Panametrics
a Baker Hughes business

PanaFlow FLI

Ultrasonic Flowmeter

Installation Guide

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Services

Panametrics provides customers with an experienced staff of customer support personnel ready to respond to technical inquiries, as well as other remote and on-site support needs. To complement our broad portfolio of industry-leading solutions, we offer several types of flexible and scalable support services including: Training, Product Repairs, Service Agreements and more.

Please visit https://www.bakerhughes.com/panametrics/panametrics-services for more details.

Typographical Conventions

Note: *These paragraphs provide information that provides a deeper understanding of the situation, but is not essential to the proper completion of the instructions.*

IMPORTANT: These paragraphs provide information that emphasizes instructions that are essential to proper setup of the equipment. Failure to follow these instructions carefully may cause unreliable performance.

CAUTION! **This symbol indicates a risk of potential minor personal injury and/or severe damage to the equipment, unless these instructions are followed carefully.**

WARNING! **This symbol indicates a risk of potential serious personal injury, unless these instructions are followed carefully.**

Safety Issues

WARNING! **It is the responsibility of the user to make sure all local, county, state and national codes, regulations, rules and laws related to safety and safe operating conditions are met for each installation.**

Attention European Customers! To meet CE Mark requirements for all units intended for use in the EU, all electrical cables must be installed as described in this manual.

Local Safety Standards

The user must make sure that he operates the equipment in accordance with the applicable local codes, standards, regulations, or laws.

Qualification of Personnel

Make sure that all personnel have applicable training to use the equipment.

Personal Safety Equipment

Make sure that operators and maintenance personnel have all safety equipment applicable.

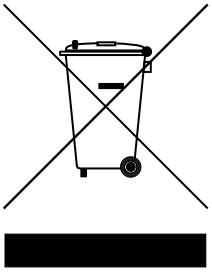
Unauthorized Operation

Make sure that unauthorized personnel cannot gain access to the operation of the equipment.

Environmental Compliance

Waste Electrical and Electronic Equipment (WEEE) Directive

Panametrics is an active participant in Europe's *Waste Electrical and Electronic Equipment* (WEEE) take-back initiative, directive 2012/19/EU.



The equipment that you bought has required the extraction and use of natural resources for its production. It may contain hazardous substances that could impact health and the environment.

In order to avoid the dissemination of those substances in our environment and to diminish the pressure on the natural resources, we encourage you to use the appropriate take-back systems. Those systems will reuse or recycle most of the materials of your end of life equipment in a sound way.

The crossed-out wheeled bin symbol invites you to use those systems.

If you need more information on the collection, reuse and recycling systems, please contact your local or regional waste administration.

Please visit www.bakerhughes.com/health-safety-and-environment-hse for take-back instructions and more information about this initiative.

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Chapter 1. Flowcell or Nozzle

1.1 Overview

The PanaFlow FLI is a wetted gas ultrasonic flowmeter with low process pressure transducer retractability or insertion that uses a small and compact insertion mechanism.

The complete flowmeter system includes:

1. A certified XGx868i Ultrasonic Flow Transmitter (XGM868i, XGF868i, or XGS868i)
2. A pair of Flowmeter Cables
3. A PanaFlow FLI system consisting of:
   a. T5 or T5MAX transducer with preamplifier
   b. FLI insertion mechanism
   c. Isolation valve
   d. Calibrated flowcell (PFLIFC option) / Nozzle with a threaded or flanged configuration (PFLINZ option)

Note: *This manual is specific to the installation of the PanaFlow FLI meter body system only. For details on wiring, programming, and servicing the XGF868i, XGM868i, and XGS868i, please reference to these separate manuals.*

Figure 1: PanaFlow FLI system

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Chapter 2. Installation

The PanaFlow FLI system can be installed either by flowcell (spoolpiece) or nozzle with threaded or flanged configuration.

WARNING! **The user shall take the necessary precautions to minimize the risk from electrostatic discharge. To prevent the risk of electrostatic sparking, the apparatus, meter and transducers should only be cleaned with a damp cloth. Further guidance on protection against the risk of ignition due to electrostatic discharge can be found in IEC TS 60079-32, ANSI/UL 60079-32, C22.2 No. 60079-32 and similar guides.**

2.1 Flowcell Installation

The transducers, insertion mechanism, and the isolation valve can be directly mounted on a flowcell. A flowcell is a separately manufactured pipe section, matched to the existing pipe, which contains ports for mounting the transducers. This approach allows the transducers to be aligned and calibrated before mounting the flowcell into the pipeline.

2.1.1 Selecting the Flowcell Location

The PanaFlow FLI accuracy is affected by the flowcell location in the process piping and on the orientation of the transducers. Thus, in addition to accessibility for maintenance, adhere to the following installation guidelines:

- Locate the flowcell so that there are at least 20 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the measurement point (see *Figure 2*). Undisturbed flow means avoiding sources of turbulence in the fluid (e.g., valves, flanges, expansions, elbows, etc.), avoiding swirl, and avoiding cavitation.

CAUTION! **Do not place thermal insulation on or around the transducers, the junction boxes, or the meter electronics. The transducer and junction box act as a heat sink that protects the transducer from high and low temperatures.**

CAUTION! **Ensure the ambient temperature around the junction box (on the transducer) shall not exceed the permitted -40°C to +60°C range, regardless of process temperature.**

IMPORTANT: The temperature classification rating of the transducer assembly is dependent upon the maximum process temperature (See temperature classification rating in *"Specific Conditions of Use" on page 47*).

CAUTION! **The standard transducers are made of titanium and are potential ignitions sources when subjected to impact or friction by a metal object e.g. a tool. This spark risk shall be taken into consideration during installation and all other assembly and disassembly operations.**

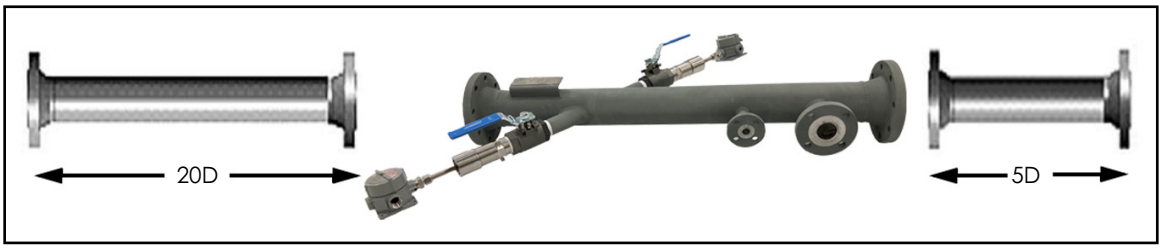


Figure 2: Minimum straight run pipe requirements

CAUTION! **Remote mounting of the meter is always required for vertical pipes.**

Installing on vertical pipes

- For vertical pipes, the meter cannot be mounted directly onto the pipe. Only remote mounting of the meter is allowed as meter must be installed with the cylindrical enclosure in a horizontal position and the mounting boss pointing downwards.
- Locate the transducers in a common axial plane along the pipe. The flow direction shall be in the upwards direction.

Installing on horizontal pipes

- Both remote or local mounting of the meter is allowed.
- Locate the transducers on a horizontal plane along the pipe (3 o'clock - 9 o'clock) instead of on the top or the bottom.

2.2 Pipe Nozzle Installation

2.2.1 Introduction

CAUTION! **Please follow all applicable site, local, and regional safety measures when conducting tapping of nozzles to pipe. Great care shall be taken to ensure activity is not being conducted in a flammable environment without proper mitigation strategies.**

CAUTION! **Any deviation from this prescribed procedure can result in accidental release of process gas that may be dangerous or hazardous due to its pressure, flammability, or composition. Safe work practices should be followed and periodic review of this procedure is highly recommended before conducting this work.**

CAUTION! **Ensure the ambient temperature around the junction box (on the transducer) shall not exceed the permitted -40°C to +60°C range, regardless of process temperature.**

IMPORTANT: The temperature classification of the transducer assembly is dependent upon the maximum process temperature (see Temperature Classification Rating in *"Specific Conditions of Use" on page 47*).

