UL/ULC Listed

Red Thread® IIA Piping System

General Installation Instructions

Time-Tested Fiberglass Primary and Secondary Containment Piping for Underground Fuel Installations

www.fgspipe.com

2700 West 65th Street
Little Rock, Arkansas 72209
Phone: 1 (501) 618-2256

25 S. Main Street
Sand Springs, Oklahoma 74063
1 (918) 245-6651

NOV Fiber Glass Systems

IMPORTANT - READ THIS FIRST

Before beginning the actual assembly procedures, verify all individuals involved in the installation thoroughly understand the following suggestions and precautions.

Matching taper angles for the spigot and the bell make it possible to mechanically “lock up” a joint by wedging the spigot into the bell. This produces a very thin line of adhesive called the bond line, or glue line, that is only a few thousandths of an inch thick.

Matching taper angles allow the joint to mechanically lock up, producing a thin line of adhesive called a glue line.

In all cases, the bonding surfaces must be clean before applying adhesive.

Bonding surfaces must be clean.

Joint strength of the bell and spigot joint is controlled by the adhesive thickness between the two matching tapered surfaces. The adhesive is relatively brittle in thick sections and fails easily if the bond line is too thick. The mechanical lock determines adhesive thickness.

Joint strength is controlled by the adhesive thickness - thin is good, thick is bad.

Joints that are not “locked up” during installation may pass an initial steady pressure test but can fail prematurely at a later date due to reduced bond strength caused by the thick adhesive. Therefore, it is essential that the installation crew be familiar with the joint concept and understand the importance of completely inserting and locking the spigot into the bell.

Mechanical locking of the joint is absolutely essential to develop full strength of the joint.

Using mechanical force (such as hammering against a wooden block placed against a fitting or bell end of pipe) helps achieve “lock up.” NOTE: This is the same mechanical lock of matching tapers that is commonly used in machine tools. For T.A.B. (threaded and bonded) joints, special T.A.B. wrenches or strap wrenches are recommended to achieve the mechanical lock up of the joint.

Using mechanical force helps achieve joint lock up.

Cool weather conditions require special precautions when bonding pipe and fittings. The adhesive is very viscous (thick) when it is cool or when it is applied to cool pipe. This thick adhesive can be stiff enough to prevent complete joint “lock up.” There are different installation procedures for both warm and cool weather installations. This concept is often overlooked when a crew installs piping and there are significant temperature variations throughout the day or week.

Follow the appropriate installation procedures for warm or cool weather.

All bonding surfaces must be factory fresh in appearance. When end caps have been lost, surfaces will weather and result in loss of bond strength. When surfaces are weathered, retaper spigots and sand bells to achieve a factory fresh appearance. NOTE: DO NOT USE T.A.B. COUPLINGS THAT ARE WEATHERED.

All bonding surfaces must be factory fresh in appearance.

INTRODUCTION

NOV FIBER GLASS SYSTEMS
PIPE INSTALLATION HANDBOOK
UL/ULC Listed
RED THREAD IIA Primary and
Secondary Containment Pipe and Fittings

This manual is offered to assist in the proper fabrication and installation procedures when assembling NOV Fiber Glass Systems piping systems.

Part One details installation procedures for 2", 3", and 4" (50, 75, and 100 mm) diameter primary product piping.

Part Two explains installation procedures for 3", 4" and 6" (75, 100 and 150 mm) diameter secondary containment piping.

ENGINEERING AND PRODUCT DATA:
Success by Design software performs flow and other engineering calculations. Included in the CD-ROM is a complete catalog and installation video. Contact your sales representative to obtain a copy or visit our web site at www.fgspipe.com.

NOV Fiber Glass Systems' products must be installed and used in accordance with sound, proven practice and common sense.

The information supplied in the literature must be considered as an expression of guidelines based on field experience rather than a warranty for which NOV Fiber Glass Systems assumes responsibility. A limited warranty of the products are offered in the Terms and Conditions of Sale.

CAUTION

This pipe may carry hazardous material and/or operate at a hazardous pressure level; therefore, it is imperative the instructions in this manual are followed to avoid serious personal injury or property damage. In any event, improper installation can cause injury or damage. Installers should read and follow all cautions and warnings on adhesive kits, heat packs, propane torches, etc. to avoid personal injury. Also, observe general safety practices with all saws, tools, etc. to avoid personal injury. Wear protective clothing when necessary.

Make sure work surfaces are clean and stable and that work areas are properly ventilated.

INSTALLATION TRAINING SEMINARS

Although any requirement for installation training is the responsibility of the regulatory authority, specifier, or end user, NOV Fiber Glass Systems recommends anyone directly involved in underground piping installations attend our installation training seminar.

In-depth training seminars cover both primary and secondary containment product installation procedures. The training seminar involves hands-on participation, and each attendee receives installation manuals used during the seminar. Each installer attending also receives documentary proof of attendance which expires after three years. Contact your local distributor or representative for information on these seminars.

To assist installers with proper installation of fiberglass piping systems, Red Thread IIA Installation Checklist for Underground Petroleum Pipe (**B2161**) is available. This sheet is included in the Petroleum Marketing Catalog and accompanies each bundle of pipe. For a copy of this checklist, contact your local distributor or representative.

Publications available:
B2101 Red Thread IIA Product Brochure
B2102 General Specifications
B2103 Series Piping
B2104 Vacuum Monitoring System
B2107 Single-Wall Sump Entry/Termination Fitting
B2108 Bonded Sump Entry/Termination Fitting
B2109 Gasketed Sump Entry/Termination Fitting
B2161 Red Thread IIA Installation Checklist
F6600 1"-6" Tapering Tool Instructions
F6625 Model 2100 Power Tool Instructions
F6624 Model 2102 Power Tool Instructions
F6640 Operating Instructions for Electric Heating Collar

TABLE OF CONTENTS

Read This First..... I
Introduction..... II
Installation Training Seminars..... II

PIPING SYSTEM INFORMATION

Pipe Products..... 1
Storage and Handling..... 1

PART ONE
Red Thread IIA PRIMARY
PIPING INSTALLATION

Joining Systems..... 2
Layout and Preparation..... 2
Tools, Equipment, and Supplies..... 3
Cutting & Tapering Pipe..... 3
Trenching & Backfilling..... 4
Joint Prep..... 5
Adhesives..... 6
Adhesive Mixing..... 6
Adhesive Working Life..... 6
Joint Assembly:
- Bell x Spigot Joints..... 7
- T.A.B. Joints..... 8

Joint Cure..... 8
Connecting to Other Systems..... 9
Potential Causes of Joint Failure..... 10
Testing..... 10
Repair Procedures..... 11

PART TWO
Red Thread IIA SECONDARY
PIPING INSTALLATION

General Concepts..... 12
Layout and Preparation..... 12
Scarfing Pipe..... 13
Piping Layout..... 13
Containment Fittings..... 13
Containment Crossover Details..... 14
Sump Connections..... 14
Reducers..... 15
Saddles..... 15
Joint Prep..... 15
Adhesives & Adhesives Mixing..... 16
Joint Assembly..... 16
Joint Cure..... 17
Testing..... 17
Repairs..... 18

HELPFUL INFORMATION

Conversions..... 19
Decimal Equivalents of Fractions..... 19
Definition of Terms..... 20

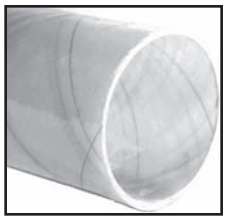
LIST OF TABLES

Table 1 Standard Packaging of Pipe..... 1
Table 2 Suggested Units of Labor for Installation..... 2
Table 3 Wattage Requirements for Electric Heating Collars..... 3
Table 4 Extension Cord Length..... 3
Table 5 Recommended Minimum Burial Depths..... 5
Table 6 Adhesive Kit Data..... 7
Table 7 Adhesive Cure Times..... 8
Table 8 Adhesive Cure Times When Using Electric Heating Collars..... 9
Table 9 Make-up Dimensions (Wet)..... 12
Table 10 Containment Crossover Information..... 14
Table 11 Pipe Separation Distances..... 14
Table 12 Termination Fitting Connections..... 15
Table 13 Adhesive Kits per Containment Fitting..... 16

PIPE PRODUCTS

Red Thread IIA PIPE

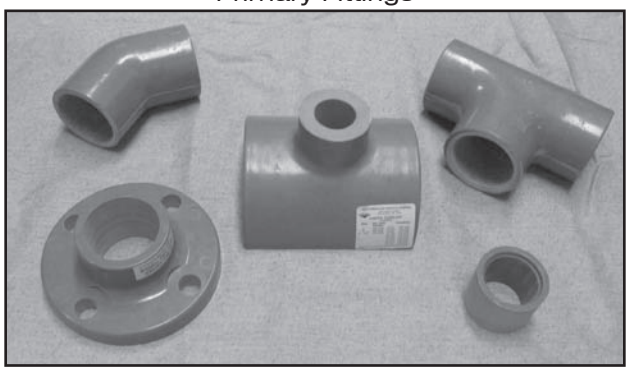
Epoxy pipe that is light weight and provides long service life and corrosion resistance. UL/ULC Listed piping is available in 2"-4" primary pipe sizes and 3"-6" containment pipe sizes. Non UL/ULC Listed containment piping is available in 8"-16" diameters. T.A.B. (Threaded and Bonded bell and spigot) is the primary joining method for 2"-6" pipe. Pipe comes in 15, 25, and 30 foot random lengths.



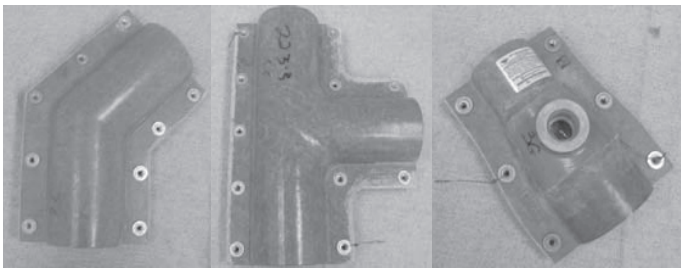
FITTINGS

(UL Labels are supplied on the smallest packaging container, not the Fitting.)

Primary Fittings



Clam Shell Secondary Containment Fittings



STORAGE AND HANDLING

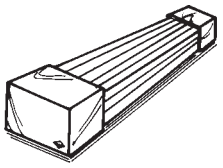
Packaging, Ordering, Shipping Information

Pipe comes in 15, 25 and 30 ft. (5, 7.6 and 9.2 meter) random lengths. The number of lengths per bundle varies with the pipe diameter. Two-inch pipe is supplied with a protective mesh covering. **The protective mesh covering must remain in place on primary pipe that is not contained. The protective mesh covering may be removed when installed in containment pipe.**

TABLE 1. Standard Packaging of Pipe

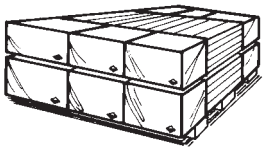
Pipe Size		Random Length		Lengths Per Bundle
In.	mm	Ft.	m	
2	50	15, 25, 30	5, 7.6, 9.2	8
3	75	15, 25, 30	5,7.6, 9.2	6
4	100	15, 25, 30	5, 7.6, 9.2	4
6	150	15, 25. 30	5, 7.6, 9.2	2

Pipe is furnished factory packaged in compact, easy-to-handle bundles complete with protective end caps. **Caps should remain in place until installation time to protect the pipe ends as well as prevent dirt or other material from entering the pipe.** Fittings and adhesives should be stored in a cool dry area. If fittings are removed from the boxes, protect machined bells and spigots from exposure to direct sunlight.



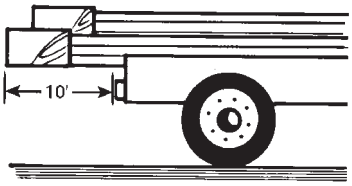
Storing

Bundles can be safely stored on level ground or on racks with 10 foot (3 m) or less support spacing. Use supports with a minimum of four-inch (100 mm) wide bearing area to prevent damage to the pipe. Do not store on rocks or other hard objects that could cause point-loading damage. When outdoor storage is required, check to assure the pipes' protective end caps are in place to protect the machined surfaces from weathering. Use black polyethylene or other ultraviolet ray blocking material to cover all factory-prepared bonding surfaces if end caps are missing or not available.



