Description

Dualoy 3000/LCX rigid fiberglass coaxial piping is a cost-effective solution for contained piping systems. LCX is used for product delivery lines in underground fuel handling systems to convey fuel from the tank to the dispensers. Dualoy 3000/LCX pipe is UL Listed for use with motor vehicle (MV), high blend (HB), concentrated (CT) and aviation and marine (A&M) fuels. Based on currently known tests, NOV Fiber Glass Systems found this product to be suitable for conveying all blends of biodiesel and ethanol type fuels and the conveyance of DEF.

The LCX pipe is manufactured as an integral unit. The primary is made of chemically inert, non-permeable, fiberglass reinforced epoxy resin which is inherently resistant to deterioration due to water and microbial attack. This layer is covered with a porous layer to provide the small volume interstitial space, which facilitates rapid leak detection. Then, the containment layer, comprised of the same material as the primary, is wound over the primary and porous layers.

The containment system is installed with custom designed clamshell containment fittings. Both the primary and containment systems are bonded for long-term, reliable performance.

- Dualoy 3000/LCX containment fittings are typically bolted in place while the adhesive cures.
- Dualoy 3000/LCX reduces installation and inspection time dramatically, retaining system integrity.
- Dualoy 3000/LCX double wall design significantly improves impact resistance over single wall pipe.
- Dualoy 3000/LCX systems provide true double wall design which permits rapid communication through the interstice.

Listings and Approvals

The rigid fiberglass piping used in Dualoy 3000/LCX is Listed in the United States with Underwriters Laboratories for nonmetallic underground piping for MV, HB, CT and A&M fuels under File No. MH9162. Dualoy 3000/LCX pipe and fittings are also Listed with Underwriters Laboratories of Canada for Petroleum Products and Oxygenated Fuels (File CMH715). Underwriters Laboratories has also approved Dualoy 3000/L and Dualoy 3000/LCX for use with MTBE fluids.

Performance

Primary operating pressures to 200 psig (13.8 bar)

Continuous operating temperature to 150°F (66°C)

Containment system pressures to 50 psig (3.45 bar)

Individual system components may not have the same ratings as the pipe. Refer to the detailed product information for the specific components to determine the pressure rating for the system as a whole.

Composition

Primary pipe: Filament-wound fiberglass reinforced epoxy pipe with integral epoxy liner. When classified in accordance with ASTM D2310 and ASTM D2996, the pipe meets the following cell limits: RTRP 11CF1-5420.

Pipe containment: Filament-wound fiberglass reinforced epoxy pipe.

Interstitial space: Dry, graded glass beads secured in place with adhesive backed tape.

Fittings: Compression molded or filament-wound fiberglass reinforced epoxy primary fittings. Containment fittings are molded.

Adhesive: PSX™ •20 or PSX™ •34 ambient-cure, two-part epoxy for all services (including alcohols and MTBE).

Joining System

Primary:

Bell and spigot taper/taper adhesive-bonded joint

Containment:

Adhesive-bonded clamshell fittings. Parts are compression molded for exact fit and match. Material is identical to primary fittings and is UL Listed for all services, including use in MTBE fluids.

Pipe Lengths

Standard 20 ft. (6.1 m) random lengths 17 to 21 ft. (5.2 to 6.4 m)
and 30 ft. (9.1 m) random lengths 27 to 32 ft. (8.2 to 9.7 m)

Other lengths up to 42 ft. (12.8 m) available upon request.

Fittings

Primary	Adapters: bell x NPT male[1]	Flange stub ends[1]
	Adapters: bell x NPT female[2]	Isolation bushings[1]
	Adapters: spigot x NPT female[2]	Nipples[2]
	Adapters: spigot x NPT male[2]	Reducer bushings[1]
	45° elbows[1]	Repair couplings[1]
	90° elbows[1]	Sleeve couplings[2]
	End caps[1]	Tees[1]
	Flange rings[1]	Dispenser pan penetration fittings[1]
Containment	45° elbows[1]	Couplings[1]
	90° elbows[1]	Tees[1]
	Termination sleeves[1], [3]	

[1] Molded fitting
[2] Filament-wound fitting
[3] 2" (50 mm) available with or without test valve. 3" and 4" (80 and 100 mm) available only with test valve

Typical Pipe Dimensions and Weights

Pipe Size		Primary Pipe ID		Primary Pipe OD[1]		Primary Wall Thickness		Containment OD		Capacity		Weight	
in	mm	in	mm	in	mm	in	mm	in	mm	gal/ft	l/m	lb/ft	kg/m
2	50	2.21	56	2.37	60	0.080	2.03	2.59	66	0.20	0.76	0.90	1.34
3	80	3.32	84	3.50	89	0.085	2.16	3.70	94	0.45	1.70	1.30	1.93
4	100	4.33	110	4.50	114	0.087	2.21	4.70	119	0.77	2.92	1.74	2.59

[1] Typical outside diameters of 2"-4" (50 -100 mm) pipe are within API, ASTM and ANSI fiberglass and steel pipe dimensions.

Typical Primary Pipe Performance

Pipe Size		Pressure Rating[1]		Ultimate Internal Pressure[1]		Ultimate Collapse Pressure[2]	
in	mm	psig	MPa	psig	MPa	psig	MPa
2	50	200	2.07	1500	10.3	153	1.05
3	80	200	1.38	1000	6.9	90	0.62
4	100	175	1.21	750	5.2	39	0.27

[1] At 80°F (27°C)
[2] At 80°F (27°C) For continuous service do not exceed 75% of these values.

Fittings Pressure Performance

Pipe Size		Primary All Fittings		Containment Clamshell Fittings	
in	mm	psig	MPa	psig	kPa
2	50	200	1.38	50[1]	345
3	80	125	0.86	50[1]	345
4	100	100	0.69	20	138

[1] With reinforcing rings

For dimensions of primary fittings, consult Dualoy 3000/L Fittings Dimensions document. Pressure ratings of fittings without UL Listing are available on request.

Dualoy 3000/LCX piping systems are designed to function at temperatures ranging from -40 to 150°F (-40 to 66°C) at service pressures between -1 and 13.8 bar. Dualoy 3000/LCX pipe conforms to ASTM D2310, D2517 and D2996.