CAUTION! **The standard transducers are made of titanium and are potential ignitions sources when subjected to impact or friction by a metal object e.g. a tool. This spark risk shall be taken into consideration during installation and all other assembly and disassembly operations.**

Before the FLI insertion mechanism can be installed into the pipe, it is required to install pipe nozzles. Nozzles may be installed as part of a fabricated spoolpiece or by using the hot tap process. Nozzle installation varies depending on the PanaFlow FLI system configuration using either a NPT threaded design or an optional flanged design with the FLI mechanism threaded into a 150# adapter flange.

This section describes how to install either flanged or threaded nozzles in a tilted 45° installation. This installation applies for standard transducer configuration i.e. face to face spacings, with both transducer body axes concentric and parallel to each other. The PanaFlow FLI is designed for standard velocity range applications (gas velocities up to 100 m/s (328 ft/s)).

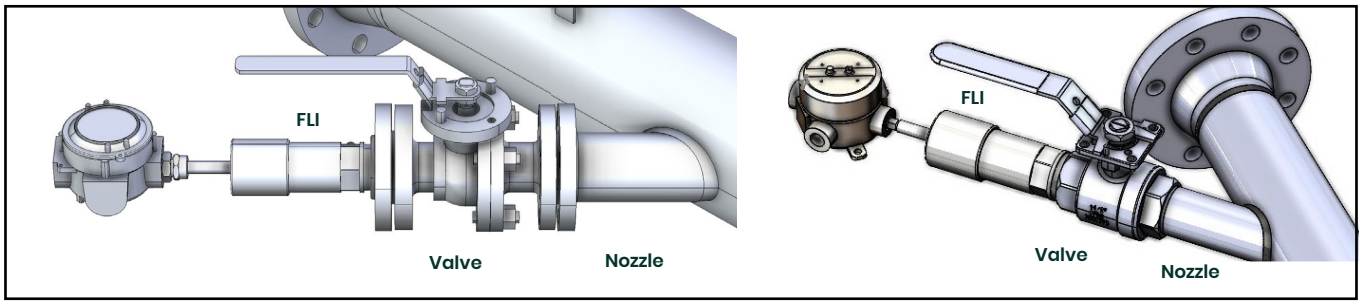


Figure 3: Nozzle installation with flanged (left) and threaded (right) configurations

2.2.2 Threaded Nozzle Installation

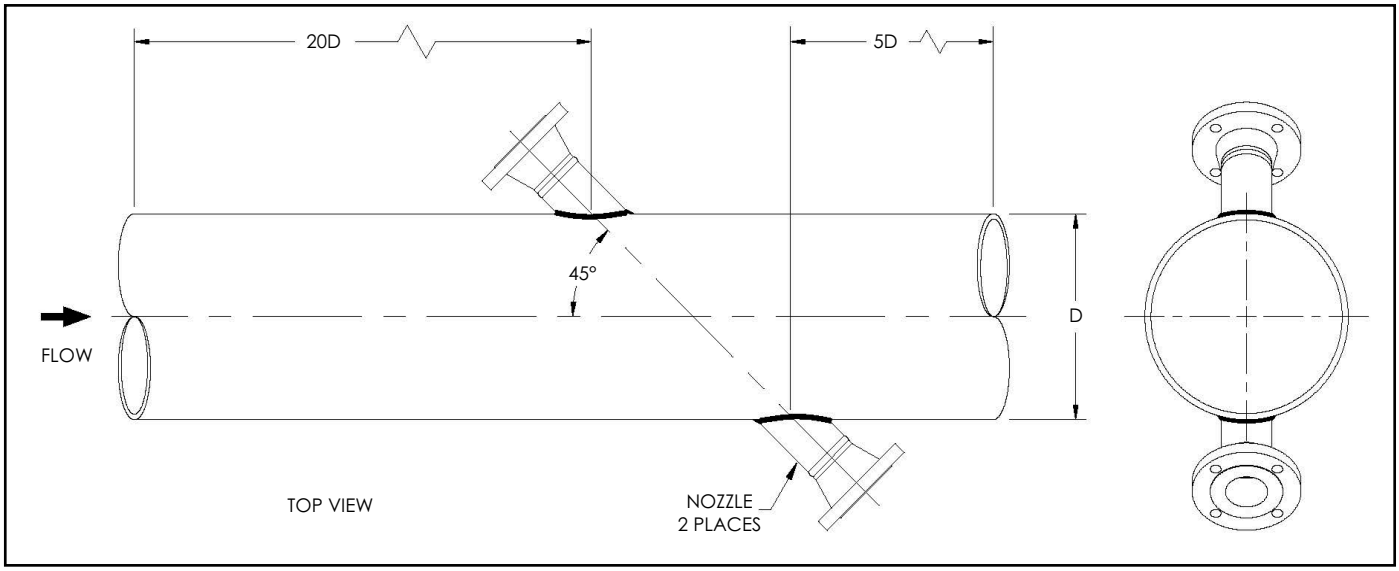
This procedure includes the following steps:

- Selecting and marking the pipe for nozzle locations
- Installing the first nozzle
- Determing and marking the second nozzle location
- Determing and marking the second welding boss

2.2.2.1 Selecting and Marking the Pipe for Nozzle Locations

CAUTION! **Correct nozzle alignment is critical to the successful operation of the flowmeter. Therefore, all marking, positioning and welding operations must be carried out with the utmost attention to accuracy. Unless otherwise stated, dimensional positioning of the nozzles must be held to a tolerance of ±1/16 in. (±1.6 mm) relative to each other and with respect to the pipe centerline. The angular tolerance must be held to ±1°. All hole cutting in process piping must be performed using hot tapping equipment.**

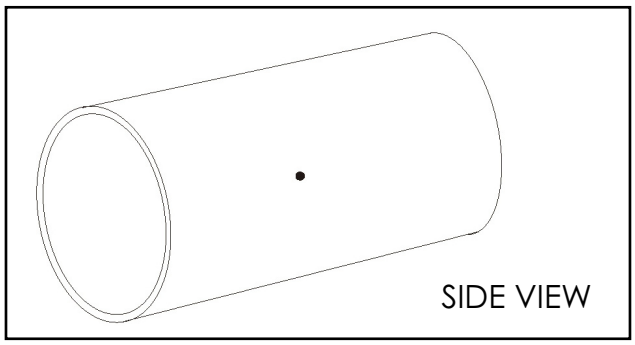
1. For optimum performance, you should select a location that has at least 20 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the point of measurement. Undisturbed flow means avoiding sources of turbulence such as flanges, elbows and tees; avoiding swirl; and avoiding disturbed flow profiles. Never install the flowmeter downstream of control valves, especially butterfly valves. If you cannot find a proper location, please consult with Panametrics Flow Application engineering.



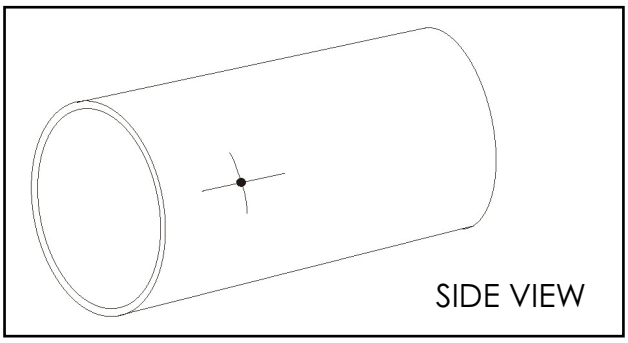
2. Install the pipe nozzles on a pipe diameter as near as possible to the horizontal plane. This would be at the 3 o'clock and 9 o'clock positions for a horizontal pipe.