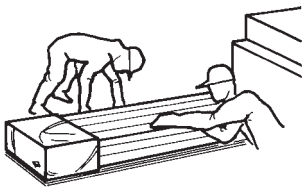
Transporting

Use care in handling the pipe and fittings. When transporting from storage to the job site, do not allow pipe to extend more than 10 feet (3 m) beyond the end of the truck or trailer bed; permanent damage can result from excessive bending stress. **Protect pipe to prevent impact and point-loading damage.** During transport, strap the pipe down with nylon or hemp rope tie downs. This will help prevent abnormal movement of the pipe during transportation. Wood or padded supports are essential for truck or trailer beds that have sharp edges (such as metal plates on the back of a flat-bed trailer). When transporting the pipe on trucks with narrow overhead piping racks, padded supports must be used to prevent point loads. If chains are used during transport, they must be well padded to prevent damage to pipe walls.



Loading and Unloading

When the pipe is not specially packaged, it should be loaded and unloaded by hand. When properly palletized or otherwise adequately protected, forklifts may be used. Do not throw or drop pipe and/or fittings from the truck to the ground.



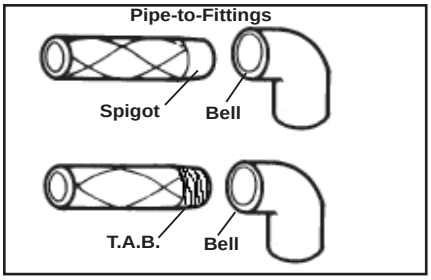
PART ONE

INSTALLATION INSTRUCTION FOR Red Thread IIA PRIMARY PRODUCT PIPING

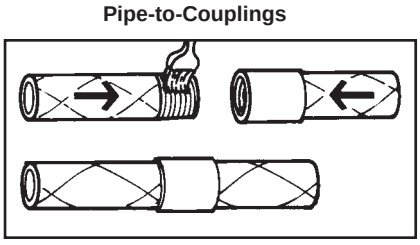
- Proper installation is the key to achieving a highly reliable, adhesive bonded, matching taper, bell and spigot joint.
- Matching taper angles on spigot and bell ends make it possible to lock up a joint by wedging the spigot into the bell so that it takes significant force to separate them. Proper lock up is essential.
- A very **thin** line of adhesive (called the bond line or glue line) between the two matching tapered surfaces is necessary to achieve **optimum** joint strength.
- Proper installation results in joint strength equivalent to or stronger than the piping systems.
- To achieve the most reliable piping system, **it is essential that the installation crew be familiar with the joining techniques in this manual.**

JOINING SYSTEMS

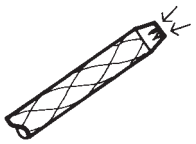
The adhesive bonded, tapered bell and spigot joint is the primary joining method for 2"-4" (50 mm-100 mm) pipe-to-fittings. The T.A.B. joint is the primary joining method for pipe-to-couplings. When combined with the adhesive, the mechanical locking action promotes positive make up of the joint and prevents backout during adhesive curing.



Pipe is supplied with T.A.B. spigot x T.A.B. spigot ends. **Fittings are manufactured to accept either a tapered spigot or T.A.B. spigot end of the pipe.** Tapers can be made in the field with tools designed for this purpose (see page 3). Bells cannot be field made. When a belled end is needed, a sleeve coupling is required.



LAYOUT AND PREPARATION



While handling, storing, and transporting the pipe, it sometimes incurs rough treatment. Inspect all pipe surfaces for possible damage to the pipe wall and spigot ends. Damaged pipe must be cut out and replaced. Inspect fittings for any damage. If in doubt about damage, contact your distributor or representative.

Exposing machined surfaces to direct sunlight will result in loss of joint bonding strength. Because the degree of weathering or surface degradation and subsequent effect on bond strength varies greatly, it is difficult to place a fixed time limit on the acceptable amount of exposure. In all instances where protective coverings are removed from machined surfaces and ultraviolet exposure exceeds one day, corrective action must be taken.

Layout - Advance planning of the piping layout can reduce the quantities of material required and will make servicing the system easier. **NOTE: The scarfed containment pipe must be positioned over the product pipe before bonding the product pipe.**

Installation Crew Size and Organization

Each installation is different and requirements change depending on whether the installation is simple (long, straight runs of piping) or complex. Requirements are also affected by pipe size, installation temperature, and site locations.

TABLE 2. Suggested Units of Labor for Installation

Pipe Size In./ mm		Cutting Min/ Opr	Tapering		Joint Make-up Minutes
			Hand Tool Min/Opr	Power Tool Min/Opr	
2	50	0.5	1.5	0.3	1.0
3	75	0.5	2.5	0.3	2.0
4	100	0.5	3.5	0.5	3.0

For guidance under specific circumstances, consult your distributor or representative.

Before beginning an installation, review the Red Thread IIA Installation Checklist (B2161) with the crew and fill out as the job progresses. A completed copy should be retained to document compliance with current State/Federal regulations. Installation checklists are available from your distributor or representative.

Following are general guidelines that apply to most piping installations:

- For most average-size service stations, the minimum recommended crew size is two. The crew size may be increased as the pipe diameter increase or when installing secondary containment piping.
- Organize the crew so the adhesive is spread on the bonding surfaces as quickly as possible after mixing the adhesive, particularly in extremely hot weather.
- Plan adhesive kit usage so that sufficient kits are available in the area where the bonding will take place.
- Plan ahead so a sufficient number of bonds are available to use one whole adhesive kit before the kit is mixed.

TOOLS, EQUIPMENT AND SUPPLIES REQUIRED FOR INSTALLATION

Following is a basic list of equipment that should be available before installation.

- Chain vise (bench mounted or portable) capable of securing the pipe size used. **Use** protective pads such as split sections of the same size fiberglass pipe or a sheet of 1/8" (3 mm) thick rubber to protect the pipe from clamp or chain damage.
- Power or hand tapering tool.
- Felt tip marking pen
- Pipe cutting equipment:
  Chop saw,
  Fine-tooth (32 teeth per inch) hack saw
  Circular saw with abrasive cutting blade (carbide grit or grit or masonry blade)
  Sabre saw with a fine-tooth metal or carbide grit blade
  Jigsaw with carbide grit abrasive blade
- Wrap around (for marking pipe)
- T.A.B. or strap wrenches (see page 8)
- Shop hammer, 3-6 lbs. (4-9 kg.) and a 2x4 block of wood
- Adjustable pipe stands
- Power drive adapter (optional)
- Electric heating collars
- Clean rags
- Appropriate tapering tools

Equipment for Cold Weather Pipe Assembly:

- Heat source for prewarming:
  – Electric heating collar,
  – Portable electric heat lamp, or
  – Hot air blower
- A means of maintaining adhesive kits at 70°-80°F (21°-27°C). A box with a 25 watt light bulb or keep the adhesive in a heated truck cab or building.
- Heat assisted curing source - **Retract protective mesh covering on 2" pipe prior to use of heating collars.**
  – Electric Heating Collars - When using electric heating collars, assure an adequate power source is available and the extension cords are properly sized. Wattage requirements and extension cord lenghts are shown in Tables 3 and 4.

Table 3. Wattage Requirements for Electric Heating Collars

Size		110V or 220V Heating Collar (Watts)
In.	mm	
2	50	90
3	75	155
4	100	200
6	150	285

Table 4. Extension Cord Length

Wire Size (AWG)	Suggested Length (Ft.)	Maximum Length (Ft.)
12	20	22
10	30	36
8	50	57

CUTTING AND TAPERING PIPE

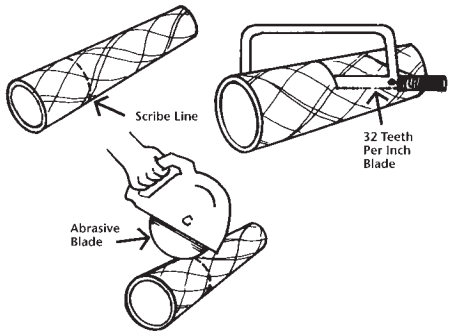
Cutting

Cut pipe with one of the tools listed above**.**

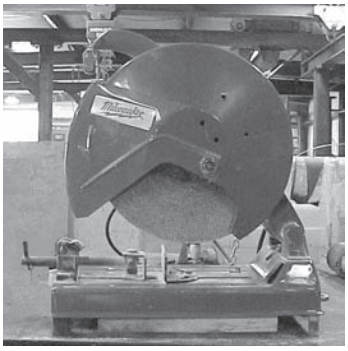
When cutting, protect pipe from chain vise damage by placing rubber sections or sleeves (180° sections of pipe cut from the same size pipe being tapered) between the pipe and the chain vise.

Cutting operations for fiberglass pipe can generate dust or cutting chips that are irritating to the skin, upper respiratory tract, and eyes. Because these materials are irritating, proper ventilation for the installation crew should be used to prevent exposure.

A nuisance dust breathing filter should be used when working in areas where dust will be present. Operators should wear heavy cotton clothing, including long-sleeve shirts, that protect the skin from dust. Eye protection is required when operating tools



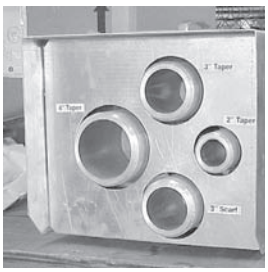
Chop Saw



Tapering

Always retract the protective mesh covering on 2" pipe approximately 12" from the end before tapering.

- **Model 2100 Tool (F6625) -** Power tool designed to taper 2"-3" Red Thread IIA pipe and scarf 3"-4" Red Thread IIA pipe.
- **Model 2102 Tool (F6624) -** Power tool designed to taper 2"-4" Red Thread IIA pipe and scarf 3" Red Thread IIA pipe.
- **Model 2100-I** and **Model 2102-I** are available where 240 volt is required.



Proper tapering tolerances are set at the factory. However, it is recommended the tool settings be checked prior to tapering pipe. To compensate for wear of the grinding drum, the mandrels can be field adjusted. Refer to the tool operating instructions for field adjustment procedures.

The tapering tools will produce a field-made taper that inserts into the same bell to ±1/8" (3 mm) tolerance when compared to a factory-made tapered spigot. The angle for properly made field tapers for 2"-4" (50 mm-100 mm) diameter pipe should be 1 3/4 degrees. **NOTE:** If the manual tapering tool is used, make sure the blade holder reads 1 3/4 degree. If not, it should be replaced.

WARNING - When tapering pipe with a 2000 series power tool, DO NOT rotate pipe with your hand over the end of the pipe as this could result in serious injury. Place both hands firmly around the pipe a minimum of 2" from the end of the pipe and rotate counter clockwise. Keep a firm grip on the pipe at all times and keep moving in a constant motion. If you loosen your grip on the pipe, the grinding drum could grab the pipe and spin it backwards resulting in the pipe being locked up on the tool and possibly causing injury.

There are several power tapering tools available for use with Red Thread IIA piping systems that our company does not manufacture. **It is the tool operator's responsibility to ensure that the tool being used is reproducing a field-made taper that is within the tolerances of a factory-made tapered spigot.** Refer to **Manual No. F6600** for the correct procedures to verify matching tapered spigot tolerances.

- If the power tools are not available, a manual tapering tool kit should be used. The 1"-6" tool (**F6600**) is a hand-held tool that can be adapted for a power drive when a large number of tapers are required.

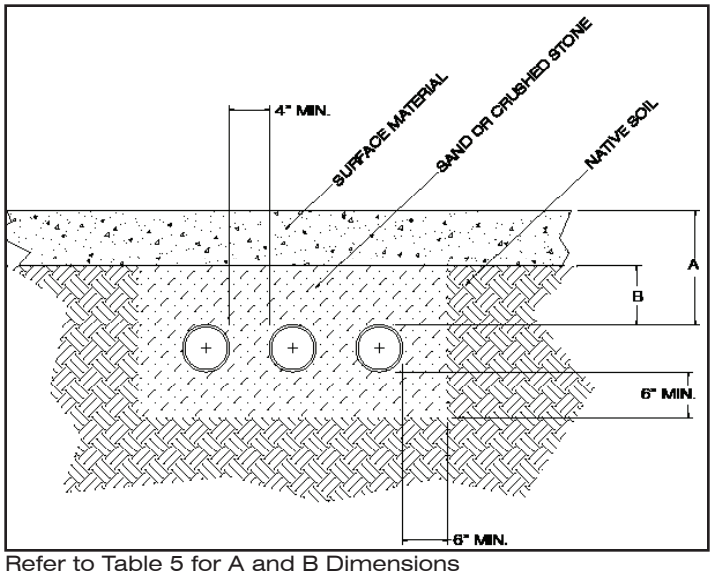
When using a manual tool and pipe is clamped into a chain vise, extend pipe at least 12 inches (300 mm) beyond chain to prevent ovaling of the pipe. For short nipples, taper one end of the pipe and cut to the desired finished length. Insert the tapered side into a sleeve coupling. Insert into tool and taper.