Typical Physical Properties of Primary Pipe

Pipe Property	Units	Value	ASTM
Thermal conductivity	Btu-in/(h•ft²•°F) W/m•°C	1.7 7.6	C177
Linear thermal expansion	10^{-6} in/in/°F 10^{-6} cm/cm/°C	8.5 15.3	D696
Friction factor	Hazen-Williams	150.0	—
Absolute roughness	10^{-6} ft 10^{-6}m	15.0 4.6	—
Specific gravity	—	1.81	D792
Barcol Hardness	Impressor 934-1	65.0	D2583

Typical Mechanical Properties of Primary Pipe

Pipe Property[1]	Units	Value[1]	ASTM
Tensile strength			
Longitudinal	10^3 psi MPA	35.0 241.0	D2105
Circumferential	10^3 psi MPA	70.0 483.0	D1599
Tensile modulus			
Longitudinal	10^6 psi GPa	2.5 17.2	D2105
Circumferential	10^6 psi GPa	3.8 26.2	FGSTM
Compressive strength			
Longitudinal	10^3 psi MPa	24.5 168.9	FGSTM
Compressive modulus			
Longitudinal	10^6 psi GPa	2.6 17.8	FGSTM
Cyclic	10^3 psi MPa	8.0 55.0	D2992(A)
Poisson's Ratio[2]			
ν_{xy}	—	0.16	FGSTM
ν_{yx}	—	0.17	FGSTM

(1) Based on structural wall thickness.

(2) The first subscript denotes the direction of applied stress and the second that of measured contraction
x denotes longitudinal direction.
y denotes circumferential direction.

Bending Radius

Pipe Size		Minimum Bending Radius[1]		Maximum Deflection per 20 ft Joint	Minimum Length Required for 10° Change	
in	mm	ft	m	deg	ft	m
2	50	75	23	15	13	4
3	80	100	38	9	22	7
4	100	150	46	7.5	27	8

(1) At rated pressure. Sharper bends may create excessive stress concentrations. Do not bend pipe until adhesive has cured.

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NOV Fiber Glass Systems

FH3600 September 2012

Dualoy® 3000/LCX Secondary Containment Fittings

Uses and Applications

- Service station product, vent and vapor recovery piping
- Bulk plant terminals and fueling terminals
- Central fuel oil systems
- Marinas and marine terminals (onshore only)
- All underground piping systems requiring UL or ULC Listing for MV, HB, CT and A&M fuels
- Containment piping for all of the above
- Designed for use with pressure, vacuum or hydrostatic monitoring systems

Description

Dualoy 3000/LCX systems employ a coaxial construction for the pipe wall and specially designed primary and containment fittings. The system provides a complete double-wall enclosure for all product, vent and vapor recovery lines. The "LCX" contained system has been designed for providing a compact profile and easy, fast and reliable installation. "LCX" can be installed in either parallel or series patterns, taking advantage, where possible, of the reduced cost and number of buried fittings afforded by the series pattern. See details below.

Features of Dualoy 3000/LCX containment systems include:

- Filament-wound, fiberglass-reinforced pipe with integral liner;
- Compact fittings dimensions to minimize trench excavation;
- Smooth exterior pipe surface that eliminates the need for special end preparation tools;
- Ready accessibility to and complete inspectability of primary fittings prior to closure of the containment;
- Complete testability during installation and at any time thereafter;
- Rapid joint makeup with pre-inserted nuts and ambient cure adhesive.

Listings

Dualoy 3000/LCX is Listed in the United States with Underwriters Laboratories for nonmetallic underground piping for motor vehicle (MV), high blend (HB), concentrated (CT) and aviation and marine (A&M) under File MH9162. Dualoy 3000/LCX pipe and fittings are also Listed with Underwriters' Laboratories of Canada (File CMH715)

Performance

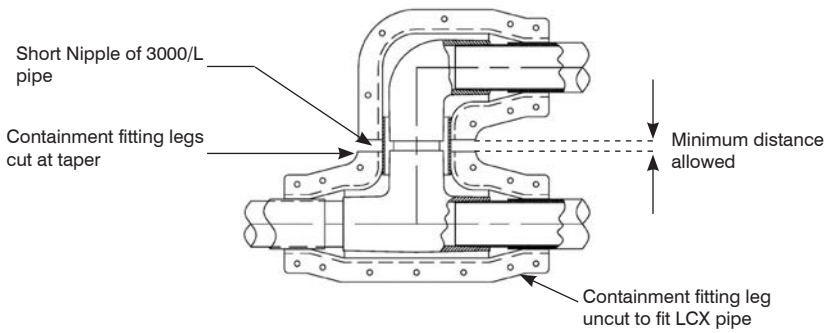
Containment pressure rated to 50 psig

Continuous operating temperatures to 150°F (66°C)

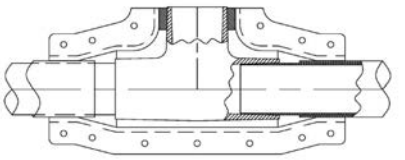
Individual system components may not have the same ratings as the pipe. Refer to the detailed product information for the specific components to determine the pressure rating for the system as a whole.

Piping System Features

Low Profile Crossovers - Dualoy 3000/LCX clamshell fittings are specifically designed to allow the minimum distance between primary fittings to be maintained when crossovers or offsets are needed. The center portion of the fitting is designed to fit the next-size-larger single wall pipe size. When distance between primary fittings is critical, simply cut off the corresponding tapered legs of the clamshell fittings and connect them with single wall pipe. (Reference dimension E on part drawings.) The distance between center lines shown in the drawing below is exactly the same as it would be for a single-wall system.

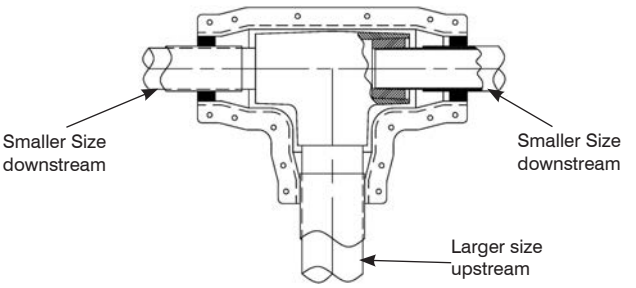


Branch Termination for Series Installation - Dualoy 3000/LCX piping can be installed in series with the pipe coming in on one side of the sump and exiting the other side. To maintain the containment continuity through the sump, the system can be configured with a termination ring on the branch of the tee or leg of an elbow. To do this, the tapered portion of the clamshell fitting leg is cut off and a termination ring is bonded between the primary fitting and the clamshell. A bushing or pipe nipple can be bonded into the primary bell as needed.