Note: *If you cannot find a proper location, please consult with Panametrics Flow Application engineering.*

3. At the 3 o'clock position, center punch the pipe to mark the position for the center of the first nozzle.



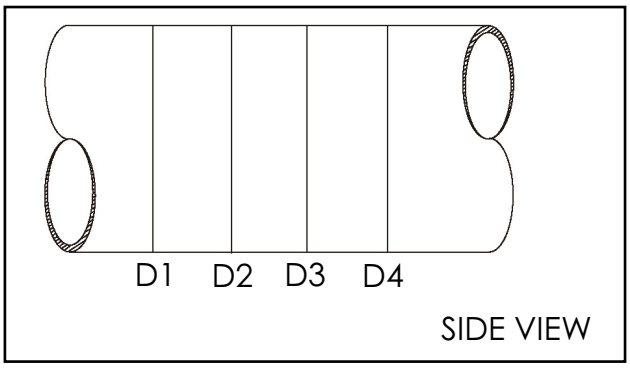
4. Spray this area with a marking dye product. Using a metal straight edge, scribe 6 in. long vertical and horizontal lines that intersect at the center punch mark.



2.2.2.2 Determining and Marking the Second Nozzle Location

1. The second nozzle is located a distance equal to one pipe O.D. along the pipe centerline and on the opposite side of the pipe (180° around the circumference). Spray this area with a marking dye product.

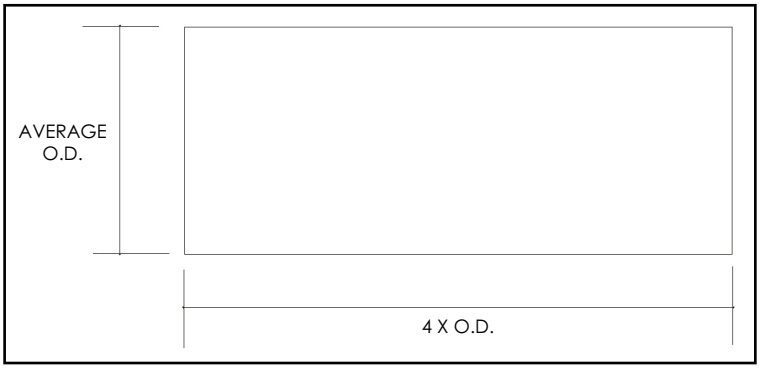
Note: *For installation angles other than 45°, the distance along the pipe centerline is equal to the pipe O.D. times the tangent of the installation angle.*



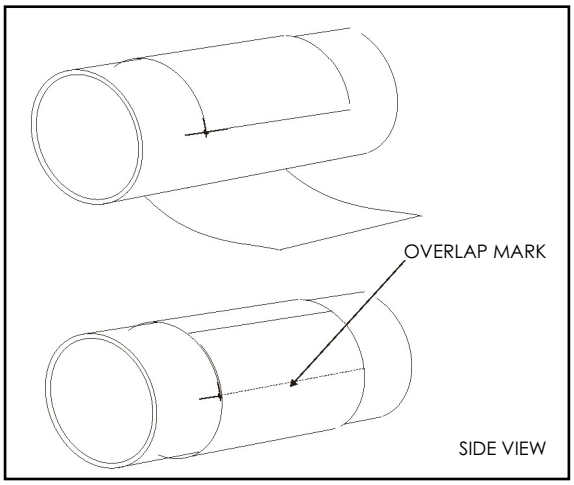
2. To account for possible variations in the O.D. of the pipe, measure the pipe O.D. at four location between the nozzle centers. Calculate the average outside diameter based on these measurements.
3. Using a roll of polyester film (or equivalent), cut a strip of film to the following width and length:

IMPORTANT: Ensure that the sides of the film are cut parallel to each other.

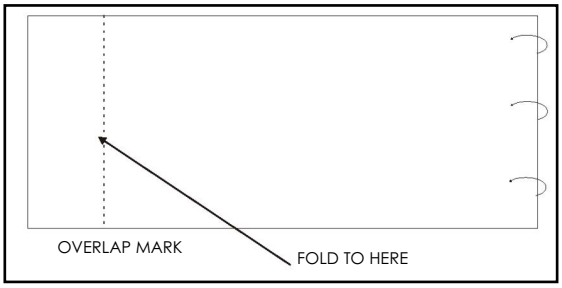
- **Width**: equal to the average pipe O.D., as calculated in Step 1 above.
- **Length**: equal to 4 times the average pipe O.D., as calculated in Step 1 above.



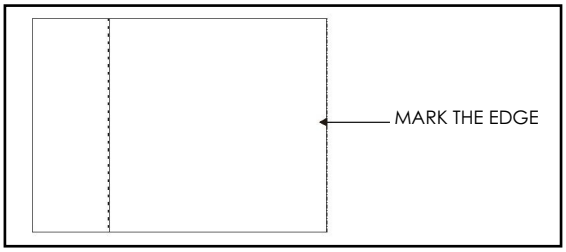
4. Wrap the strip of film around the pipe with one edge running along the vertical scribe line at the first nozzle location. Make sure the strip overlaps squarely all the way around the pipe, and mark the overlap location of the strip. This equals the circumference of the pipe.



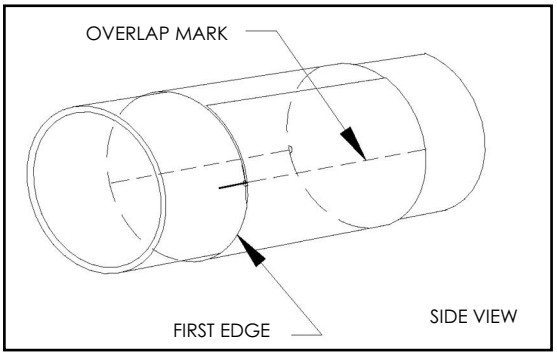
5. Remove the strip of film and fold it as shown below to determine the position which is diametrically opposite the overlap position when the film is reapplied to the pipe.



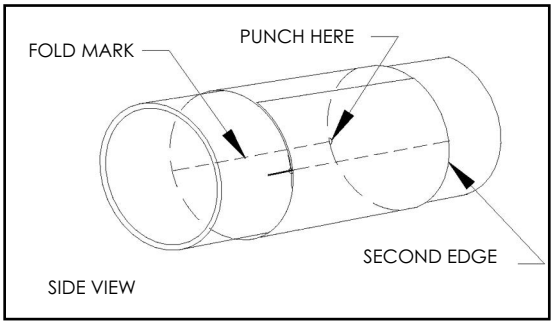
6. Mark the outside of the fold for reference.



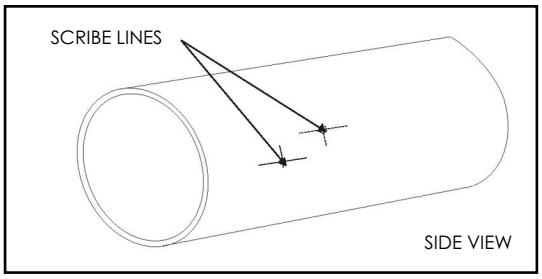
7. Wrap the strip of film around the pipe again. This time, line up the overlap mark with the horizontal and vertical scribe lines. Again, make sure you wrap the strip of film squarely all the way around the pipe.



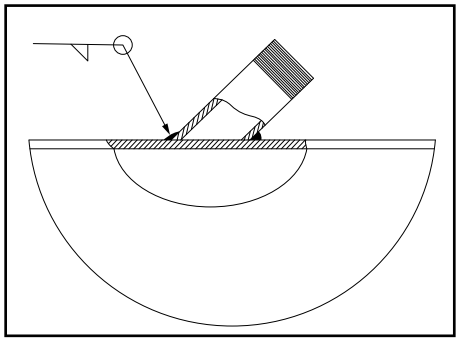
8. The new location of the center of the second nozzle is now identified as the intersection of the fold line and the second edge of the strip of film. Center punch this location prior to removing the strip of film.



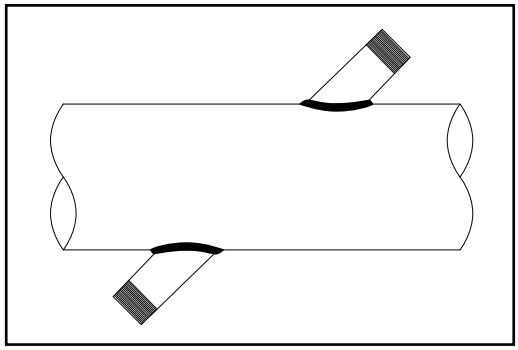
9. Remove the strip of film from the pipe.
10. Scribe 6 in. long vertical and horizontal lines which intersect at the new center-punch mark.