All tapering tool settings should be checked at the beginning of each job.

TRENCHING AND BACKFILLING

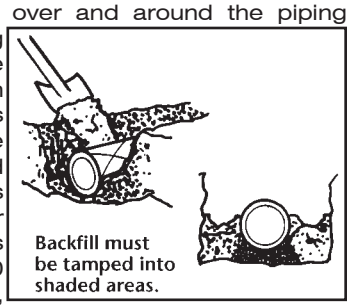
Proper construction of trenches is important. They should be wide and deep enough to accommodate the piping and backfill material. See Table 5 for recommended minimum burial depths.

- Typically, piping should be sloped at least 1/8" (3 mm) per foot toward the tank. Support pipe properly to prevent low points.
- The piping should be separated by a distance of at least four to six inches (100 mm-150 mm). For double-wall secondary containment piping installations, refer to Table 11 on page 14 for recommended distances.

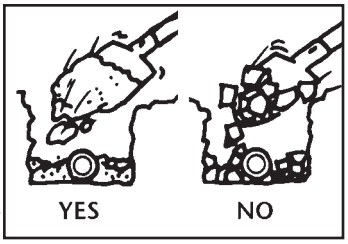


Refer to Table 5 for A and B Dimensions

- Compact backfill carefully over and around the piping system. When using tamping equipment, take care to prevent vibration from driving small stones into the pipe wall. The amount of compaction and the type of soil determines the soil modulus. For example, pea gravel has a typical modulus of 1,000 psi with no compaction, while sand requires slight compaction (85% Proctor density) to achieve a modulus of 1,000 psi. Refer to ASTM D3839 or AWWA C950 for further details.



- Cover the pipe as soon as possible after successful testing to eliminate the chance of damage to the pipe, floating of the pipe due to flooding, or shifting of the line due to caving in of the trench walls. If damage is suspected, the lines should be retested.



- Frozen earth will eventually thaw, leaving the pipe with insufficient support and voids around the pipe. Take care to remove frozen lumps from all backfill materials before using.

In all cases, the pipe must be completely surrounded with select backfill (sand, 1/8" to 3/4" pea gravel, or 1/8" to 1/2" washed, crushed stone). There should not be any voids under or around the pipe. Six inches (150 mm) of the fill must be placed under the pipe as bedding material. **Native backfill materials should never be used.**

TABLE 5. Recommended Minimum Burial Depths Based on Soil Modulus of 1,000 psi or Higher (Refer to ASTM D3839 or AWWA C950 for Method/Theory)

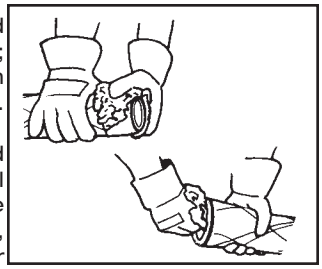
Pipe Size		Surface Condition	Minimum Burial Depth		Min. Amount of Sand, Pea Gravel, Crushed Stone Above Top of Pipe	
			A		B	
In.	mm		In.	mm	In.	mm
2	50	Unpaved	17	432	12	305
		Paved, min. 4" (100 mm) asphalt	12	305	8	203
		Paved, min. 4" (100 mm) concrete	9	229	5	127
		Paved, min. 6" (150 mm) concrete	9	229	3	76
3	75	Unpaved	20	508	14	356
		Paved, min. 4" (100 mm) asphalt	13	330	9	229
		Paved, min. 4" (100 mm) concrete	11	279	7	178
		Paved, min. 6" (150 mm) concrete	10	254	4	102
4	100	Unpaved	20	508	14	356
		Paved, min. 4" (100 mm) asphalt	14	356	10	254
		Paved, min. 4" (100 mm) concrete	11	279	7	178
		Paved, min. 6" (150 mm) concrete	10	254	4	102
6	150	Unpaved	36	914	14	356
		Paved, min. 4" (100 mm) asphalt	24	610	10	254
		Paved, min. 4" (100 mm) concrete	20	508	7	178
		Paved, min. 6" (150 mm) concrete	16	406	4	102

JOINT PREP

It is recommended that all bonding surfaces be cleaned before bonding. **Do not touch the bonding surfaces or allow them to become contaminated.**

Acceptable cleaning methods are as follows:

- Sand all bonding surfaces until contamination is removed. The sanding operation must be light enough to prevent changing the taper angle.
- Cut off contaminated surface and replace with a new taper or sleeve coupling.
- Wire brushes may be used for cleaning T.A.B. surfaces; however, they must be clean and free of oil contamination.



Solvent may be used if preferred by the customer. Some typical cleaning solvents available are acetone, methylene chloride, and methyl ethyl ketone. After cleaning, be sure any residual solvent has evaporated before applying adhesive. Do not use solvents that leave an oily film on the bonding surfaces.

WARNING: Some degreaseres and solvents are extremely flammable. Read warning labels on containers. Never use gasoline, turpentine, or diesel fuel to clean joints. All solvent should be evaporated before applying adhesive.

Repairing Weathered Surfaces (UV Degradation)

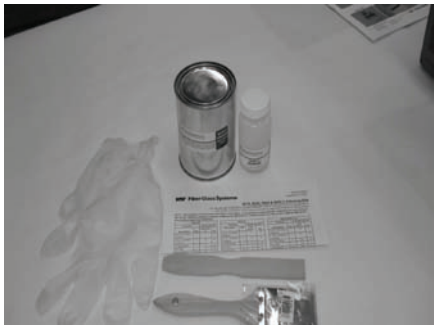
When machined surfaces of pipe and fittings are exposed to direct sunlight for a prolonged period of time, the result could be a loss of bond strength. All machined surfaces that have turned yellow or brown in color must be repaired. For exposed T.A.B. ends, cut ½" minimum off of the end of the spigot and retaper. Exposed fitting bells and pipe tapers should be lightly sanded with an 80 to 120 grit sandpaper or Emery cloth until the original factory-fresh appearance returns. T.A.B. couplings cannot be repaired; they must be replaced.

ADHESIVES

Two basic adhesive systems are available from NOV Fiber Glass Systems. The 7000 and 8000 series adhesives differ in operating characteristics and working time (pot life). See Table 6 for recommended usage and approximate number of bonds per kit. The working life of each kit is based on an ambient temperature of 75° F (24° C).

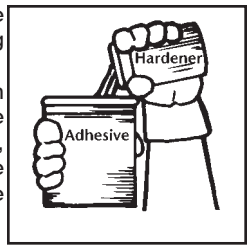
The adhesives are a two-component system that must be mixed prior to use. Detailed instructions for adhesives are provided with each kit. Read instructions thoroughly and follow the recommended procedures. Refer to Adhesive Working Life for both warm and cool weather conditions.

ADHESIVE MIXING



Thoroughly mix the adhesive. **Complete information and safety precautions are packaged with each adhesive kit. Review all safety precautions thoroughly before mixing the adhesive.**

- At 65°F or below, pre-warm the adhesive kits to 70° to 80°F minimum.
- Empty all of the contents of the hardener bottle into the can of base adhesive.
- Mix **all** of the adhesive with all of the hardener. NEVER SPLIT A KIT.
- Do not spill hardener during the mixing process. Cut through the adhesive with the edge of the mixing stick to assist in mixing the two components.
- Mix until the adhesive has a uniform color and a consistent flow off the mixing stick. Wipe down the sides, bottom, and under the rim of the can with the mixing stick to assure complete mixture.



ADHESIVE WORKING LIFE

Working life or pot life is the time it takes for the adhesive to harden in the mixing can. This time is measured from the time the adhesive and hardener are first mixed. **Working life is shorter at temperatures above 75**°F (21°C) and becomes longer as the temperature drops below 75°F (21°C). Working life is affected by the quantity of mixed adhesive as well as by temperature. Use the following methods to optimize the working life of adhesives:

Warm Weather:

- Occasionally stir the adhesive mixture during application.
- Use small ice chests or other containers with freezer packs to keep adhesive cool.

Cool Weather:

- Store adhesive kits inside.
- Pre-warm to between 70°-80°F (21.1°-26.7°C) before use.

CAUTION: If adhesive becomes warm and starts to harden in the container, discard immediately. DO NOT USE THIS ADHESIVE TO BOND A JOINT!

When adhesive is allowed to harden in the metal container, the container may reach approximately 400°F (205°C). Do not handle hot containers without heavy gloves. The exothermic reaction will generate a dense, foul-smelling smoke. Place the container outdoors in an open area until it cools. Avoid inhaling smoke.

ADHESIVE DISPOSAL: Once the adhesive and catalyst have been mixed and reacted, nothing can be extracted, and it is classified as non-hazardous material. Dispose of in a normal manner as other solid waste. Excess adhesive and catalyst can be mixed, allowed to react, and disposed of as above. If extra cans of adhesive or tubes of catalyst have accumulated without the other component to mix and react, contact your regional manager. Catalyst tubes, when empty are not subject to EPA regulation and can be disposed of in a normal manner. These guidelines are based on federal regulations. State and local regulations and ordinances should be reviewed.

TABLE 6. 7000 & 8000 Adhesive Kit Data

Kit ID Number	Label Colors[1]	2" Quantity Base Adhesive	Approx. No. of Bonds Per Kit[4]			Working Life[2] at 75°F (23.9°C) Minutes
			2" (50 mm)	3" (75 mm)	4" (100 mm)	
7014	Red	5.4 oz. (153 grams)	25	18	10	25
7024 (Twin Pack)	Black	2.0 oz. ea. (57 grams ea.)	9/9	6/6	4/4	25
7069[3]	Blue	7.8 oz. (221 grams)	-	-	-	25
8014	Green	5.5 oz. (156 grams)	21	15	8	15
8024 (Twin Pack)	Yellow	2.3 oz. ea. (65 grams ea.)	9/9	6/6	4/4	15
8069[3]	Orange	8.0 oz. (227 grams)	-	-	-	15

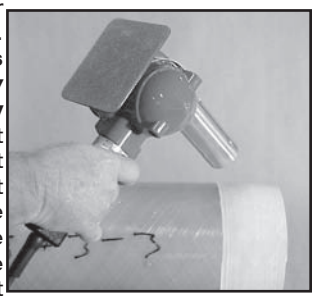
(These adhesives are for Red Thread IIA piping systems conveying petroleum products including leaded and unleaded gasoline, diesel, 100% ethanol or methanol, all alcohol-gasoline mixtures and biodiesel fuels.)

[1]Match the labeled adhesive color to the hardener color before mixing.
[2]When adhesive is properly mixed, it has a limited "working life" during which joints may be bonded. Use of the adhesive beyond the working life is prohibited.
[3]Recommended for secondary containment installations due to size of kit.
[4]Number of bonds depend on ambient temperature.

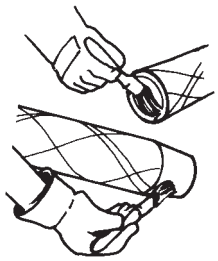
JOINT ASSEMBLY

Bell and Spigot Joint
The Spigot Must Be Aligned and Locked in the Bell. A cocked or misaligned joint will result in false lock up and possible joint failure during testing or at a later date.

- When the temperature is below 65°F (18.3°C), pre-warm the bonding surfaces (after the joint has been cleaned). **CAUTION: If a solvent is used, evaporation may be slow at extremely low temperatures**. Use a hot air blower and apply heat uniformly to the bell and spigot until warm (not hot) to the touch. Check temperature by touching outside of the bell and inside of the spigot to avoid contact with clean bonding surfaces. If hot to the touch, let cool before applying adhesive. If an electric heating collar is used to pre-warm, place the joint together dry, then heat the O.D. of the bell to avoid contaminating the spigot.