Size Reductions - For large systems where larger diameter trunk lines are used, pipe diameter reductions are easily made with the Dualoy 3000/LCX system at fittings. Single piece bushings are used in the primary fitting to reduce the primary pipe size. The containment pipe size is reduced by bonding a 2-piece reducer ring between the clamshell and the smaller pipe jacket. No cutting of clamshell fitting tapers is involved.

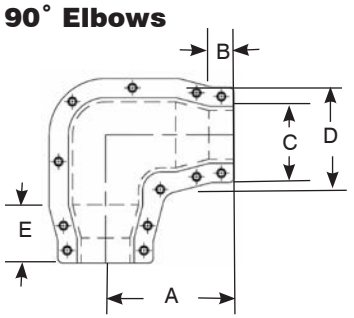
Size reduction can be done on any fitting leg or legs (as on a tee).



Continuous Monitoring - The Dualoy 3000/LCX system has exceptional performance in continuously monitored systems. Due to its small interstitial space, it is very reliable in detecting leaks in systems monitored by pressure, vacuum or hydrostatic methods. False alarms are eliminated by the lesser sensitivity to external conditions while detection capability of actual leaks is increased. Consult NOV Fiber Glass Systems Engineering for details and design of monitoring methods.

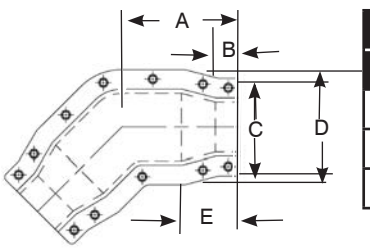
LCX Fittings Dimensions

90˚ Elbows



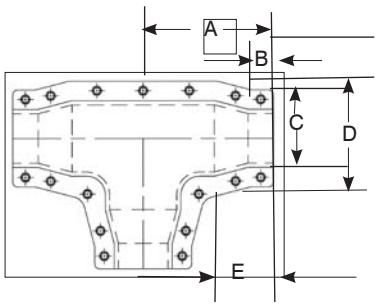
Size		A	B	C	D	E	Weight
(in)	(mm)						lbs
2	50	6.88	1.34	5.12	6.04	3.00	3.55
3	80	7.75	1.38	6.32	7.13	3.00	4.70
4	100	8.75	1.35	7.23	9.19	3.50	7.50

45˚ Elbows



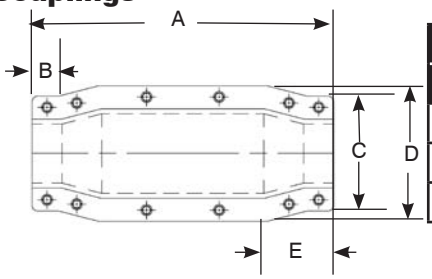
Size		A	B	C	D	E	Weight
(in)	(mm)						lbs.
2	50	6.25	1.34	5.12	6.04	3.00	3.30
3	80	6.75	1.38	6.32	7.13	3.00	4.15
4	100	7.50	1.35	7.23	9.19	3.50	6.50

Tees



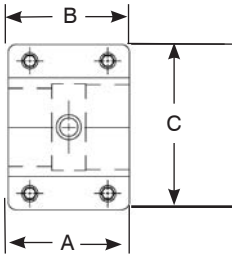
Size		A	B	C	D	E	Weight
(in)	(mm)						lbs.
2	50	6.88	1.34	5.12	6.04	3.00	4.30
3	80	7.75	1.38	6.32	7.13	3.00	6.00
4	100	8.75	1.35	7.23	9.19	3.50	9.95

Containment-Couplings



Size		A	B	C	D	E	Weight
(in)	(mm)						lbs.
2	50	13.50	1.34	5.12	6.04	3.00	3.12
3	80	12.81	1.38	6.32	7.13	3.00	2.95
4	100	12.25	1.38	7.23	9.19	3.50	3.44

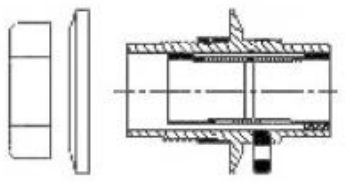
Termination



Size		A	B	C	Weight
(in)	(mm)				lbs.
2	50	3.75	1.34	5.12	1.00
3	80	3.75	1.38	6.32	1.35
4	100	3.75	1.35	7.23	1.45

Sump Penetration Fittings

Sump penetration fittings (SPF) can be used on straight sumps. Dualoy 3000/LCX pipe can pass through or be terminated at the SPF. Ends are closed by bonding half-sections of 2-inch coupling clamshells between the SPF and the pipe jacket. Shrader valves can be supplied for testing or monitoring. SPF is not open to mid-wall of double wall sump, as provided. Field drilling of SPF body near flange can be done to open interstice between SPF and pipe to sump interstice.



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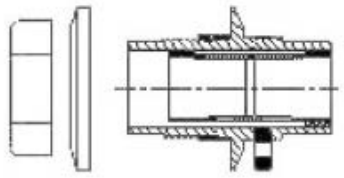
NOV Fiber Glass Systems

FH3610 - September 2012

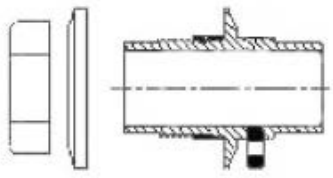
Dualoy Sump Penetration Fitting
for Secondary Containment Piping Systems

Description

The Dualoy sump penetration fitting provides a superior means of routing contained fuel handling systems through standard flat sided fiberglass tank sumps or dispenser sumps (single or double wall). The standard fitting consists of a body that mounts through the sump wall, a washer, and a threaded nut that engages from the outside to hold the assembly in place. The body of the fitting, the washer and the nut are fabricated from corrosion-resistant, chemically inert, fiberglass-reinforced epoxy resins. The inside diameter of the fitting accommodates the primary line; the outside diameter is sized to make up to the next size larger Dualoy 3000/L pipe or the same size of LCX, by use of a half coupling. The standard penetration fitting permits the annular space between the primary line and the containment to communicate with the space inside the sump, by means of a pipe nipple. The fittings can also be used with continuous monitoring systems, such as vacuum, pressure or hydrostatic sump wall, a washer, and a threaded nut that engages from the outside to hold the assembly in place. The body of the fitting, the washer and the nut are fabricated from corrosion-resistant, chemically inert, fiberglass-reinforced epoxy resins. The inside diameter of the fitting accommodates the primary line; the outside diameter is sized to make up to the next size larger Dualoy 3000/L pipe or the same size of LCX, by use of a half coupling. The standard penetration fitting permits the annular space between the primary line and the containment to communicate with the space inside of the sump, by means of a pipe nipple. The fittings can also be used with continuous monitoring systems, such as vacuum, pressure or hydrostatic.