11. After marking, weld the nozzle as shown in the figure below.



12. The complete installation should appear as shown below.



2.2.3 Flanged Nozzle Installation

This procedure includes the following steps:

- Identifying and checking the nozzle installation kit components
- Selecting and marking the pipe for nozzle locations
- Installing the first welding boss
- Installing the first nozzle
- Installing the second welding boss and nozzle

IMPORTANT: This procedure only applies if you are using a Nozzle Installation Kit. If you are tapping the pipe without using a Nozzle Installation Kit, refer to the supplied drawings in your shipment.

2.2.3.1 Identifying and Checking the Nozzle Installation Kit Components

The Nozzle Installation Kit contains the materials listed below. Use below to help identify each component.

- 2 Nozzles
- 2 Welding bosses
- 1 Jig
- 1 Threaded rod (1 in. diameter), with washer and nut

IMPORTANT: You will need eight 1/2 in. studs with two nuts each for the 1.5 in. -150# flanges.

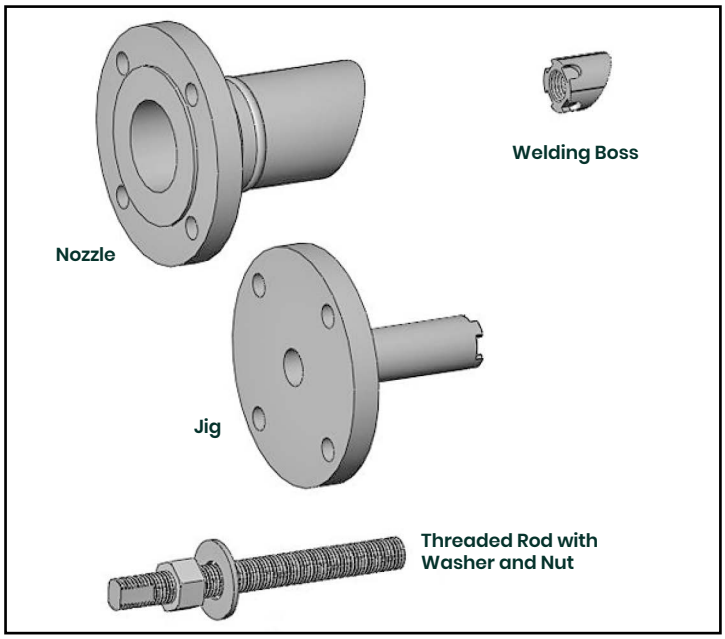


Figure 4: Components for Nozzle Installation Kit

Check the markings on the side of the welding boss. The pipe outside diameter (O.D.) and the mounting angle are engraved on the boss, as shown below.

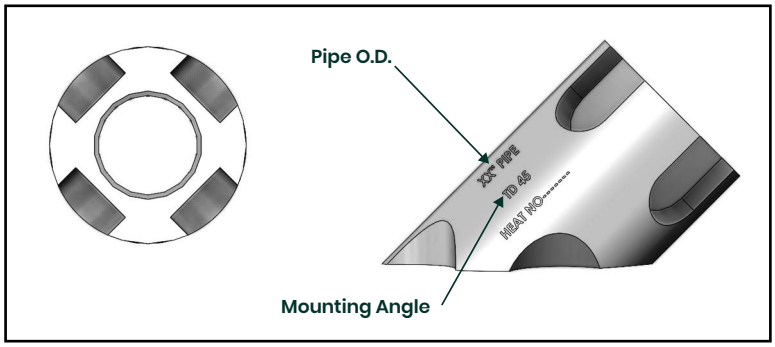
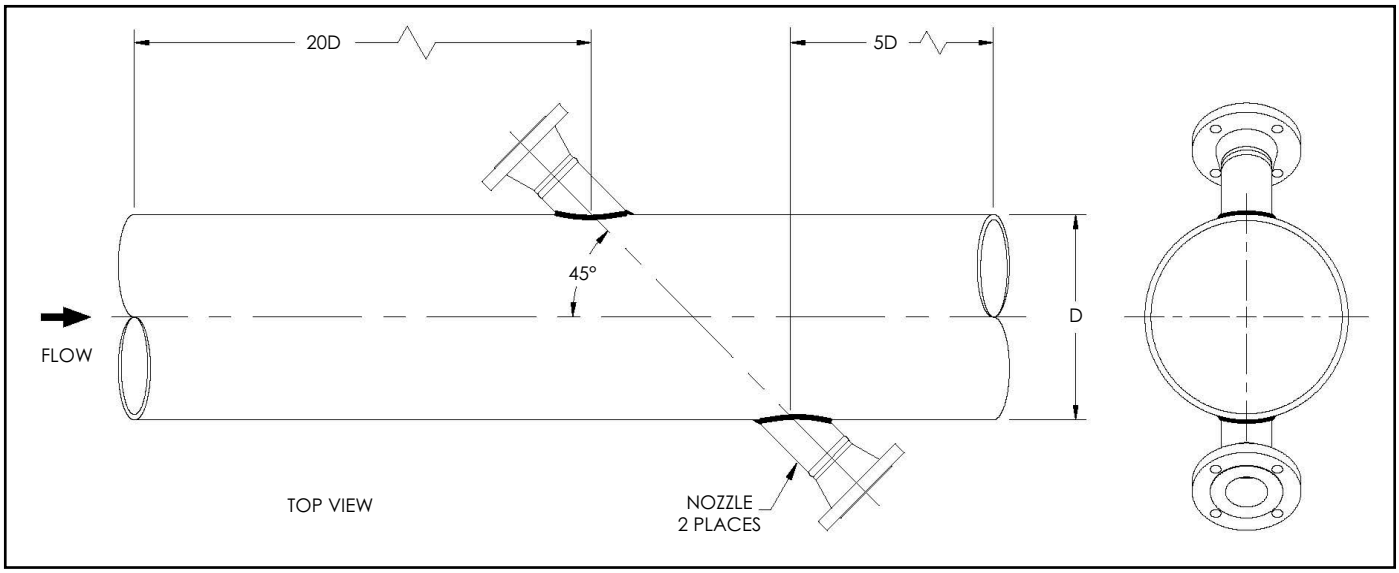


Figure 5: Pipe O.D. and mounting angle are engraved in the end of the welding boss

2.2.3.2 Selecting and Marking the First Nozzle Location

CAUTION! **Correct nozzle alignment is critical to the successful operation of the flowmeter. Therefore, all marking, positioning and welding operations must be carried out with the utmost attention to accuracy. Unless otherwise stated, dimensional positioning of the nozzles must be held to a tolerance of ±1/16 in. (±1.6 mm) relative to each other and with respect to the pipe centerline. The angular tolerance must be held to ±1°. All hole cutting in process piping must be performed using hot tapping equipment.**

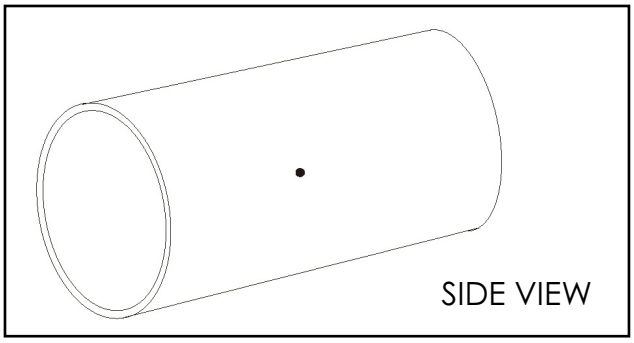
1. For optimum performance, you should select a location that has at least 20 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the point of measurement. Undisturbed flow means avoiding sources of turbulence such as flanges, elbows and tees; avoiding swirl; and avoiding disturbed flow profiles. Never install the flowmeter downstream of control valves, especially butterfly valves. If you cannot find a proper location, please consult with Panametrics Flow Application engineering.