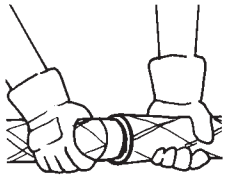


- Brush adhesive on both surfaces, applying a thin, uniform coating. To minimize contamination, apply adhesive to the bell first. Adhesive should always be worked into the machined surface by applying pressure during application. This will "wet out" the machined surface and maintain the required thin bond line. Be sure that all machined surfaces in the bell and on the spigot and cut end of the pipe are uniformly covered. **Excess adhesive will make the joint more difficult to lockup and can result in a flow restriction.**

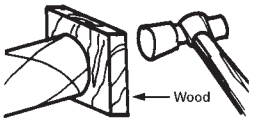


Connections into fittings are made using the normal bell and spigot method. A threaded (T.A.B.) spigot can be bonded into a smooth bell (fitting), or a smooth spigot can be bonded into a threaded (T.A.B.) bell.

- Align and lock the joint. For 2" (50 mm) fittings, insert spigot into the bell until surfaces touch, then push and turn at the same time until a lock is achieved. Only a quarter turn to a half turn is usually needed. On 3" and 4" (75 and 100 mm) diameter fittings, pushing and turning to lock the joint is impractical. A driving force may be used.



If the adhesive or the pipe surfaces are cool, push and hold for a few seconds to allow time for the adhesive to start flowing out of the tapered joint. If additional force is needed, a rubber mallet or a strong piece of wood and hammer to drive the joint together is the preferred method.



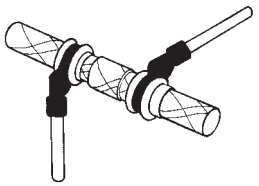
When the adhesive starts squeezing out of the joint, use stronger blows. Proper pipe alignment is important. Maintain back pressure against previously assembled joints to avoid shaking them loose. After the joint has started to make up, hit until no further engagement can be seen at the joint. When engagement stops, the joint is locked. Always check previous bonded joints to ensure they have not backed out.

Do not use additional force on a spigot.

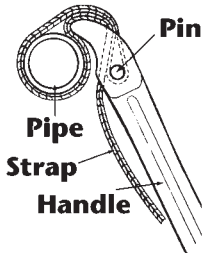
- Check lock up by moving free end of pipe in an up-and-down or side-to-side motion. The movement must be sufficient to move the joint being checked. No movement should be visible in the joint. If any movement exists, the joint is not locked up and the joint assembly procedure must be repeated.

T.A.B. Joint

T.A.B. joint installation procedures follow the normal bell and spigot operations of cleaning, adhesive mixing, etc. as described previously. The threads on the bonding surfaces are designed to improve the reliability of the joint, particularly under adverse conditions. Two T.A.B. wrenches or strap wrenches (Ridgid No. 2-P) are recommended when joining T.A.B. pipe. Separate T.A.B. wrenches are available from the factory for each size pipe. The wrenches must be placed 6" to 12" (150 mm to 300 mm) from the joint to minimize ovaling and ensure proper make-up.



CAUTION: Improper use of strap wrenches can cause point-loading damage and/or bad joints that are locked up. To prevent damage to the pipe wall, wrap the strap wrench around the pipe as shown.



- Cover all machined areas on the spigot and at least one-half inch beyond the last thread in the bell with the adhesive.
- Screw the pipe together by hand, ensuring the joint is not cross threaded. Two inch (50 mm) diameter pipe can be hand tightened. To ensure complete joint make up for 3" and 4" (75 mm and 100 mm) diameter pipe, use T.A.B. wrenches.
- DO NOT OVER TIGHTEN.
- Check lock up by moving free end of pipe in an up-and-down or side-to-side motion. The movement must be sufficient to move the joint being checked. No movement should be visible in the joint. If any movement exists, continue to tighten until no movement is visible.

Connections into fittings are made using the normal bell and spigot methods.

JOINT CURE

Ambient Cure

Cure time is the time required for the adhesive in the assembled joint to harden. Cure time depends on the type of adhesive and the ambient temperature, as shown in Table 7.

TABLE 7. Adhesive Ambient Cure Time

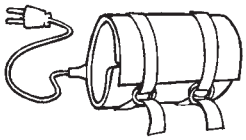
Adhesive Type	Temperature		Cure Time (Hours)
	Degrees F	Degrees C	
7000	110	43.3	2
	90	32.2	3
	80	26.7	5
	70	21.1	8
	60	15.6	18
	55	12.8	24
8000	110	43.3	1
	90	32.2	2
	80	26.7	4
	70	21.1	6
	60	15.6	12
	55	12.8	18

NOTE: Cure time is the time before the line can be tested. Times may vary depending on temperature, humidity, etc.

Heat Assist Methods

When working at temperatures below 55ºF or in situations where rapid cure is necessary, NOV Fiber Glass Systems has developed heat assist methods for curing adhesive bonded pipe or fitting joints.

A. Electric Heating Collar

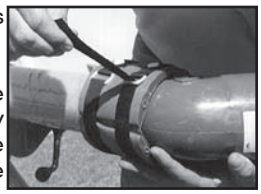


- The most effective method of heat assist is electric heat collars. Reusable 110/120 volt heating collars are standard (220/240 volt heating collars are available on special order and are shipped without the male plug).
- The curing operation should occur as soon as possible after the bonding operation. In cold weather it is preferable to bond only the amount of pipe that can be cured during the same day. If a generator is used, assure the power supply is adequate for all of the units being used. Use 110/120 Volt A.C. only. When extension cords are used, make certain they can handle the total wattage of the collars used. Refer to Table 4 on page 3.
- When temperatures fall below 32°F (0°C), fiberglass insulation should be added to heating collars to achieve a proper cure.
- Pipe or sub-assemblies can be moved before the joints are cured if care is taken and the joint is not disturbed. Avoid bending or excessive movement.
- Refer to Bulletin F6640 for complete operating instructions.

Do not bend or fold heating collar; this may break the heating elements and cause inadequate heat to cure the joint.

For Pipe and Fittings:

- Use the same size heating collar as the pipe size being installed, with the exception of flanges. Retract protective mesh covering on 2" pipe prior to use of heating collars.



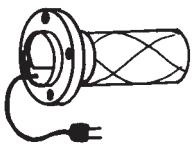
Do not use a heating collar that is designed for a larger size pipe.

- With the uninsulated flap on the bottom (next to the fitting), carefully wrap the heating collar around the joint. Feed the strap through the square ring.

CAUTION: The uninsulated flap is extremely hot when the collar is on. **DO NOT TOUCH with bare hands.**

- Tighten the straps until the heating collar is snug against the joint.

For Flanges:



- For 3" and 4" flange joints, use a heating collar that is one pipe size smaller. Remove the straps from the heating collar.
- Carefully turn the collar inside out with the heated area facing the I.D. of the pipe. Place the heating collar in the I.D. of the flange.

- A split ring of pipe may be used to hold the collar in place while the joint is curing.
- Heat collar is not available for 2" flanges. An industrial heat gun may be required to cure the joint. Be sure the end of the gun is at least six inches from the opening of the flange.

For Saddles:
To heat cure a saddle, place the heating collar over the saddle outlet. During cool weather, a wind shield is recommended to keep heat on the joint. Saddles must be heat cured for two hours.

TABLE 8.
Adhesive Cure Times for Electric Heating Collars

Piping System/ Adhesive Grade	Pipe Size	Cure Time		
		Pipe (Min)	Fitting (Min)	Flange (Min)
Red Thread IIA 7000 or 8000	2"-6"	10	20	15

Allow the joint to return to ambient temperature before applying stress to the joint.

NOTE: NOV Fiber Glass Systems' electric heating collars are designed to fit around fittings and will overlap on pipe joints and couplings. Exceeding the recommended cure time on pipe joints where the heating collar overlaps may shorten the life of the heating collar and/or damage the pipe.

B. **Heat Packs** - Although heating collars are the preferred method for heat curing joints, heat packs that cure joints in approximately one hour are also available. Retract protective mesh covering on 2" pipe prior of use of heat packs.

Refer to Heat Pack Literature (D4500) included with each kit for complete instructions. Observe all safety precautions listed on the installation sheet.

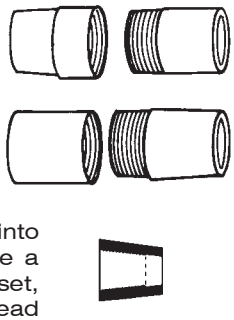
The adhesive bead will cure faster than the adhesive in the joint. It is important that the joint not be pressurized until it has been subjected to the proper time-temperature cycle. A temperature versus time to pressure curve is indicated in the instructions packaged with each adhesive kit.

CONNECTING TO OTHER SYSTEMS

Adapters available for connecting to other systems include the following: threaded adapters (bell or spigot by NPT or BSP threads), reducer bushings (NPT), and flanges.

NOTE: When using adapters with spigot ends, it may be necessary to cut off a portion of the factory pipe bell if the threads are not fully exposed.

Threaded Adapters and Reducer Bushings

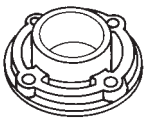


Before making up threaded connections, inspect the threads. Do not use fittings with damaged threads. **Inspect all steel threads and remove any burrs.** Threads must be clean and dry before applying thread lubricant. When using threaded adapters, thread them into the other system before bonding onto pipe. Otherwise, unless a union is used, it may be impossible to turn the adapter into the mating thread. For best results use a strap wrench and a solvent-free, soft-set, non-metallic thread lubricant. The thread lubricant must be chemically resistant (compatible) with the petroleum or alcohol product conveyed in the piping system.

Threaded Adapters
- Do not use thread sealing tapes.
- Apply thread lubricant to all threaded surfaces.
- Series 7000 and 8000 adhesives may be used in place of thread lube.
- Tighten to 1 to 1½ turns past hand tight.
- Do not use metallic wrenches that may cause damage to fittings.
- Do not over tighten. Tighten the adapters as if they were brass or other soft material.

Reducer Bushings
- When using threaded reducer bushings, the bushing should be BONDED and CURED before the male thread is screwed into the bushing.
- Adhesive instead of thread lubricant may be used on reducer bushings. Tighten the threaded reducer bushings as with standard thread lubricant.

Flanges
- Before bonding the flange onto the pipe, make sure the bolt holes line up with the mating bolt holes on the other system. Do not bolt the flange before bonding unless insertion depth of the spigot is previously checked to be certain the spigot does not bottom out or extend through the flange. The use of flat SAE washers on all nuts and bolts is required. The maximum allowable torque is indicated on each flange.



- Flanges meet ANSI B16.5 Class 150 bolt hole standards. Full-face gasketing materials, 1/8" (3 mm) thick, with a Shore A hardness of 60 to 70 durometer, are recommended for flanges. Gaskets made from Teflon and PVC usually have high durometer ratings and are not acceptable.

Connecting to Flat-Face Flanges - NOV Fiber Glass Systems' flanges must be joined to flat-face flanges.

Connecting to Pump/Dispenser - Several methods are available to connect the product piping lines and vent/vapor recovery lines to the underground storage tank and dispenser: Fiberglass fittings, flexible connector, steel fitting or swing Joint. **Use of flexible connectors at each location facilitates ease of installation.**

INSPECTING FOR POTENTIAL CAUSES OF JOINT FAILURE

Joint Backout - When assembling a bell and spigot joint, a bead of adhesive is normally formed at the edge of the bell. If the joint is not locked up and backs out before the adhesive cures, the bead will no longer be next to the edge of the bell.

Cocked Joint - If a joint is cocked or misaligned, there will usually be a large gap between the bell and spigot on one side. The opposite side will usually have a smaller or no gap. Misalignment is easier to detect if one sights down the line and views the joint from a distance.

When using heat assist, the pipe may bend if it is under stress while curing. In this case it is extremely difficult to determine if the pipe is bent because of heating or if it is a cocked joint. Avoid making up pipe and fitting joints when pipe is under stress.

Improperly Cured Joint - If the adhesive bead is soft or flexible, the adhesive is not sufficiently cured. If the bead is cured, it is hard and brittle when checked with a knife. When the bead is not hard after exposure to the recommended temperature and time cycle, the adhesive was not mixed properly.

Weather Damage - If a joint has been exposed to sunlight for a period of time and the machined area has turned from white in color to yellow or brown and was bonded without a proper repair, the joint may be suspect and could leak or even separate. Inspect for color change on all machined areas before bonding.

Although not all inclusive, the conditions mentioned above are the most common indications of failure to achieve a properly assembled joint.

All damaged or improperly assembled joints must be replaced. See Repair Procedures on pages 11-12.