Termination Style



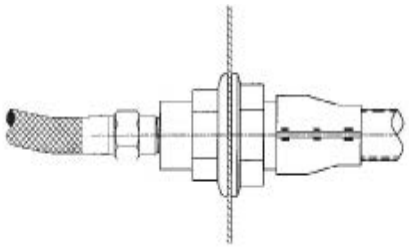
Pass-Through Style

Advantages

The Dualoy penetration fitting offers a number of benefits to both contractor and user:

- **Corrosion-resistant construction** — The standard sump penetration fitting is fabricated from chemically inert, fiberglass-reinforced epoxy resins throughout.
- **Positive, adhesive seal at riser wall** — The Dualoy penetration fitting is joined to the sump wall using PSX™ •20 epoxy adhesive and does not rely on rubber or thermoplastic grommets, cuffs or flashings to protect the inside of the riser or sump from intrusion of ground water or soil contaminants.
- **Simple installation** — The penetration can be mounted in place with the same tools used to install any Dualoy 3000/L contained piping system and a hole saw.
- **Variety of sizes** —The Dualoy sump penetration fitting is available in 2-inch, 3-inch and 4-inch sizes. These sizes designate the size of the primary pipe and the secondary pipe would be one size larger or, in the case of Dualoy 3000/LCX, the same nominal size.
- **Variety of configurations** — The Dualoy sump penetration fitting is available in two configurations:
  - The **Termination Style** fitting has a primary coupling installed in the body of the fitting. When the fitting is installed, the primary pipe is joined to this coupling from outside the sump. A threaded reducer bushing or a spigot end adapter is joined to the coupling from inside the sump. A flex connector can be attached to the bushing or adapter. Alternately, a pipe nipple can be bonded to the primary coupling inside the sump, with a primary fitting (usually a 90° elbow) bonded to the other end. A half coupling is then installed on the end outside the sump using the appropriate size to connect the containment pipe onto the outside of the fitting. A test port is provided on the fitting to allow easy testing from inside the sump.

- A second configuration involves the fitting without an internal coupling (**Pass-Through Style**). Using the proper size pipe, this allows the primary pipe or LCX coaxial pipe to travel through the fitting to a primary elbow or tee. If a tee is used, the pipe can continue on through another penetration fitting in the opposite wall of the sump (for series layouts). The secondary pipe outside the sump is again attached to the fitting using the correct half coupling. The containment can be left open inside the sump (for inspection), can be terminated at each end (to create "zones" in the containment) or can be continuous through the sump.



Assembly of Termination Style Fittimg with Flex Connector

Tapered Alignment Rings

The Dualoy sump penetration fittings are designed to be installed with 3000/L or LCX pipe at a 90° angle from the existing sump wall. Installation of the system should begin at each sump with length and fit adjustments made in the "middle" of the pipe run. If for any reason the pipe cannot maintain a 90° angle, or a slope beyond the flexibility of the pipe wall is needed, NOV Fiber Glass Systems has tapered alignment rings available. These rings, used in pairs, will adjust the angle of the penetration fitting and allow for up to 5° articulation of the fitting and pipe. The rings are fiberglass and are installed using standard adhesive.

Sump Penetration Fittings Part Numbers for use with	Termination Style	Pass-Through Style
2" 3000/LCX or 3" over 2" 3000/L	22856821	22856822
3"3000/LCX or 4" over 3" 3000/L	33856821	33856822
4" 3000/LCX or 6" over 4" 3000/L	44856821	44856822

Alignment Rings Part Numbers	
3"	22359224
4"	33359224
6"	44359224

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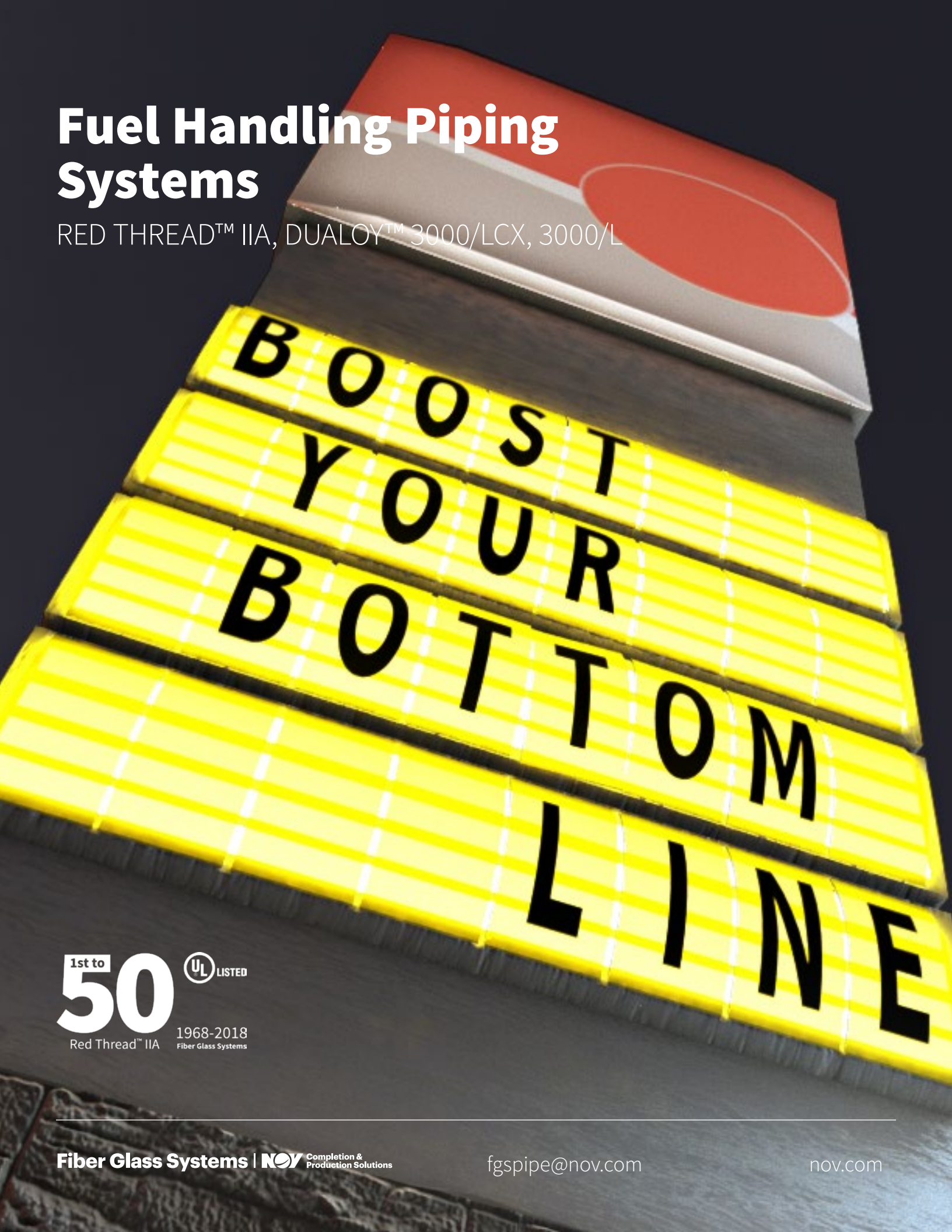
NOV Fiber Glass Systems