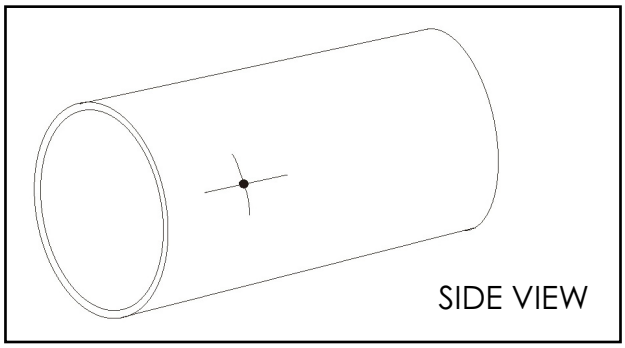
2. Install the pipe nozzles on a pipe diameter as near as possible to the horizontal plane. This would be at the 3 o'clock and 9 o'clock positions for a horizontal pipe.

Note: *If you cannot find a proper location, please consult with Panametrics Flow Application engineering.*

3. At the 3 o'clock position, center punch the pipe to mark the position for the center of the first nozzle.



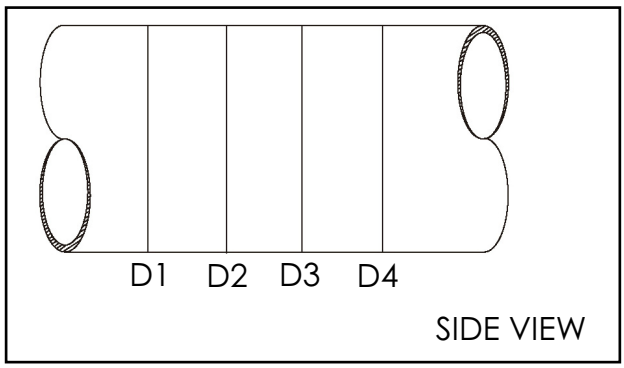
4. Spray this area with a marking dye product. Using a metal straight edge, scribe 6 in. long vertical and horizontal lines that intersect at the center punch mark.



2.2.3.3 Determining and Marking the Second Nozzle Location

1. The second nozzle is located a distance equal to one pipe O.D. along the pipe centerline and on the opposite side of the pipe (180° around the circumference). Spray this area with a marking dye product.

Note: *For installation angles other than 45°, the distance along the pipe centerline is equal to the pipe O.D. times the tangent of the installation angle.*

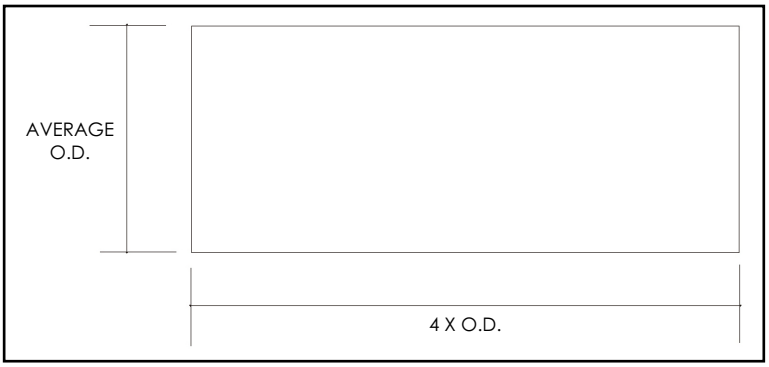


2. To account for possible variations in the O.D. of the pipe, measure the pipe O.D. at four location between the nozzle centers. Calculate the average outside diameter based on these measurements.

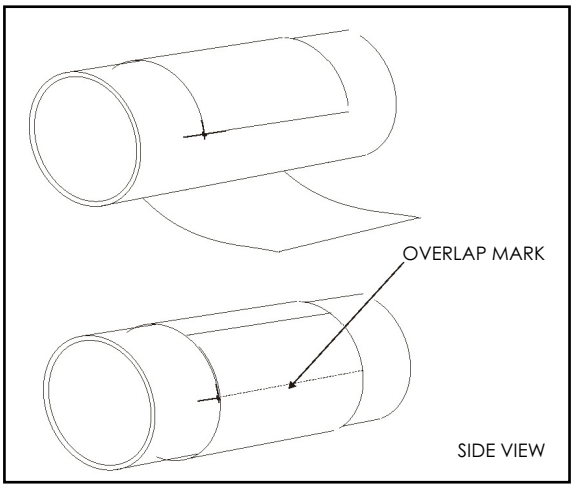
3. Using a roll of polyester film (or equivalent), cut a strip of film to the following width and length:

IMPORTANT: Ensure that the sides of the film are cut parallel to each other.

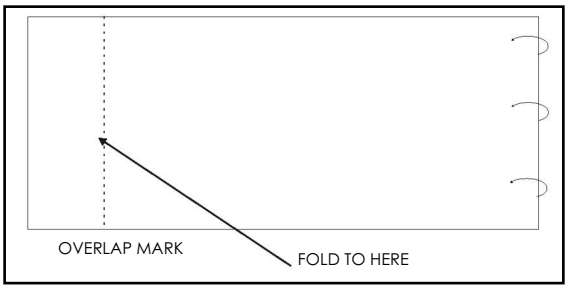
- **Width** - equal to the average pipe O.D., as calculated in Step 1 above.
- **Length** - equal to 4 times the average pipe O.D., as calculated in Step 1 above.



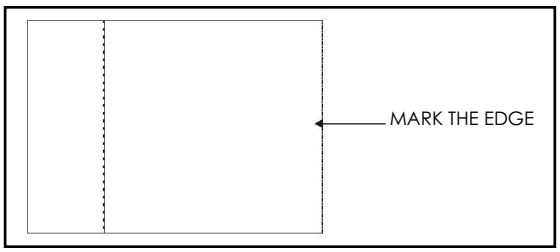
4. Wrap the strip of film around the pipe with one edge running along the vertical scribe line at the first nozzle location. Make sure the strip overlaps squarely all the way around the pipe, and mark the overlap location of the strip. This equals the circumference of the pipe.



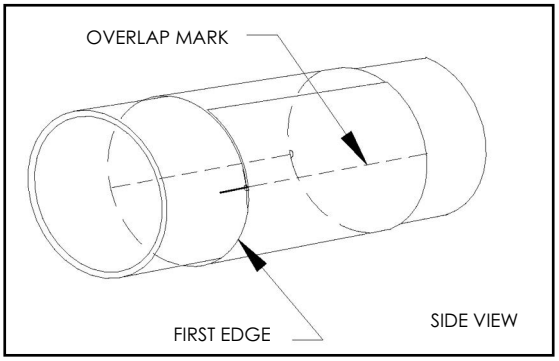
5. Remove the strip of film and fold it as shown below to determine the position which is diametrically opposite the overlap position when the film is reapplied to the pipe.



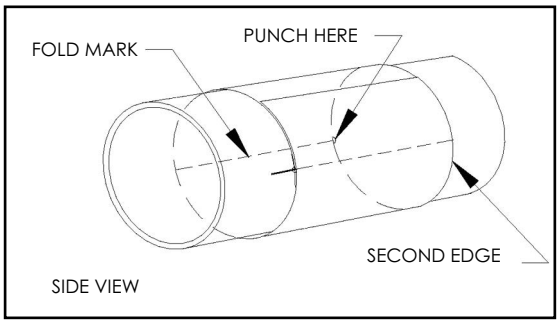
6. Mark the outside of the fold for reference.



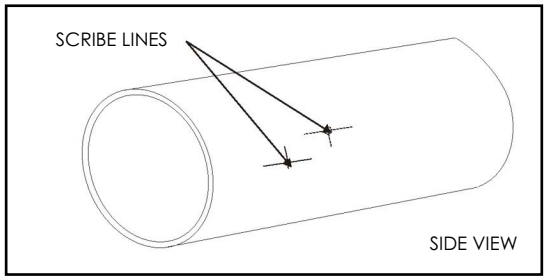
7. Wrap the strip of film around the pipe again. This time, line up the overlap mark with the horizontal and vertical scribe lines. Again, make sure you wrap the strip of film squarely all the way around the pipe.