TESTING RECOMMENDATIONS

- **Safety Precautions**
  NOV FIBER GLASS SYSTEMS SHALL NOT BE LIABLE UNDER ANY WARRANTY, CONTRACT, OR IN TORT, FOR ANY RESULTING INJURY TO PERSONNEL OR DAMAGE TO EQUIPMENT, PIPE, OR OTHER PERSONAL PROPERTY FOR FAILURE TO FOLLOW THE PROCEDURES AND COMPLY WITH THE PRECAUTIONS SET FORTH.

As in any system where pressure is employed, adequate safety precautions should be exercised.

In buried applications, it is suggested that long pipe runs be partially backfilled at various points to secure them in place. All joints and connections should be left exposed for inspection.

NOV Fiber Glass Systems does not recommend testing any installation with air or gas because of the safety hazards created. The light weight, flexibility, and elasticity of fiberglass pipe creates different conditions than are present with steel pipe. If a failure should occur while testing fiberglass pipe with air or gas, the system would be subject to considerable whipping and other shock-induced conditions due to the sudden release of stored energy. The violent release can cause severe personal injury or death to personnel in the area and can also cause damage to the pipe or other property.

If a line is tested with air or gas, NOV Fiber Glass Systems will not be responsible for any resulting injury to personnel or damage to property, including the pipe. Such testing is done entirely at the risk of those involved.

Test Procedures - Installed pipe systems should be tested prior to use to assure soundness of all joints and connections. In testing, sudden pressure surges or "water hammer" must be avoided, as in some instances surge or hammer can produce pressures of several times the rating of the pipe and fittings. 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.

The normal recommended procedure is to conduct a hydrostatic cyclic pressure test. The piping system is subjected to 10 pressurization cycles at 1½ times the anticipated or design operating pressure.

The test pressure should not exceed 1½ **times the maximum rated operating pressure for the lowest rated element in the system.** Pressure is then kept on the system for 1-8 hours while the line is inspected for leaks.

Air Test Procedures and Safety Precautions
TESTING WITH AIR OR GAS IS EXTREMELY DANGEROUS AND SHOULD NOT BE DONE. CONSULT YOUR REPRESENTATIVE OR CALL 501-568-4010 FOR TECHNICAL ASSISTANCE, IF YOU CONTEMPLATE EXCEEDING THE RECOMMENDED PRESSURES FOR THE LOWEST RATED ELEMENT OF THE SYSTEM OR IF YOU CONTEMPLATE USING AIR OR GAS IN SPITE OF THE WARNING, REVIEW ALL SAFETY PRECAUTIONS BEFORE STARTING THE TEST.

If testing with air or gas is required or requested to be performed, the following testing procedures and precautions must be followed. EXERCISE DUE CARE IN INSTALLING AND TESTING THE PIPING SYSTEM.

- Visually inspect all bonded joints for proper insertion and adhesive cure prior to pressurizing the piping system. A gap between the adhesive bead and the fitting shoulder indicates the possibility that joint failure exists. Make any necessary repairs before pressurizing the piping system.

- Check the integrity of the joints by pressurizing the system to 25 psig (0.172 MPa) and holding the pressure for a minimum of one minute. Soap all joints to test for leaks.

- If there are no leaks, raise the line pressure in the system to a **maximum** of 50 psig (0.345 MPa). Again, hold the pressure for a least one minute and soap all joints to check for leaks.

- As serious personal injury or death can result, the pipe inspector should take precautions for his/her personal safety and protection against flying debris and also against the whipping action of the pipe that can result from the sudden release of stored energy. Goggles should be worn to protect against flying debris.

- Avoid personal contact with the piping system while it is pressurized during testing except for actual checking of the joints for leaks. Absolutely no one should be in the trench while the pipe is being initially pressurized for leak testing. Notify all site personnel before beginning the testing procedure.

- Do not straddle the pipe during testing or while checking the piping system for possible leaks.

- While the pipe is being checked for leaks, do not stand at the end of the piping system or where it changes directions.

CAUTION: Failure to strictly follow these instructions can result in serious personal injury, death, and/or property damage.

- After the piping has passed the 50 psig (0.345 MPa) pressure test, we recommend the contractor reduce the product line pressure to a pressure of not more than 25 psig (0.172 MPa) and maintain this pressure until all paving has been completed. Leave pressure gauge on each line for inspection. The contractor should check the gauge daily to verify the pipe is holding pressure.

If a leak is encountered during the test procedure, immediately release all pressure in the piping system and refer to page 11 for proper repair procedures. Upon completing any necessary repairs to the piping system, follow the proper testing sequence and verify the system's integrity.

Vacuum or Inert Gas Test Procedures
Testing with vacuum and/or pressurized inert gases have been successfully used with our piping systems. Although helium testing in a closed atmosphere and at measured levels is useful, testing in the field with helium has shown inconsistencies when attempting to identify leak location.

Do not use these testing procedures for Red Thread IIA secondary containment piping systems. Refer to page 17.

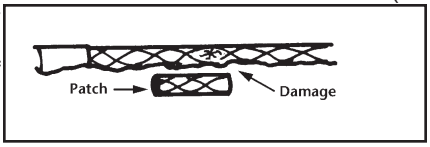
REPAIR PROCEDURES

For damaged pipe, NOV Fiber Glass Systems recommends only the repair methods listed below. DO NOT attempt to repair damaged fittings. Always pressure test repair work before putting the line back into service to assure the soundness of the repaired section. Contact your local representative for further information.

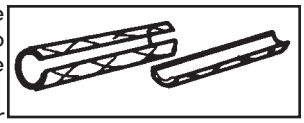
During repair, the pipeline should not be under pressure, and the area to be repaired must be clean and dry throughout the procedure.

Pipe Patching
Follow these instructions to repair pipe wall damage where the damaged area is two inches (50 mm) or less in diameter:

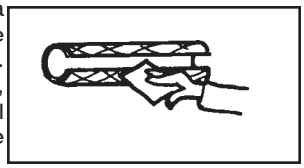
- For 2" pipe, cut the protective mesh covering and slide away from damaged area.
- Cut a length of good pipe long enough to adequately cover the damaged area and extend at least three inches (75 mm) and preferably four inches (100 mm) to either side of the damaged area.



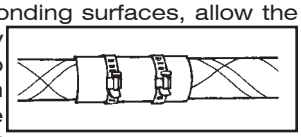
- Slit the "patch" lengthwise twice and remove a section so that about three-fourths of the circumference remains.



- Thoroughly sand the inner surface of the patch and sand a corresponding area on the pipe around the damaged section. Use coarse sandpaper, a file, or a disc sander to remove all gloss from the surface to be bonded.



- If solvent is used to clean all bonding surfaces, allow the solvent to evaporate then apply a thick coating of adhesive to both surfaces, snap the patch in place, and apply pressure with hose clamps or banding material until the adhesive hardens. The clamps may be left on or removed after curing.



- Replace the protective mesh covering if the repair is made on 2" pipe.

Repairing Extensive Damage
When the damaged area in the pipe wall is larger than two inches (50 mm) in diameter, follow these instructions:

- For 2" pipe, cut the protective mesh covering and slide away from damaged area.
- When damage is local (less than two inches/50 mm long but more than two inches/50 mm around the circumference of the pipe), check to see if there is enough slack in the pipe to cut out the damaged section. If so, cut out the damaged section, retaper the cut ends, and bond a sleeve coupling between the tapered ends. Make sure the joints are locked up and fully cured before pressure testing the repair.

If the pipe is buried, excavate a working area large enough to allow for tapering tool rotation. Taper the cut ends of the pipeline and install the sleeve coupling.

- When damage is extensive (too large for replacement by a sleeve coupling), cut out the damaged section, taper the cut ends, and install two sleeve couplings and a pipe nipple. This procedure requires sufficient slack in the line to make the final joint by lifting the pipe (or moving the pipe to one side) to engage the bell and spigot joint. Therefore, it may be necessary to remove additional backfill from a buried line to allow the pipeline movement of several feet.
  - — Cut out the damaged section of pipe,
  - — Taper one end of a piece of pipe at least as long as the damaged section. This taper will be used as a gauge. Cut this nipple to the proper length in the following steps.

To determine the insertion length of the tapered ends, move one of the couplings to the side and use the end of the repair nipple made in the previous step to determine the dry fit into each bell. (NOTE: The dry fit must be very tight, i.e. use additional force to drive the joint together tightly enough that it is difficult to separate.) The total length of the repair nipple is determined by adding these two measurements to the distance between the sleeve couplings and then adding the two make-up dimensions from Table 9.

TABLE 9. Make-up Dimensions (Wet)

Pipe Size		Make-up Dimensions	
In.	mm	In.	mm
2	50	1/8	3
3	75	3/16	5
4	100	3/16	5

This added length is needed due to additional insertion that occurs because the adhesive acts as a lubricant. CAUTION: This additional insertion will be greater if a tight, dry fit is not achieved when measuring.

After the final nipple length is determined, cut the other end of the nipple and taper it, making sure the nipple is on the tapering tool in exactly the same position as the first taper that was used to measure the insertion length.

- If solvent is used to clean bonding surfaces, allow the cleaner to evaporate. Apply adhesive to all bonding surfaces and insert the nipple into the line by lifting the line or moving it to one side. Pushing the pipe back into the line will push the nipple into the bell. Make certain all tapers are tightly locked.
- Replace the protective mesh covering if the repair is made on 2" pipe.

Leaking Joints
Any adhesive-bonded joint that leaks during pressure testing **MUST BE REMOVED AND REPLACED**. Follow the previous procedures using two sleeve couplings and pipe nipple.

After completing any necessary repairs to the piping system, follow the proper testing sequence to verify the system's integrity.

PART TWO

INSTALLATION INSTRUCTIONS FOR Red Thread IIA SECONDARY CONTAINMENT PIPING

The secondary containment piping system is designed for use with Red Thread IIA product pipe. The system consists of the next larger size pipe and special two-piece fittings.

Many of the procedures used for installing primary product pipe and fittings are also used for installing secondary containment pipe and fittings. Refer to these sections and to Bulletin Nos. F6625 or F6624 for tapering tool operating instructions.

Following are useful sections previously outlined:
Storage and Handling (page 1)
Layout and Preparation (pages 2-3)
Tool and Equipment List (page 3)

For installation of bolts, the following is recommended:
- Variable speed impact wrench with 3/8" socket
- Variable speed drill motor with 3/8" socket
- One 3/8" wrench

For installing saddles, the following is recommended:
- Sanding equipment:
  – power sander with rough surface sanding disk (flexible pad with 40 grit or less disk), or
  – hand file (coarse)
- Fine tooth circular hole saw with pilot drill
- Hose clamps or Band-It® banding tool large enough to secure saddles to pipe. (If banding is used, the Band-It banding tool is preferred as this tool does not allow slack in the band when the tool is removed. Two Band-It tools are recommended so the saddle can be pulled down uniformly. Use ¾" (19 mm) banding. (Band-It information is available at www.band-it-index.com).

Cutting and Tapering (page 3)
Installation (piping layout and trench design; adhesive mixing and curing, pages 5-11)

Secondary Containment Pipe
NOV Fiber Glass Systems' secondary containment piping sizes are as follows:

Containment Pipe Size		Primary Pipe Size	
3"	75 mm	2"	50 mm
4"	100 mm	3"	75 mm
6"	150 mm	4"	100 mm

Secondary Containment Fittings
Available secondary containment fittings are tees, 90° elbows, 45° elbows, couplings, nipples, concentric reducers, termination fittings (with or without ¾" NPT threaded outlet), saddles (belled or with NPT threaded outlets), and sump entry termination fittings. Inserts are required on 3" and 4" 90° elbows and tees for Closed Interstitial Monitored Systems. Inserts are not required for Open Gravity Flow Systems.

Adhesive for Secondary Containment Piping
When joining secondary containment pipe-to-fittings and fittings-to-fittings, fiberglass filler must be added to the 7000 or 8000 series adhesive to ensure optimum performance of this type of bonded joint.

Filler is available from NOV Fiber Glass Systems. Due to the quantity of adhesive required for joining secondary containment fittings, it is recommended that only 7069 or 8069 kits be used (See Table 13 on page 16). If 7014 and 8014 kits are used, please note that extra kits (50% more than 7069 or 8069) must be used for each secondary containment fitting.