FH3620 - August 2012

Fuel Handling Piping Systems

RED THREAD™ IIA, DUALOY™ 3000/LCX, 3000/L



1st to 50 Red Thread™ IIA

UL LISTED

1968-2018 Fiber Glass Systems

Fiber Glass Systems | NOV Completion & Production Solutions

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Fuel Handling: The Industry Leader

Fiber Glass Systems is the leader for time-tested piping systems for underground fueling systems. We have proven our leadership with almost 50 years of continuous supply of two brands of UL Listed products for underground fuel handling. With a combined experience approaching 100 years, Red Thread IIA, Dualoy 3000/L and 3000/LCX have never been removed due to fuel incompatibility. Our products are manufactured for today's fuel blends and tomorrow's.

Lower Your Total Cost of Ownership

Our products are made with thermosetting, aromatic amine cured epoxy resin, ensuring no maintenance or replacement costs due to fuel incompatibility. In addition, our superior flow capabilities mean more flow at significantly lower pumping costs when compared to competitive products. Finally, using our Bonded Sump Entry Fitting – Termination Style helps eliminate the expense of pumping out leaking sumps, which can be substantial.

100+
Million Feet

Over 100 million feet of Red Thread IIA and Dualoy fiberglass piping systems have been installed.

2.1+
Trillion Gallons

Over 2.1 trillion gallons of gasoline and diesel have been pumped using Red Thread IIA and Dualoy fiberglass piping systems in the last 30 years

30
Year Warranty

30-year pipe warranty for both internal/ external corrosion when using our Red Thread IIA and Dualoy fiberglass piping systems.

50
Years UL LISTED

Our Red Thread IIA product line was the FIRST composite pipe to receive UL LISTED (UL 971) approval in 1968 for underground fuel handling.

HISTORY OF FIBERGLASS PIPE IN FUEL HANDLING

Fiberglass pipe was first listed by Underwriters Laboratories Inc. (UL) in 1968. The product was a welcome addition to the market due to the corrosion and thread leak problems associated with single-wall steel pipe, the incumbent material.

UL physical requirements for pressure, bending and tensile performance vs. rating have remained virtually unchanged since that time. The "chemical" requirements have changed significantly since the original draft of UL Subject 971, "Standard for Nonmetallic Underground Piping for Flammable Liquids". The original requirements of the standard allowed no measurable weight change of the product holding a variety of fuels and liquids over a 180 day period. Both of the NOV products, Red Thread IIA and Dualoy 3000/L met this requirement. Another stringent requirement passed by fiberglass pipe was the required strength retention after 270 days of total immersion (open, square-cut pieces of pipe immersed in a battery of fuels and other liquids).

Since the initial authorization to apply the Listing Mark was given, the fuel market has changed, most notably with the use of alcohol in fuel (both ethanol and methanol) and the requirement for secondary containment. Requirements for the piping have changed, also. In 1995, UL relaxed the requirements for fuel permeation (tested in terms of weight loss) and also allowed candidate products to be tested with "single-sided immersion" where the test fuel or liquid was only in contact with the interior surface of the product. With fiberglass pipe already passing the more demanding test criteria, this level of performance was easily demonstrated.

In 2004, after poor field experience with several products, UL "tightened" the requirements on permeation and instituted new criteria for dimensional stability and weight gain, and also increased the percent strength retention requirements. Following the permeation requirements for primary pipe through this chronology reveals the allowable fluid migration through piping to go from zero (from 1968 to 1995) to 4 grams per square meter per day (to 2004) to the current 1 gram per square meter per day.

Put in more practical terms, this equates to a little over 1/20 (one-twentieth) of a gallon per day per 100 ft. of 2-inch pipe. This is down from the 1/5 of a gallon per day per 100 ft. of 2-inch pipe that existed between 1995 and 2004, but is still higher than the "zero" originally allowed.

The 30-year warranty against internal and external corrosion when used for underground transfer of fuels has been proven repeatedly through almost 50 years of unparalleled performance by any other product offered, ever.

Fiber Glass Systems offers piping products for all fuel types, services and product types. These include:

Red Thread IIA

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.

Dualoy 3000/L

Listed with Underwriters Laboratories Standard 971-2004 for nonmetallic underground piping for motor vehicle (MV), high blend (HB), concentrated (CT) and aviation and marine (A&M) fuels (File MH9162). Dualoy 3000/L pipe and fittings are also Listed with Underwriters Laboratories of Canada (File CMH 715). In Great Britain the Dualoy 3000/L system has been tested and accepted by the London Fire and Civil Defence Authority. Dualoy 3000/L has been issued a Certificate of Compliance to the Institute of Petroleum (IP) Specification by ERA Technology, Ltd.