8. The new location of the center of the second nozzle is now identified as the intersection of the fold line and the second edge of the strip of film. Center punch this location prior to removing the strip of film.



9. Remove the strip of film from the pipe.
10. Scribe 6 in. long vertical and horizontal lines which intersect at the new center-punch mark.



2.2.3.4 Installing the First Welding Boss

1. Before welding the first boss, you must add another scribe line known as the oblique center line. The oblique center line compensates for the slope or oblique of the boss. The oblique center line is offset from the true center (vertical) scribe line marked earlier by a distance of X, which is dependent on the pipe outside diameter as follows:

$$X = D/2 - \frac{d/2}{\tan[\sin^{-1}(d/D)]}$$

Where:

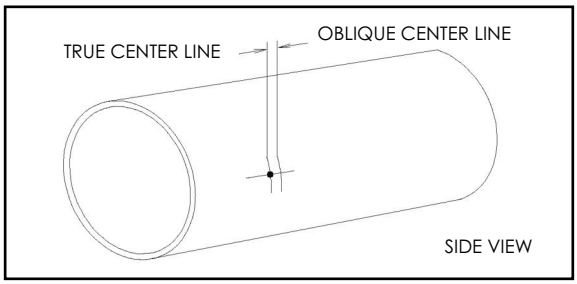
D = pipe outside diameter

d = welding boss outside diameter (1.05 in.) See *Table 1* for values of X for various pipe sizes.

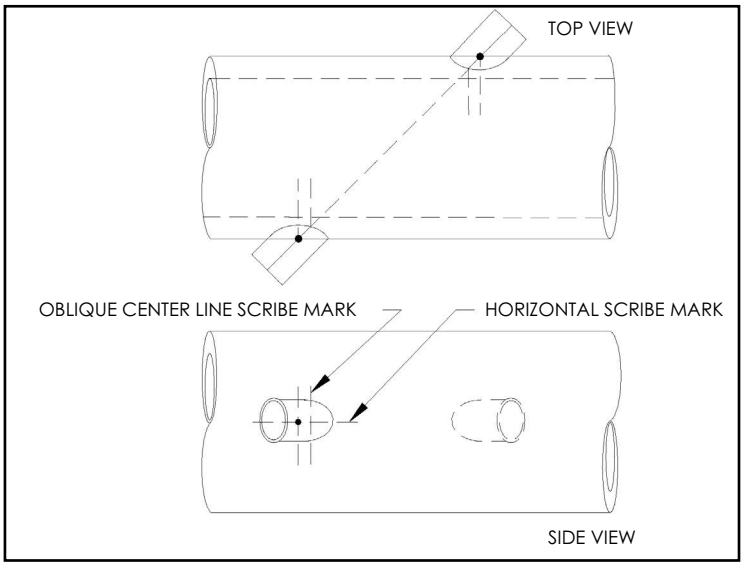
Table 1: Values for Various Pipe Sizes

Pipe Size		X Dimensions
NPS (DN)	O.D.	
6 in. (150 mm)	6.625 in. (168 mm)	0.042 in. (1.07 mm)
8 in. (200 mm)	8.625 in. (219 mm)	0.033 in. (0.82 mm)
10 in. (250 mm)	10.750 in. (273 mm)	0.026 in. (0.66 mm)
12 in. (300 mm)	12.750 in. (324 mm)	0.022 in. (0.55 mm)
14 in. (350 mm)	14.000 in. (356 mm)	0.020 in. (0.51 mm)

2. Scribe the oblique center line on the pipe at the calculated distance from the true center line. The oblique center line should be marked on the side of the true center line that is closer to the second nozzle location.



3. Position the welding boss such that the four scribe lines on the welding boss are lined up with the horizontal scribe mark and the oblique center line on the pipe. Make sure you orient the boss as shown below.

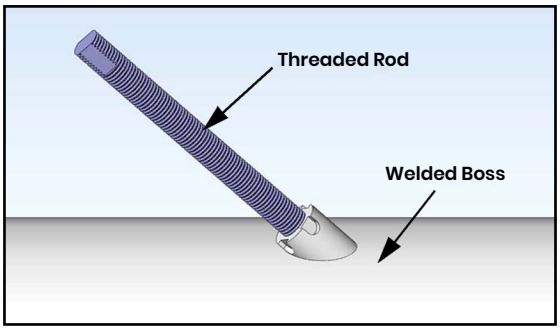


4. Clamp the boss in place using a pipe strap or equivalent so that it cannot move during tack welding.
5. Check the boss alignment, then tack weld the carbon steel boss to the pipe in each of the four grooves between the boss scribe marks.
6. Remove the clamp and check the alignment again. If the boss is misaligned by 0.02 in. (0.5 mm) or more, remove the boss, grind off the welds and reinstall the boss.

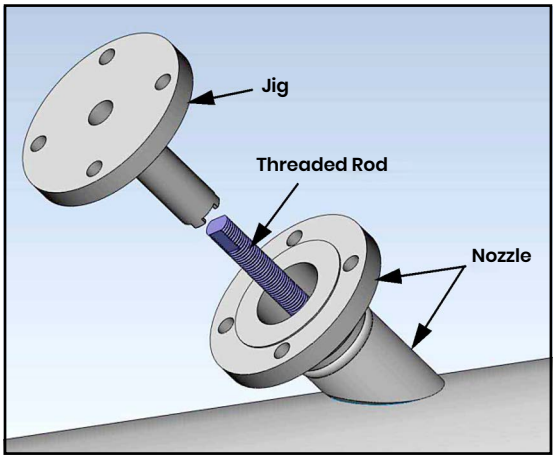
2.2.3.5 Installing the First Nozzle

IMPORTANT: Prior to welding the nozzle, it is essential that the nozzle is set up and fixed in position using the jig and the 1-in. threaded rod provided in the kit.

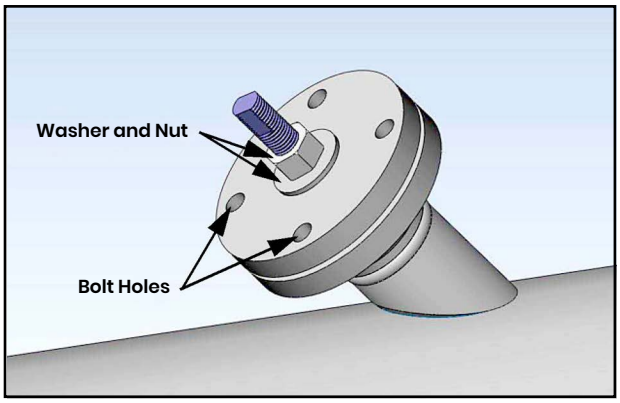
1. Screw the threaded rod into boss that is welded onto the pipe. If necessary, remove the washer and nut from the threaded rod.



2. Slide the nozzle over the threaded rod, and align the contoured end of the nozzle so that it matches the pipe arc. Then slide the jig over the threaded rod and fit the jig into the welding boss.



3. Align the jig bolt holes with the nozzle bolt holes. Then, tighten the assembly together, using the washer and nut on the threaded rod.