LAYOUT AND PREPARATION

Before installing the secondary containment piping system, review and verify the recommendations for proper installation set forth previously:

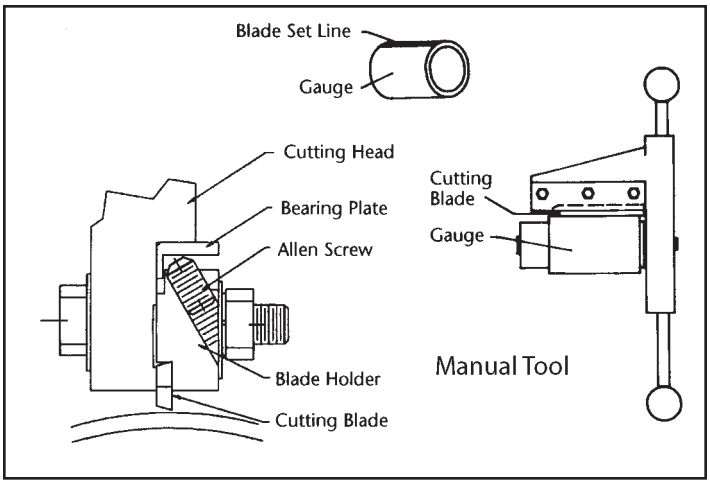
Layout and Preparation (Installation Crew Size and Organization) (page 2)

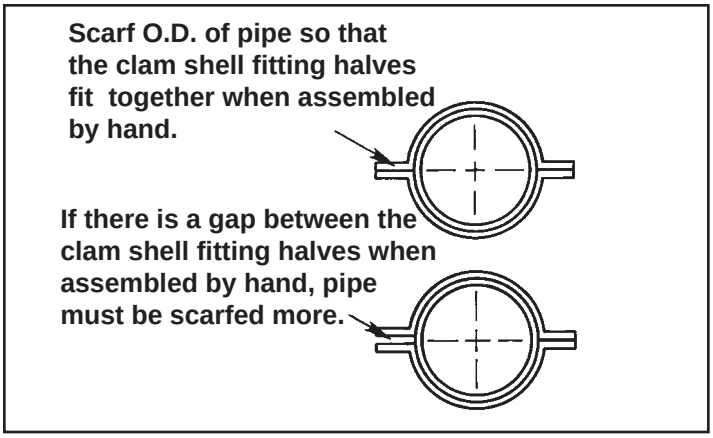
Piping Layout, Pipe Trenches and Burial (pages 4-5)
Most of the standard procedures for installing a secondary containment piping system can be handled by the same size crew that would install a single-wall product piping system. It is essential that each phase of an installation be evaluated and the proper number of workers be assigned to assure an efficient installation.

SCARFING PIPE

All piping should be scarfed before bonding. Couplings may be needed for making containment pipe size reductions or straight pipe runs. Spigots may be needed for pipe runs or for making a containment sump connection.

The ends of the containment pipe that are to be joined to secondary containment fittings must be thoroughly scarfed for a minimum length of 3 inches (75 mm). See page 3 for scarfing tools available or refer to **Bulletin Nos. F6624, F6625,** or **F6600** for complete operating instructions.





Properly scarfed ends are most easily accomplished by using the Model 2100 power tool. Preset at the factory, it can scarf 3" and 4" (75 mm and 100 mm) Red Thread IIA secondary containment pipe. It also tapers 2" and 3" (50 mm and 75 mm) Red Thread IIA primary pipe.

If the Model 2100 or 2102 power tool is not available, the ends may be scarfed using the manual tapering tool in conjunction with a secondary containment scarfing adapter kit. This kit consists of a special scarfing blade (approximately 4"/100 mm long), scarfing blade holder, 1/8" Allen wrench, and 3" and 4" (75 mm and 100 mm) scarfing gauges, that are required to set the tool tolerances. The scarfing adapter kit is easily adapted to the 2"-6" (50 mm-150 mm) manual tapering tool kit.

Assemble the proper size mandrel and scarfing blade holder following the procedures in **Manual No. F6600**, Installation Instruction for 1"-6" Tapering Tool.

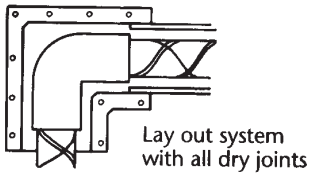
Rotate the tool body so that the scarfing blade holder is at a 12 o'clock position; this assures the blade will rest on top of the gauge. Slide the proper size gauge all the way to the back of the mandrel. Insert the special blade into the blade holder all the way to the back of the tool body. After positioning the black reference mark on the gauge under the blade, be sure the blade makes uniform contact with the gauge and the blade holder is resting on the blade.

Using the nuts, bolts, and washers supplied, tighten the blade holder to secure the blade. Now insert and slide the bearing plate into the slot located between the tool body and the blade holder. The bearing plate will rest loosely on the blade holder until it is locked into place using the supplied Allen screws. The two Allen screws should now be positioned so each makes LIGHT contact with the bearing plate. The Allen screws only prevent the blade holder from opening during use.

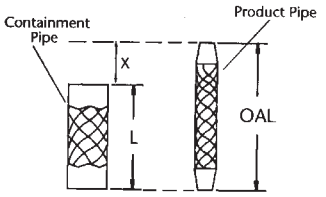
The tool is now prepared to remove (scarf) the resin gloss from the ends of the containment pipe. After removing the gauge, insert the tool into the pipe to be scarfed until the point of the blade touches the end of the pipe. The tool must be rotated in the same direction the wide side of the blade faces. Advance the tool in approximately ¼" (6 mm) increments after each revolution. Continue the operation until the resin gloss has been removed for a minimum length of 3" (75 mm).

PIPING LAYOUT

Pre-installation of the secondary containment pipe is best accomplished at the same time the product pipe is dry fitted together.



Typically, the length of the containment pipe should be 4" shorter than the primary pipe.



WARNING: Fit all secondary containment connections to make sure the insertion is approximately 3". Be sure the containment pipe is not inserted too far into the containment fitting. **The glossy O.D. of the pipe should not be seated in the containment fitting.**

CONTAINMENT FITTINGS

All containment fittings consist of two halves with flanges. The bottom half has threaded inserts for ease of assembly.

These fittings are assembled with adhesive and ¼-20 washer head bolts that are furnished with the fittings. The required bolts are supplied in small plastic bags. If extra bolts are required, they can be purchased from your distributor or standard ¼-20 x 1" long hex head bolts can be used. If standard bolts are used, place a flat washer on the bolt before torquing.

The bonding surfaces of the containment fittings are pre-sanded when manufactured. Two-piece secondary containment fittings must be joined using a greater amount of adhesive than is necessary for joining bell and spigot joints of product piping. Coat the ID of both halves of the containment fittings completely.

CONTAINMENT CROSSOVER DETAIL

When installing a secondary containment system, some preparation is necessary if the closest possible separation of lines is required. To minimize the overall change in elevation when installing a containment crossover, it is necessary to shorten one leg of the 45° containment elbow and the side outlet run of the containment tee.

Refer to Table 10 for the maximum length that can be removed and for the minimum nipple length of both product piping and secondary containment piping.

NOTE: Use self-tapping screws or match drill two holes ($^5/_{16}$") at a distance of $^3/_4$" (19 mm) from the cut end of the 45° elbow and the tee.

TABLE 10. Containment Crossover Information

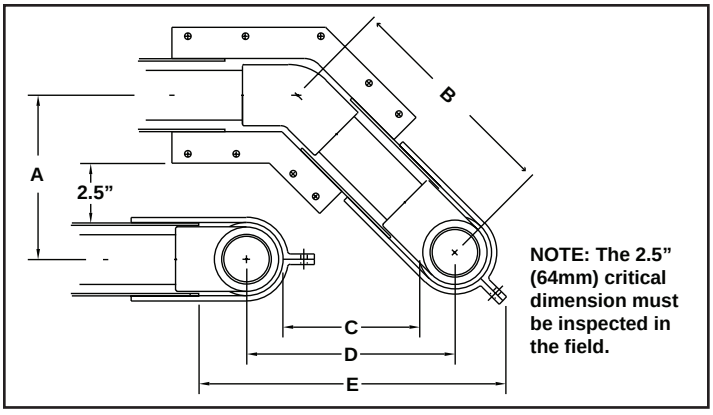
Fitting	Containment Pipe Size		
	3" (max. in.)	4" (max. in.)	6" (max. in.)
Remove from 45° elbow	1.25	2.00	1.25
Remove from side run of tee	1.50	1.63	1.00
Product nipple size (1)	2x8	3x8	4x10
Containmentnipple size	3x6	4x6	6x8

(1) Actual length of the product nipple will vary slightly because of different insertion lengths due to variations of tapers.

To prevent interference of the pipelines, do not locate two containment fittings closer than shown in Table 11 and the drawing below.

TABLE 11. Pipe Separation Distances

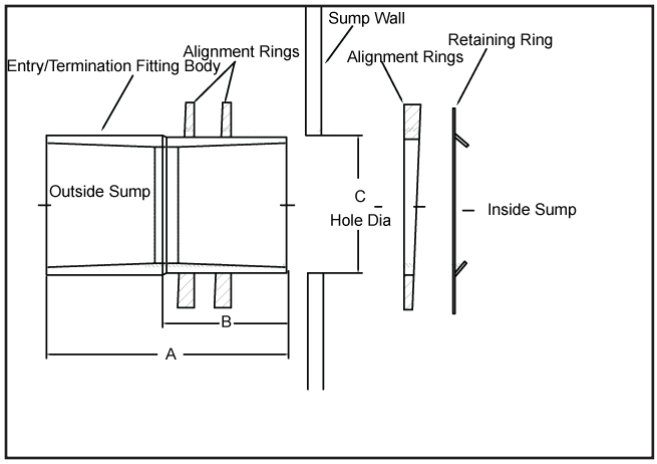
Containment Pipe Inches	A In.	B In.	C In.	D In.	E In.
3	7.50	10.60	6.50	10.00	14.50
4	8.50	12.00	7.50	12.00	16.50
6	10.65	15.00	8.00	14.75	22.00
Containment Pipe mm	A mm	B mm	C mm	D mm	E mm
75	191	269	165	254	368
100	216	305	191	305	419
150	271	381	203	375	559



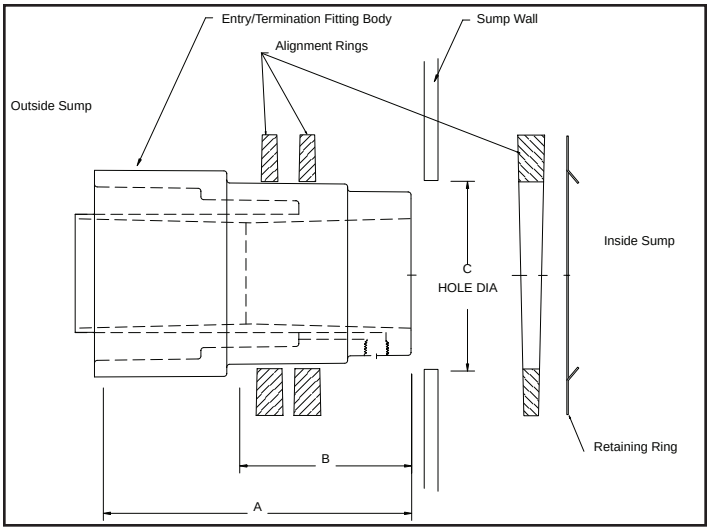
NOTE: The 2.5" (64mm) critical dimension must be inspected in the field.

SUMP CONNECTIONS

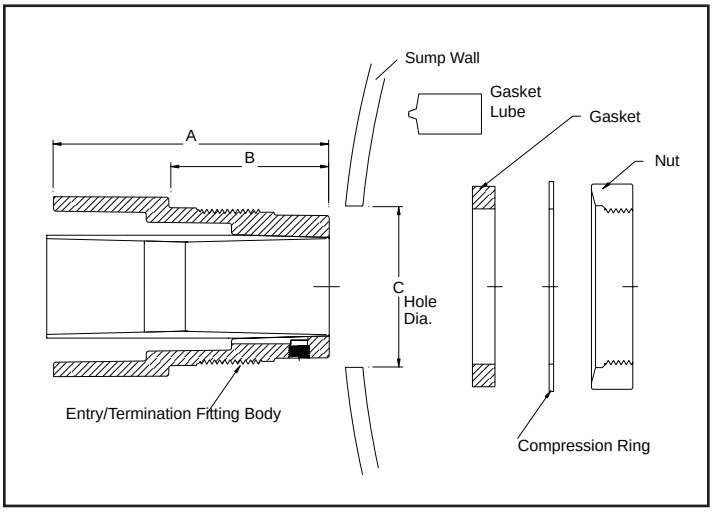
- **Single Wall Sump Entry/Termination Fitting**
  (Refer to B2107 for installation information)



- **Double Wall Sump Entry/Termination Fitting with Bonded Fiberglass Alignment Rings**
  (Refer to B2108 for installation information)



- **Sump Entry/Termination Fitting with Gasket**
  (Refer to B2109 for installation information)



Alternate Termination
Termination of the secondary containment piping system at the storage tank is accomplished using a termination fitting with ¾" female NPT threaded outlet. See figure below. The ¾" threaded outlet allows easy access for pressure testing of the secondary containment piping system and may also be used as an access for a leak detection probe.