Dualoy 3000/LCX

Listed in the United States with Underwriters Laboratories for nonmetallic underground piping for motor vehicle (MV), high blend (HB), concentrated (CT) and aviation and marine (A&M) under File MH9162. Dualoy 3000/LCX pipe and fittings are also Listed with Underwriters Laboratories of Canada for Petroleum Products and Oxygenated Fuels (File CMH715). Underwriters Laboratories has also approved Dualoy 3000/L-A and Dualoy 3000/LCX for use with MTBE fluids.

RED THREAD IIA PIPE SYSTEMS

Red Thread IIA piping systems are made of fiberglass reinforced, aromatic amine cured, rigid, thermosetting epoxy resin. The pipe is manufactured using the classical reciprocal filament winding process where fibers are wound around a steel mandrel under controlled tension at a prescribed angle, optimized for stresses caused by pressure. Most fittings are made in matched-die compression molds where the pre-impregnated (pre-preg) fiberglass bands are chopped and placed in the mold cavities where heat and pressure are applied to form the consolidated part. Fittings can also be made by the filament winding process, where efficiency and practicality make this possible.

Pipe and fittings are bonded together using a two-part adhesive, specially formulated for strength, fuel resistance and ease of handling, including the ability to mix, apply and cure at ambient temperatures above the minimum.

Joining Methods

The primary method of joining pipe-to-pipe is with a T. A. B. (threaded and bonded) coupling. Matching, low profile threads on the pipe and in the coupling allow a mechanical fit of the components while the adhesive cures, assuring a tight make-up.

Pipe-to-fittings bonds are made with matching tapers that “lock” together as they are joined with either an axial force or a slight twist while a “push” is being applied by hand (for 2-inch pipe only). Pipe with T. A. B. threads can also be bonded into smooth, tapered ends of fittings using the same method.

Complete joining instructions are available, along with a comprehensive set of tools to perform the installation procedures.

Secondary Containment

Where secondary containment is needed, Red Thread IIA provides a true pipe-in-a-pipe system. Containment pipe is identical to the primary pipe. Sections are joined together with matching two-piece clamshells that are bonded and bolted together. One half of the clamshell fitting is pre-fitted with female threaded fasteners to make assembly fast and easy from one side of the fitting.

Old vs. New - Pipe in the foreground was installed in 1973 and removed 27 years later when the station closed.

DUALOY™ 3000/LCX PIPE SYSTEMS

The Dualoy 3000/LCX product was developed on the technology used for the Dualoy 3000/L system. The addition of the “CX” to the product name indicated the product is of coaxial construction. The common term in the marketplace for the product is “LCX” and that will be used here, also.

To build this product, first the Dualoy 3000/L primary pipe is made on a proprietary continuous process. Adhesive-backed tape is used to carry size-graded glass beads and is wrapped over the primary pipe. Another layer of adhesive-backed tape is then wound over it to form a complete, dry, porous layer, which is then over-wrapped with the containment layer (or jacket) of fiberglass and resin.

Benefits of LCX

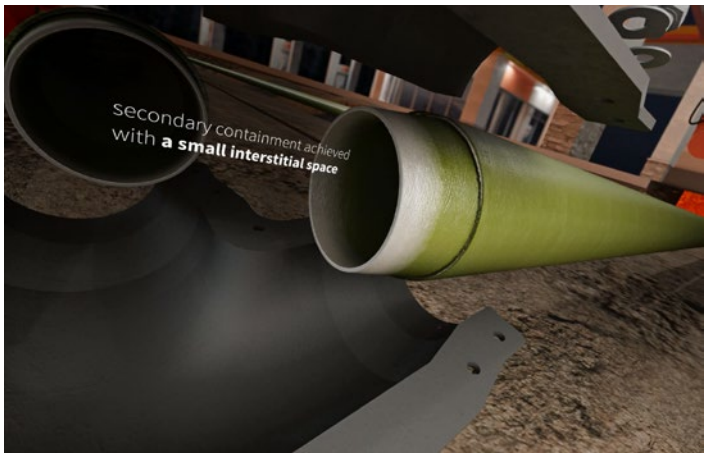
First installed in 1995, the LCX product has since gained in popularity and market share. In addition to having the benefits of fiberglass compared to other materials, the unique coaxial construction has other practical and theoretical benefits. Some of these benefits are obvious, while others are less so, but probably more significant. Both pipe walls are together, making it easier to carry and requiring fewer trips into the ditch.

- No measuring is required for containment pipe, cutting down on potential mistakes and waste.
- The pipe is compact, allowing less trenching, backfill and haul-off, as well as taking less warehouse space for inventory.
- Fittings design makes series lay-out easy and allows cross-overs for parallel systems to be made to the same dimensions as a single-wall system.
- The two pipe layers do not move relative to each other. This causes each one to support the other and enhance the strength of the pipe and the joints.

The two layers are very close to each other, although totally separated. This narrow distance and low volume have benefits that may not be obvious:

- No backfill or debris can get between the layers. This, along with there being no movement between the layers prevents any abrasive wear that may cause damage later.
- If water would get between the layers (unlikely), the volume is insufficient to allow any damage to occur, should that water freeze and expand (crushing primary in other cases).
- Should a leak occur (also very unlikely), only a very small amount will be needed before it will travel to a detection point.
- During testing at installation, any communication between the two layers will be seen as it will cause a large change in the gauge pressure in the containment (because the volume of the containment is small relative to the primary – 15:1 for 2-inch pipe).
- If a leak needs to be located, the “soapy water” test can be used to inspect the whole system (joints, fittings and pipe) – soaping the cut end of the jacket will show any leaks in that primary pipe section.

Continuous monitoring can be done with any of the approved methods, Vacuum, Pressure or Hydrostatic, with the Hydrostatic method approved by the NWGLDE and the state of California Fiber Glass Systems has the fiberglass pipe to suit all services and product type preferences.



Dualoy 3000/LCX pipe

DUALOY™ 3000/L PIPE SYSTEMS

Like Red Thread IIA, Dualoy 3000/L piping systems are made of fiberglass reinforced, aromatic amine cured, rigid, thermosetting epoxy resin. This pipe is manufactured using a unique process where a continuous cylinder is generated with the fibers oriented more near the circumferential and axial directions than with the reciprocal process. Dualoy 3000/L also includes a resin-rich liner. Fittings are compression molded or filament wound, as is further described in the Red Thread IIA text.