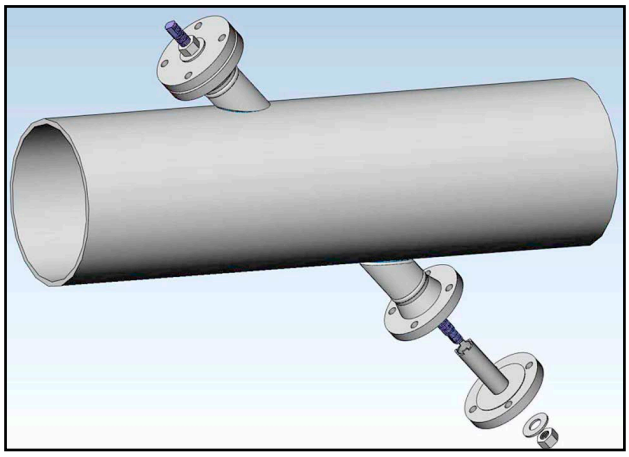
4. The jig, boss, and nozzle assembly is designed to provide a 0.094 in. (2.4 mm) root gap between the beveled edge of the nozzle and the outside diameter of the pipe. If this gap is not present all the way around the nozzle, the nozzle must be removed and ground appropriately to provide the required clearance. If the root gap is larger than the 0.094 in. (2.4 mm) dimension evenly all the way around the nozzle, then suitably sized washers may be inserted between the jig and the nozzle to reduce the root gap dimension.

WARNING! **Only qualified personnel can weld bosses and nozzles using a suitable ASME IX qualified welding procedure. All applicable safety codes must be observed.**

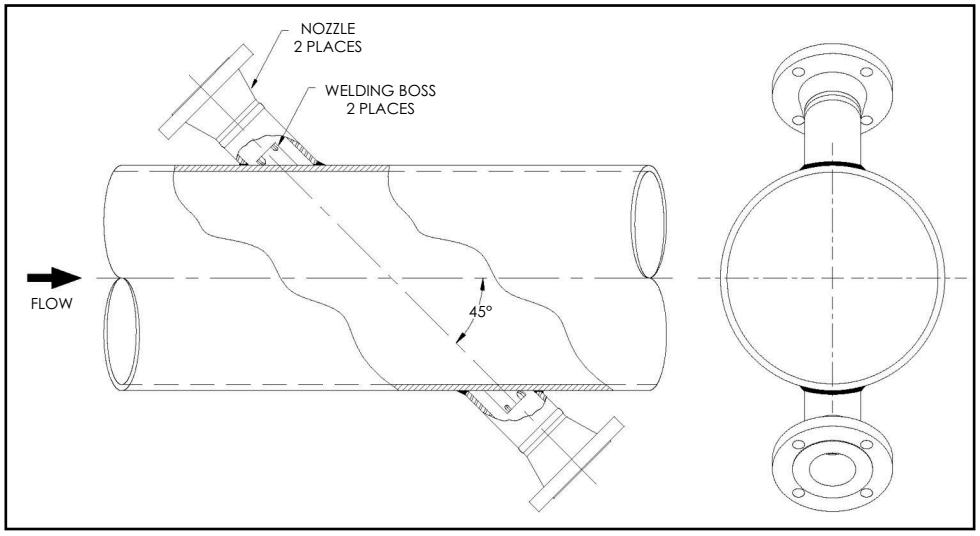
5. Tack weld the nozzle to the pipe at four diametrically opposed points, each tack being approximately 0.6 in. (15 mm) in length. Allow the weld to cool for 30 seconds between tacks.
6. Complete the root pass and subsequent filler passes as required.
7. Allow the weld to cool, and then remove the nut, washer, jig and threaded rod.

2.2.3.6 Installing the Second Welding Boss and Nozzle

Using the same procedures used for installing the first welding boss and nozzle, install the second welding boss and nozzle at the marked position on the pipe.



The completed installation should appear as shown below.



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Chapter 3. Installing the Isolation Valves

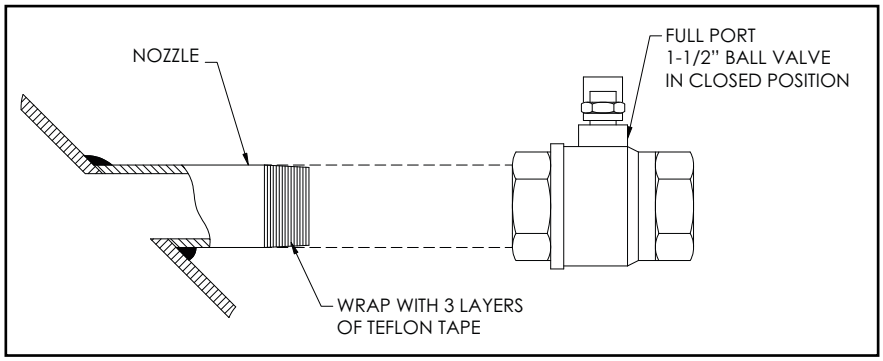
This chapter provides instructions for installing an isolation valve onto a nozzle for applications using the flare gas insertion mechanism.

CAUTION! **The standard transducers are made of titanium and are potential ignition sources when subjected to impact or friction by a metal object e.g. a tool. This spark risk shall be taken into consideration during installation and all other assembly and disassembly operations.**

Note: *Installation of the isolation valves may have been done already during the hot tapping operation.*

3.1 For 1.5 in. Threaded Valve

1. Obtain two suitable 1.5 in. NPT threaded isolation valves. The valves should be a full bore type with either 150# RF flanges and a face-to-face length of 7 in.
2. To install the isolation valves, on each of the nozzles, wrap three layers (minimum) of teflon tape on the 1.5 in. NPTM threads of the nozzle.
3. Screw and first, finger-tighten the isolation valve onto the nozzle. Then use a wrench to tighten it further by an additional 1-2 turns.

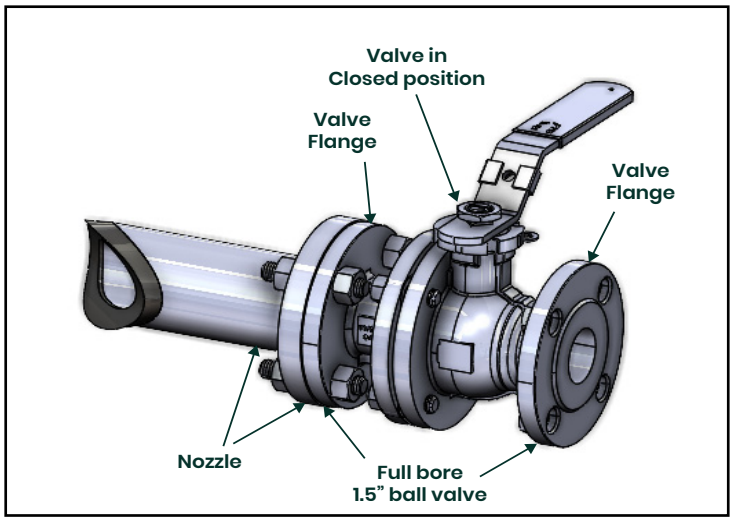


Note: *Because of the proximity of the ball valve to the process pipe, verify that the handle swings completely between the open and closed positions. If it does not, remove the valve and install using the opposite port.*

4. Orient the isolation valve handles to minimize interference during operation of the valves.
5. Set the valve to the fully closed position.

3.2 For 1.5 in. - 150# Flanges

1. Obtain two suitable 1.5 in. ANSI flanged isolation valves. The valves should be a full bore type with 150# RF flanges and a face-to-face length of 6.5 in.
2. Install one of the isolation valves, including a suitable gasket, on each of the nozzles. Secure the valves with 1/2 in. studs and nuts.
3. Orient the isolation valve handles to minimize interference during operation of the valves.
4. Set the valve to the fully closed position.



Chapter 4. Hot Tapping the Pipe

WARNING! **Hot tapping must only be performed by qualified personnel. Follow all applicable code and safety practices during these procedures.**

To hot tap the pipe complete the following steps:

1. Attach hot tapping tool to threaded valve with 3 layers (minimum) of teflon tape or flanged valve with a suitable gasket, studs and nuts.
2. Open valve.
3. Hot tap holes in the pipe using a hot tap machine equipped with a 17/32 in. (13.5 mm) drill bit.
4. Use a coupon retaining hole saw to cut a hole with a diameter of 1.125 in. (25 mm) minimum to 1.484 in. (38 mm) maximum.
5. Close valve after hot tapping hole.

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Chapter 5. Installing the FLI Transducer Insertion Mechanism

5.1 Introduction

The FLI insertion mechanism is designed for the insertion and retraction of the transducers, allowing a continuous operation and accessibility. This mechanism is assembled to the pipe using either the flanged or threaded configuration (See *Section 2.2.2* and *Section 2.2.3*). The mounting instructions for each are described below.