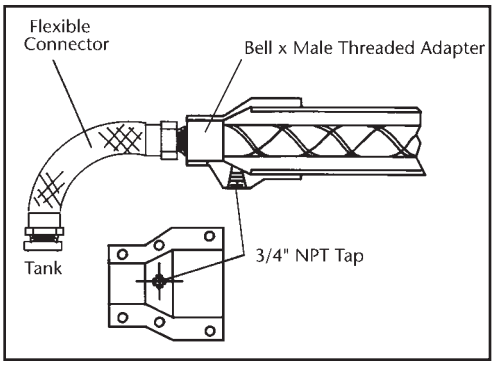


TABLE 12. Termination Fitting Connections

Part Number	Termination Fitting Size In. (mm)	Large End Fits Pipe In. (mm)	Small End Fits (Male threaded adapter or coupling)[1]
012030-236-3 w/ tap	3 x 2	3	2"
012030-235-3 w/o tap	(75 x 50)	(75)	(50)
012040-236-3 w/ tap	4 x 3	4	3"
012040-235-3 w/o tap	(100 x 75)	(100)	(50)
012060-234-7 w/tap	6 x 4	6	4"
012060-235-7 w/o tap	(150 x 100)	(150)	(100)

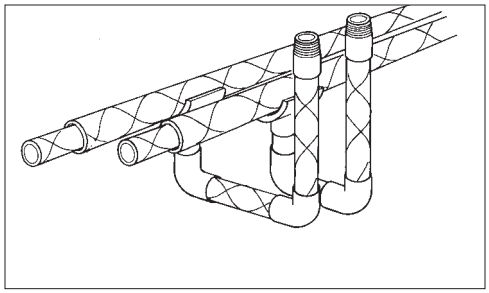
[1] A scarfed O.D. BxM adaptor or coupling is avaliable for use with the termination fittings.

SECONDARY CONTAINMENT REDUCERS

In-line secondary containment pipe size reductions are made using a concentric reducer. Reductions can be made from 6" to 4" (150 mm to 100 mm) and 4" to 3" (100 mm to 75 mm). Both ends of the concentric reducer are bonded to scarfed end of pipe.

SECONDARY CONTAINMENT SADDLES

For secondary containment piping installations requiring intermediate access stations for visual or electronic leak detection, several sizes of reducing saddles are available. See **Manual No. 2101** for saddle sizes and descriptions.



Note: If connecting components, extend to the surface where the assembly can be subjected to bending forces, flexible connectors (such as flexible hoses) must be used to eliminate bending stress.

Containment saddles must be installed prior to bonding and testing the product piping.

Procedure for installing secondary containment saddles:
- Locate saddle on pipe and mark around saddle base.
- Use a file or rough sandpaper (40 grit or less) to remove all surface gloss from the pipe O.D. where the saddle is to be bonded. Use circular or random pattern during sanding to eliminate grooves on the pipe surface.
- After sanding, locate saddle on pipe and mark hole to be cut in pipe. Using pilot drill and a fine-tooth circular hole saw, cut a hole of the same size as the outlet of the saddle. Do not force the cutter or it will fray the edges of the hole.
- All bonding surfaces must be free from contamination.
- Apply a heavy coat of adhesive to the O.D. of the pipe, I.D. of the saddle, and the edges of the pipe wall exposed by cutting the hole.
- Place the saddle over the hole and clamp with two hose clamps. Using a large screw driver, hand tighten the clamps alternately until secure and adhesive squeezes out all the way around the saddle. This will ensure the pipe O.D. conforms to the I.D. of the saddle. The clamps may be left on or removed after the bond has cured.

Do not attempt to install a saddle on the containment pipe if the product piping system has been installed and tested.

JOINT PREP

Installation Preparation
Before bonding the two-piece containment fittings, the installation procedures should be reviewed with the installation crew members. In order to maintain the efficiency of the installation, a minimum of three workers is recommended: one worker to mix and apply adhesive to the secondary containment fittings and the two remaining workers to assemble and bolt the fittings together.

Cleaning the Bonding Surfaces
It is recommended that all bonding surfaces are cleaned before bonding. DO NOT TOUCH THE BONDING SURFACES OR ALLOW THEM TO BECOME CONTAMINATED.

Acceptable cleaning methods are as follows:
- Sand all bonding surfaces until contamination is removed.
- Dirt contamination can be removed by water washing. Be sure the surfaces are dry before bonding.
- Sand all machined ends that have been exposed to sunlight and have turned yellow or brown in color.
- Use of a solvent as a cleaning method is optional. Some cleaning solvents are acetone, alcohol, methylene chloride, and methyl ethyl ketone. After cleaning, be sure any residual solvent has evaporated before applying adhesive. DO NOT USE SOLVENTS THAT LEAVE AN OIL FILM ON THE BONDING SURFACES.

WARNING: Some degreasers and solvents are extremely flammable. Be sure to read warning labels on containers. Never use gasoline, turpentine or diesel fuel to clean joints.

Contact your representative if you have questions.

ADHESIVES

For secondary containment systems conveying alcohols or alcohol/gasoline blends, use 8000 or 7000 series adhesive. Follow the adhesive mixing instructions that are packaged with each kit.

Refer to page 7 for information on adhesive labeling.

ADHESIVE MIXING

When the weather is cool or the adhesive has been stored in a cool environment (below 65°F), pre-warm the adhesive kits. (Do not heat above 100°F)

- Empty all of the contents of the hardener. **Never attempt to split a kit.** Cut through the adhesive with the edge of the mixing stick to assist in mixing the two components.
- Mix until the adhesive has a uniform color and a consistent flow off the mixing stick. Wipe down the sides, bottom, and under the rim of the can with the mixing stick to assure complete mixture.
- **FILLER MUST BE ADDED TO THICKEN THE ADHESIVE.** The filler is packaged in pre-measured quantities for use with 7014 or 8014 and 7069 or 8069 adhesive kits. One bag of filler is used for each adhesive kit. Before adding the filler to the mixed adhesive, be sure both the adhesive base and hardener are thoroughly mixed together. All of the filler in the bag should be used. The thickened adhesive may be applied with either the brush or the stir stick provided in the kit.

Refer to Table below for the number of adhesive kits required to bond containment fittings.

TABLE 13. Adhesive Kits Per Containment Fitting

Type Fitting	7069 or 8069* (Kits per Fitting)		
	3"	4"	6"
90° Elbow	1	1	1.5
45° Elbow	1	1	1.5
Tee	1	1.5	2
Coupling	1	1	1.5
Termination Fitting	1	1	1.5

*If 7014 or 8014 adhesive kits are used for secondary containment, increase the number of kits in Table 13 by 50%.

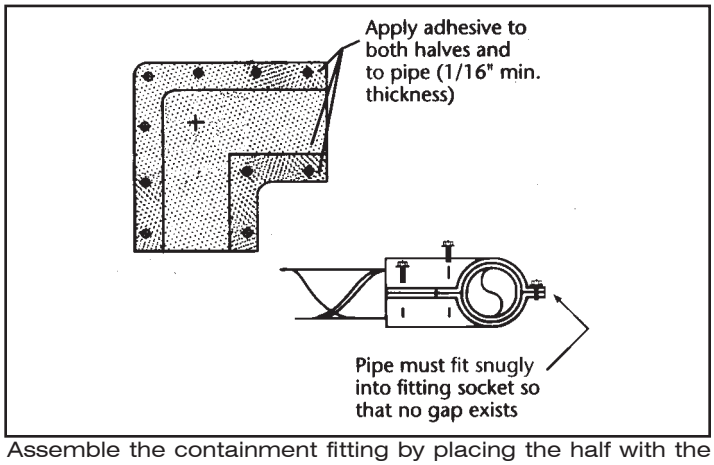
Number of adhesive kits per containment fitting is based on applying a 1/16" (1.6 mm) minimum thickness of adhesive to both halves of the fitting and to the pipe ends.

Complete information and safety precautions are packaged with each adhesive kit. Review all safety precautions thoroughly before mixing the adhesive.

Adhesive Disposal - See page 6 for instructions.

JOINT ASSEMBLY FOR RED THREAD IIA SECONDARY CONTAINMENT PIPING

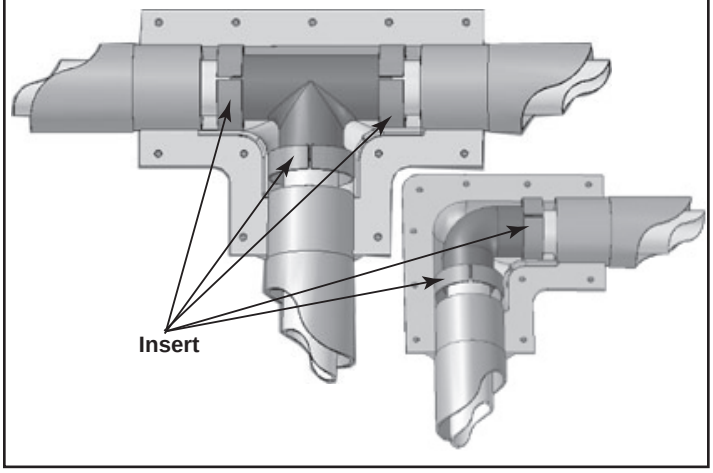
After cleaning the inside surfaces (I.D.) of both halves of the two-piece fitting, apply a thick coating (1/16"/1.6 mm minimum of filled adhesive to the entire I.D. of both halves of the fitting, including the flanges (flat bonding surfaces). Next apply a thick coating (1/16"/1.6 mm minimum) of adhesive to the scarfed or sanded surfaces of the pipe ends.



Assemble the containment fitting by placing the half with the pre-installed threaded female inserts on the bottom. Do not insert pipe past scarfed area.

Inserts must be used on 3" and 4" 90° elbows and tees for Closed Interstitial Monitored Systems. Inserts are not required for Open Gravity Flow Systems. Prior to bonding the insert, spread the insert splice 3 or 4 times to relax the insert. The insert may be placed on the containment pipe or primary fitting for easy access prior to bonding of the containment fitting. Locate the inserts next to the inside radius of the containment fitting, as shown on drawing below. The split in the insert must be facing up. Do not allow insert to overlap itself.

Closed Interstitial Monitored System Inserts



Use the bolts supplied with the clam shell fitting to assemble the fittings on the pipe. Use of an air or electric wrench with a magnetic socket will greatly facilitate assembly. When starting the bolts, allow the bolt to start with minimal pressure on the tool. Excessive pressure may push the insert from the fitting. Tighten the bolts alternately and with equal force. **Do not exceed 8 ft•lbs of torque.**

NOTE: Prior to bonding, make sure the pipe fits snugly into the socket ends of the two-piece fittings and there are no gaps between pipe ends and fitting sockets. A properly bonded joint should have adhesive visible from all bonded surfaces.

NOTE: Do not disturb a completed containment piping joint when assembling additional joints. The adhesive must be fully cured before applying stress to the assembled joints. Read and observe the filled adhesive instructions supplied with each adhesive kit.

JOINT CURE

Industrial Heat Gun
An industrial heat gun and heavy duty aluminum foil may also be used to create a mini oven around the secondary containment fitting. Wrap foil around the fitting and cinch the ends down. Cut a 10" to 12" section of 2" or 3" pipe and place inside of the foil. Place heat gun in the end of the pipe. Do not place heat gun any closer than 12" from the fitting. Cure time is approximately 15 minutes. For a proper cure, maintain the temperature between 250°F and 400°F.