Dualoy 3000/L Pipe and fittings are also bonded using a 2-part adhesive.

Joining Methods

All primary system bonds are made with matching tapers with the Dualoy 3000/L system. The same "lock" is made as they are joined with either an axial force or a slight twist while the force is being applied. Instructions and tools are also available.

Secondary Containment

Where secondary containment is needed, Dualoy 3000/L is very much the same as Red Thread IIA.

Dualoy Secondary Containment

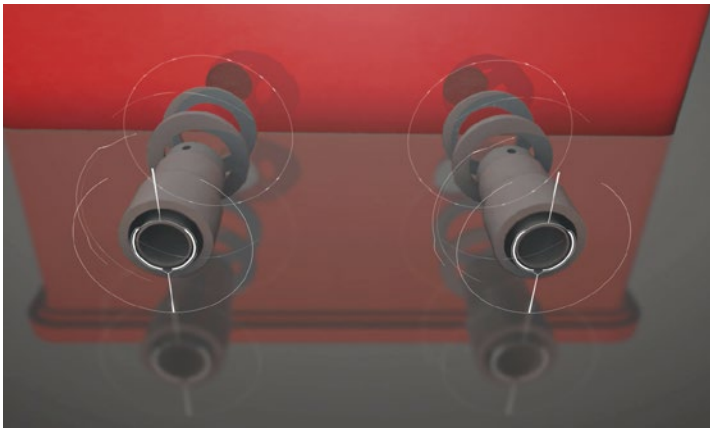
ADHESIVES

Fiber Glass Systems offers two adhesive lines: Series 8000 and PSX. Both lines can be used on Red Thread IIA and Dualoy pipe. Series 8000 is typically used for bonding primary pipe and fittings. A thickening agent is offered for bonding secondary containment fittings, particularly in warmer weather. PSX-20 is typically used for bonding primary pipe and fittings, and PSX-34, with a higher viscosity, is typically used for bonding secondary containment fittings.

Adhesive Series 8000

Adhesive Series PSX

FIBERGLASS SUMP PENETRATION FITTINGS FOR PERMANENT SUMP BONDS



Bonded Sump Entry Fitting - Termination Style for double-containment systems. Works with 3"-over-2" and 4"-over-3" Red Thread IIA and Dualoy 3000/L; and 2" and 3" Dualoy 3000/LCX. A 30-year Water Intrusion Warranty is offered with this fitting.

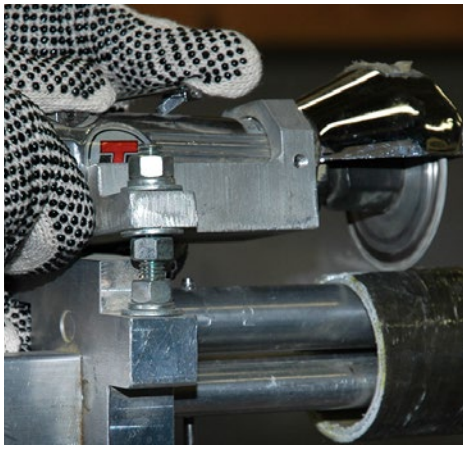
Bonded Sump Entry Fitting - Pass-thru Style for LCX. Works with 2" and 3" Dualoy 3000/LCX.

Bonded Single-Wall Sump Entry Fitting for 2" - 6" Red Thread IIA Installations.

TOOLS AND EQUIPMENT

Model 2100 Tool - Tapers 2”-3” Red Thread IIA pipe, scarfs 3”-4” pipe. Taper mandrels are available for Dualoy 3000/L products.

Model 3000 Tool - Tapers and scarfs 2” and 3” Dualoy 3000/LCX pipe.



Jacket Cutter Tool - Cuts containment jacket from 2”–4” Dualoy 3000/LCX pipe

SOFTWARE

StationWare 3000 is a stand-alone CAD program that will provide a professional looking station lay-out drawing and a bill of materials for the site. Users can select a variety of products and configurations to meet specifications or find the most efficient and economical design.

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Sump/Entry Termination Fitting with Gasket

TABLE 1 - Fitting Dimensions			
Size	A	B	C
In.	In.	In.	In.
3” x 2”	6.88	4.00	4.00
4” x 3”	6.88	4.00	5.00

1. Determine entry hole location and cut entry hole in sump wall using dimensions in Table 1.

2. Place sump entry/termination fitting through hole with the threads on the inside of the sump wall. A maximum of 2° of offset is acceptable for a proper seal on a flat surface.

For a rounded surface, no offset will be allowed; pipe must be perpendicular to the sump.

3. Locate ¼” threaded outlet to the desired location. If this fitting is used in an Open (Drainage) System, locate the ¼” threaded outlet in the “South” position. Leave ¼” plastic threaded outlet protector in place until ¼” fitting installation.

4. Lube gasket with the provided lubricant and place over the threads and against the sump wall.

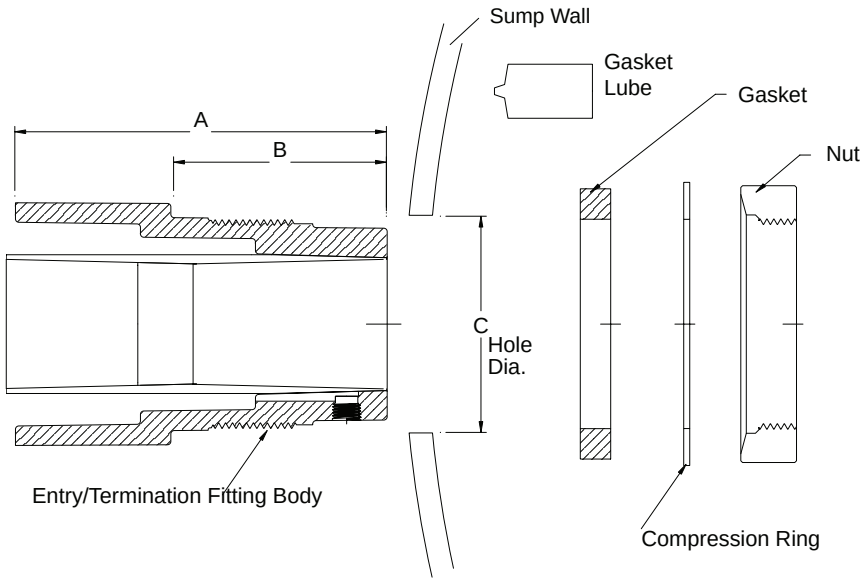
5. Place compression ring next to gasket.