TESTING RECOMMENDATIONS FOR SECONDARY CONTAINMENT PIPING

Secondary containment piping, 3"-6" (75 mm and 100 mm) diameter sizes, can be pressure tested by installing an in-line tee with a pressure gauge and a nipple in the 3/4" threaded outlet of a termination fitting. If the test piping is to be installed temporarily, use care not to over tighten when installing the steel pipe threads. Fiberglass threads may be damaged when removing the steel threads if over tightened. Use soft-set, non-metallic thread dope only.

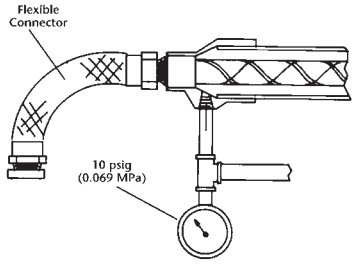
NOV Fiber Glass Systems recommends testing 3", 4", and 6" (75, 100, and 150 mm) secondary containment piping systems with air at pressures not to exceed 10 psig (0.069 MPa). The most convenient place to introduce air for the containment piping pressure test is at the threaded outlet located on the termination fitting near the underground storage tank. The system should stay pressurized until the installation is completed to monitor for possible damage to the containment piping system during additional construction.

The low pressure and low volume of the secondary containment piping system makes air testing a relatively safe procedure if normal safety precautions are followed. Refer to air safety precautions on pages 10-11.

TEST PROCEDURES FOR "IN SERVICE" SECONDARY CONTAINMENT UL PIPING SYSTEMS

Secondary Containment piping systems can be tested after the line has been installed and in operation for a period of time. All systems must be shut off before testing. It is recommended that where possible, the air input valve be in a different location than the pressure gauge. **Please read and understand all safety instructions and considerations in the Installation Manual No. B2160 before testing.**

Closed System
Test 3" and 4" secondary containment closed systems with air at pressures not to exceed 10 psig. Pressure should be left on the system for a minimum of one hour. The test pressure should not exceed the pressure rating of any component in the piping system.



Open System (Gravity Drain)
Test 3"-6" secondary containment open systems with air to the equivalent static head test pressure listed in the table below. The pressure should be left on the system for a minimum of one hour. The system must be temporarily sealed during testing. Do not exceed the pressure rating of any component in the piping system.

Test Pressure for Open System	
Feet of Head*	Test Pressure (psig)
2	1.0
4	2.0
6	2.5
8	3.0
10	4.0
12	5.0

*Highest point in system minus the lowest point in system.

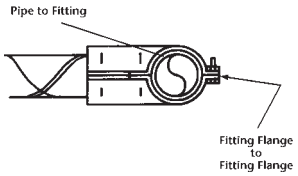
These test procedures are designed specifically for the NOV Fiber Glass Systems' piping system. The company is not responsible for any damage to "other" products in the systems such as rubber boots, hoses, etc. Please contact the manufacturer of other products for their recommended maximum test pressure and time.

Vacuum or Inert Gas Test Procedures
Testing with vacuum and/or pressurized inert gases have been successfully used with our piping systems. Although helium testing in a closed atmosphere and at measured levels is useful, testing in the field with helium has shown inconsistencies when trying to identify leak location.

REPAIR PROCEDURES

Leaks can occur if secondary containment joints are not properly bonded. Upon completion of required repairs and before putting the line back into service, always pressure test the repair work according to the procedures on page 17 to assure the integrity of the system. For damaged pipe and for leaking joints, the recommended repair methods are listed below.

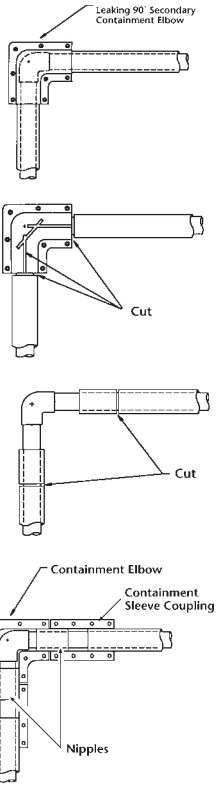
• **Replacing Leaking Two-Piece Secondary Containment Fittings** - Do not use this procedure for containment crossovers.



Example: 90° Secondary Containment Elbow

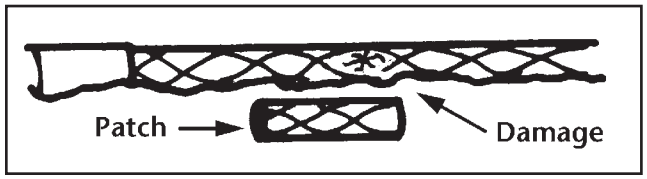
When cutting out and replacing a secondary containment fitting, do not cut the internal primary product pipe.

1. Dissect the secondary containment fitting and secondary containment pipe around its circumference as shown by the arrows. Remove the containment elbow.
2. Create a pipe nipple at least 7" (180 mm) long on either side of the joint by making another cut around the circumference of the containment pipe.
3. Using a sander, coarse file or 30-40 grit Emery cloth, remove surface gloss from both ends of the nipples and the containment pipe. Sanded area must be a minimum of 3" (75 mm) in length.
4. Position the nipples between the new containment elbow and containment sleeve couplings. NOTE: It may be necessary to remove additional sections of the containment pipe to provide clearance for the coupling.
5. Bond the elbow and containment sleeve couplings into place according to instructions.



• **Repairing Minor Damage to Pipe**

Follow the pipe patching instructions on page 11 of this manual when the damaged area is two inches (50 mm) or less in diameter.



Repairing Minor Damage to Fittings

Small repairs (pinhole leaks and leaks up to 1" in diameter) using 8088 Repair Kit:

1. Take pressure off the system and dry the area around the leak.
2. Sand an area 3" minimum on each side of the leak.
3. Cut three 3" x 3" patches from the glass supplied with the 8088 repair kit.
4. Mix adhesive per instructions supplied in the kit.
5. Paint adhesive on the sanded area of the fitting.
6. Apply the first layer of glass and wet out with adhesive. The glass may be wet out before it is applied to the leak area.
7. Repeat the previous step and apply another layer of glass.
8. Cure per the time listed in the adhesive kit instructions.

Flange section or joint leak repairs (overwrapping entire fitting) using 8088 repair kit.

1. Take pressure off the system and dry the area around the leak.
2. Grind or cut flange sections off the clam shell secondary containment fitting and sand flush with the fitting body.
3. If needed, mix adhesive with filler to grout in any gaps or voids in the bond line or to create a smooth wrapping surface.
4. Per instructions in the 8088 repair kit, apply adhesive to the sanded area. Wet out glass and wrap around the fitting as though it were a section of pipe, centering the first layer over the joint and extending 2" past the end of the fitting onto the pipe. Apply tension to squeeze adhesive through the glass layer. For elbows and tee, slits may have to be cut in the center section for glass to lie flat.
5. Repeat previous step on the center of the joint and then the other side of the fitting extending 2" over the end of the fitting. When starting the glass, overlap the first wrap a minimum of 2".
6. Repeat two previous steps until three layers of glass have been placed over the fitting.
7. Cure per the time listed in the adhesive kit instructions.

• **Repairing Extensive Pipe Damage**

When damage is less than 2" (50 mm) long but more than 2" around the circumference of the pipe, the following repair procedures should be followed, If the pipe is buried, excavate a working area large enough to allow for repairs to be made. Use a secondary containment sleeve coupling to make this type repair. Containment sleeve couplings are 14" (350 mm) long. Do not remove more than 7" (175 mm) of containment pipe.

CAUTION: When cutting out extensive damage in the containment pipe (only), be extremely careful not to damage the internal product piping.

1. After cutting free the damaged section of containment pipe (no more than 7" / 175 mm) long, slit the section of pipe in half and remove.
2. Using a sander, coarse file or 30-40 grit Emery cloth, remove surface gloss from both ends of the pipe. Sanded area must be a minimum of 3" (75 mm) in lengths. If contaminated, clean the sanded surfaces with solvent.
3. Mix the adhesive with filler. Assemble and bond the containment sleeve coupling into place and heat cure the bond.
4. After the repaired section has cured, pressure test the system following the procedures on page 17.

If damage is beyond these repair procedures, immediately contact your local distributor for assistance.

CONVERSIONS

U.S. System Units - Metric Equivalents

Lengths	1 millimeter	0.03937 inch
	1 centimeter	0.3937 inch
	1 meter	39.37 inches or 1.094 yards
	1 kilometer	1093.61 yards or 0.6214 mile
Areas	1 square millimeter	0.00155 square inch
	1 square centimeter.	0.155 square inch
	1 square meter	10.764 square feet or 1.196 sq. yards
	1 square kilometer	0.3861 square mile
Volumes	1 cubic millimeter	0.000061 cubic inch
	1 cubic centimeter	0.061 cubic inch
	1 liter	61.025 cubic inches
	1 cubic meter	35.314 cubic feet or 1.3079 cubic yards
Capacities	1 milliliter (0.001 liter)	0.0338 U.S. fluid ounce
	1 liter	2.1134 U.S. liquid pints
	1 liter	1.0567 U.S. liquid quarts
	1 liter	0.2642 U.S. gallon
Weights	1 gram	0.03527 avoir. ounce or 15.4324 grains
	1 kilogram (1000 grams)	2.2046 avoir. pounds

Lengths	1 inch	25.4 millimeters or 2.54 centimeters
	1 foot	0.3048 meter
	1 yard	0.9144 meter
	1 mile	1.6093 kilometers
Areas	1 square inch	645.16 square millimeters or 6.452 square centimeters
	1 square foot	0.0929 square meter
	1 square yard	0.8361 square meter
	1 square mile	2.59 square kilometers
Volumes	1 cubic inch	16,387.2 cubic millimeters or 16.3872 cubic centimeters
	1 cubic foot	0.02832 cubic meter
	1 cubic yard	0.7646 cubic meter
Capacities	1 U.S. fluid ounce	29.573 milliliters
	1 U.S. liquid pint	0.47317 liter
	1 U.S. liquid quart	0.94633 liter
	1 U.S. gallon	3.78533 liters
Weights	1 grain	0.0648 gram
	1 avoir. ounce	28.35 grams
	1 avoir. pound	0.4536 kilogram
	1 Troy ounce	31.1035 grams

DECIMAL EQUIVALENTS OF FRACTIONS

Inches	Decimal of an Inch
1/16	0.0625
1/8	0.0125
3/16	0.1875
1/4	0.2500
5/16	0.3125
3/8	0.3750
7/16	0.4375
1/2	0.5000
9/16	0.5625
5/8	0.6250
11/16	0.6875
3/4	0.7500
13/16	0.8125
7/8	0.8750
15/16	0.9375

DEFINITION OF TERMS

BxS - Bell (female) x spigot (male) joint.

Bond Line - Area where two surfaces are bonded together.

Closed Secondary Containment Piping System - A secondary piping system with ends normally closed at the tank and sump with a minimum rated pressure of 50 psig (350 kPa).

Cocked Joint - Appearance of BxS joint that is improperly aligned.

Cool Weather Conditions - Below 65ºF.

Cure Time - Time for a joint to completely cure after it is bonded.

Damaged Pipe - Pipe that has been affected by excessive external or bending loads.

Glue Line - See bond line.

Improperly Cured Joint - Joint that is not cured.

Joint Backout - A spigot that backs out of a bell due to incomplete lock up or movement at the other end of the pipe.

Lock Up - Spigot is fully engaged with the bell until there is no pivot action in the joint.

Machined Surface - Area of pipe or fitting that is machined to remove the surface gloss so that it may be bonded.

Matched Taper - The matching tapers on a BxS or T.A.B. joint.

Mechanical Locking - See lock up.

Open Secondary Containment Piping System - A secondary piping system with ends normally open at the sump and a minimum rated pressure of 5 psig (35 kPa).

Pot Life - Time allowed to make bonds with adhesive after mixed.

T.A.B. - Threaded and Bonded - Tapered joint with shallow threads to prevent joint back out.

Working Life - See pot life.

NOTES

ISO 9001

LITTLE ROCK, AR
SAND SPRINGS, OK
SUZHOU, CHINA

NOV FIBER GLASS SYSTEMS

c UL us LISTED

MEMBER PEI PETROLEUM EQUIPMENT INSTITUTE

www.fgspipe.com

2700 West 65th Street
Little Rock, Arkansas 72209
Phone: 1 (501) 618-2256

25 S. Main Street
Sand Springs, Oklahoma 74063
1 (918) 245-6651

NOV Fiber Glass Systems

B2160 - September 2009