6. Thread nut onto fitting hand tight. **Do not tighten until system completion.**

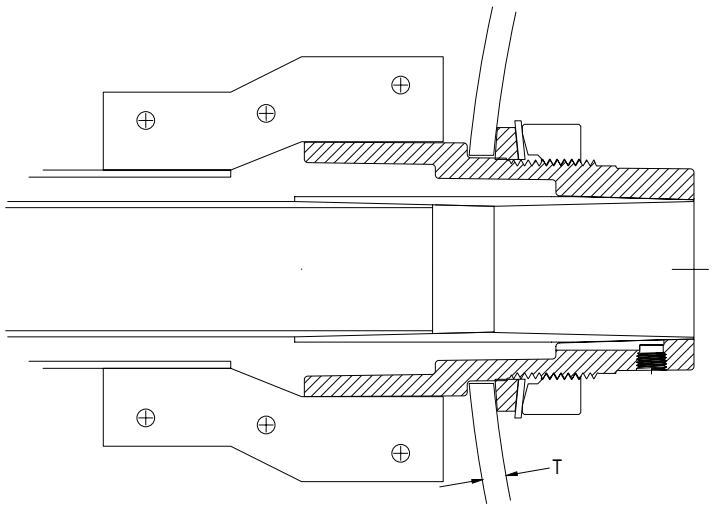
7. Remove ¼” plastic threaded outlet protector. **Apply adhesive only** to the ¼” fitting and screw into ¼” threaded outlet. Tighten to 40 in.-lbs. or 1½-2 turns past hand tight. After installing fitting, be sure the interstitial space is free from excess adhesive. Install a short hose and blow excess adhesive through air passage. **NOTE:** Verify with testing company or monitoring manufacturer if a larger thread is needed for their equipment. After the port fitting is installed, do not remove.

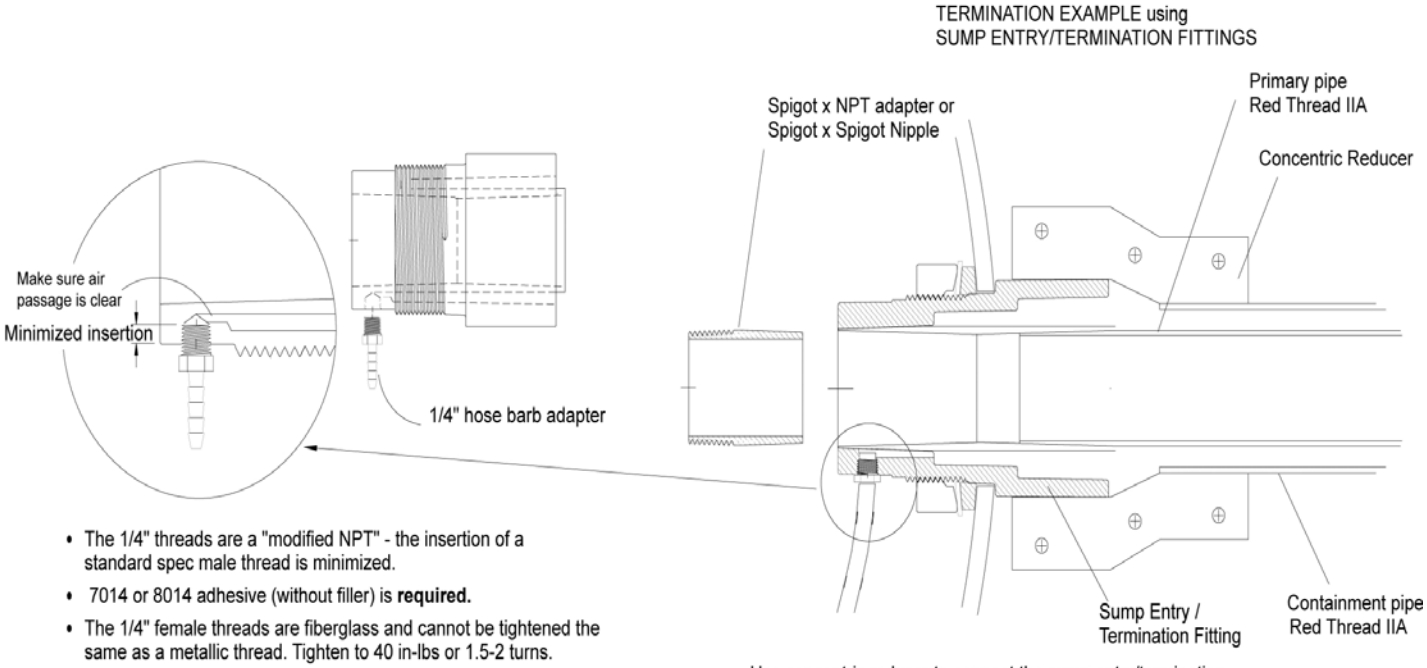
8. Connect only flexible tubing or hoses to the port fitting. NOTE: Tubing or hoses must be rated to full vacuum.

9. Tighten nut for gasket seal at sump locations prior sump test.



Maximum Acceptable Sump Wall Thickness “T”			
Fitting Size	Round 42” Sump	Round 48” Sump	Flat Dispenser
	“T”	“T”	“T”
3” x 2”	3/8”	3/8”	1/2”
4” x 3”	5/16”	3/8”	1/2”





- The 1/4" threads are a "modified NPT" - the insertion of a standard spec male thread is minimized.
- 7014 or 8014 adhesive (without filler) is **required.**
- The 1/4" female threads are fiberglass and cannot be tightened the same as a metallic thread. Tighten to 40 in-lbs or 1.5-2 turns.
- After installing a 1/4" NPT fitting, the passageway to the piping interstitial space should be cleared with air pressure to insure that it is free of thread sealant and/or adhesive.

Use concentric reducer to connect the sump entry/termination fitting to secondary containment pipe; DO NOT USE clamshell termination fittings with this style fitting.

MEMBER PEI PETROLEUM EQUIPMENT INSTITUTE

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