CAUTION! **Do not place thermal insulation on or around the transducers, the junction boxes, or the meter electronics. The transducer and junction box act as a heat sink that protects the transducer from high and low temperatures.**

WARNING! **Residual process pressure remaining within the flowcell must be less than 50psi for transducer installation/removal. Gas leaks or injury could result if the internal pipe pressure is above this limit.**

CAUTION! **Please review all connections once the system has reached operating temperature. Re-tight connection if needed.**

CAUTION! **The standard transducers are made of titanium and are potential ignitions sources when subjected to impact or friction by a metal object e.g. a tool. This spark risk shall be taken into consideration during installation and all other assembly and disassembly operations.**

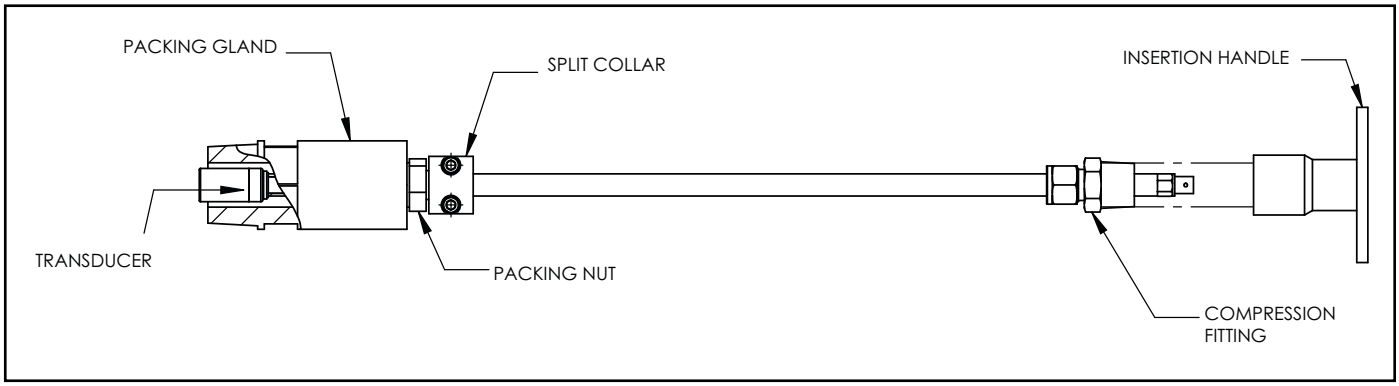
5.2 Preparing the Insertion Mechanism for Installation

Before you begin, find a work area where you can stand the insertion mechanism upright without placing any weight on the transducer (e.g., a bench with a cutout large enough for the transducer to slide through).

You will need the following items for installation:

- Teflon tape
- A gasket for the isolation valve
- A straight edge ruler
- A tag to mark the insertion depth

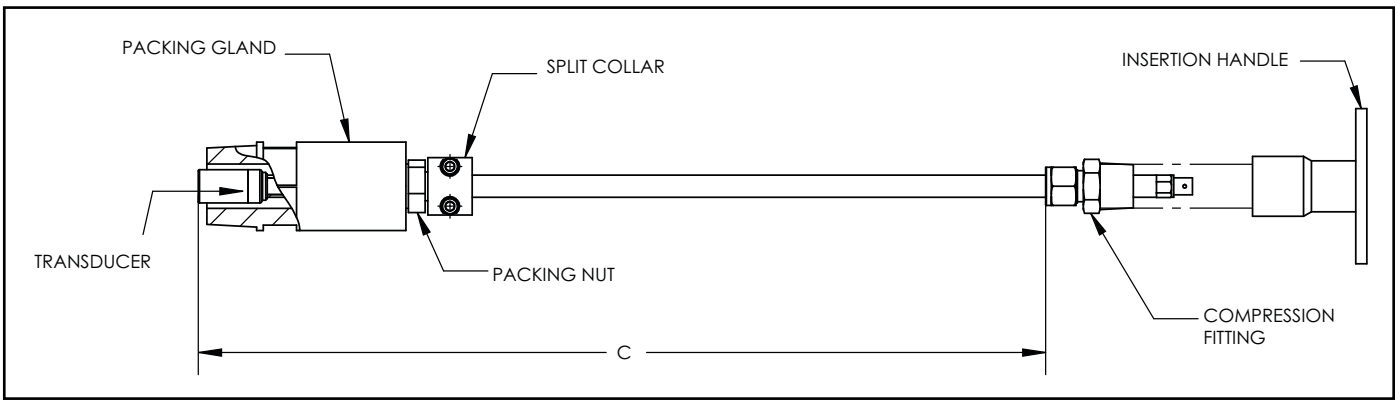
Before mounting the insertion mechanism on the isolation valve you should familiarize yourself with its components, illustrated in the figure below (protective sleeve is not shown but installed in later steps).



Note: *Explosion-proof junction boxes are not pre-mounted on the end of the transducer when shipped.*

To prepare the FLI insertion mechanism follow the following steps.

1. Screw the insertion handle onto the compression fitting on the back of the transducer.
2. As shown in the figure below, measure dimension "C" that corresponds to the distance from the face of the transducer to the front surface of the compression fitting.



3. Loosen the screws of the split collar so that the transducer can easily slide through the split collar.
4. Loosen the packing nut so that the transducer can easily slide through the packing gland.

CAUTION! **Process gas, if present within the pipe, may leak if the packing nut is loosened too much during installation.**

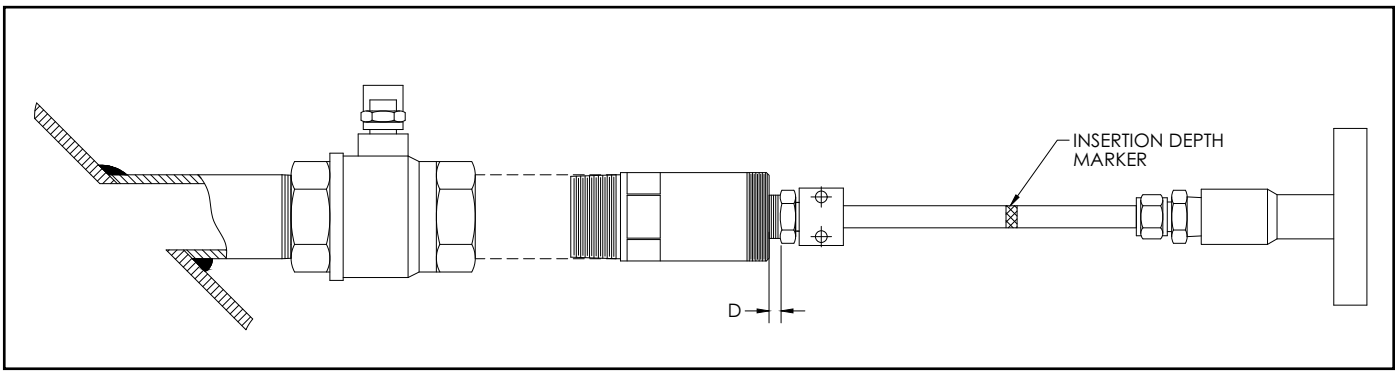
5. Retract the transducer until the transducer head hits the stop inside the packing gland.

5.3 Mounting the FLI Insertion Mechanism

5.3.1 Mounting the Insertion Mechanism for Threaded Valve Configuration

Once the insertion mechanism has been prepared, proceed with the installation to the threaded valve by following these steps:

1. Wrap three layers (minimum) of teflon tape on the 1.5 NPTM threads of the insertion mechanism.
2. To install the insertion mechanism into the ball valve, first, finger-tighten it. Then use a wrench to tighten it further by an additional 1-2 turns.



3. Measure dimension "A" from the outside surface of the pipe to the front surface of the compression fitting. For the dimension representations refer to the figure in the next step (*step 4*).

4. Use the following calculations to determine the total depth:

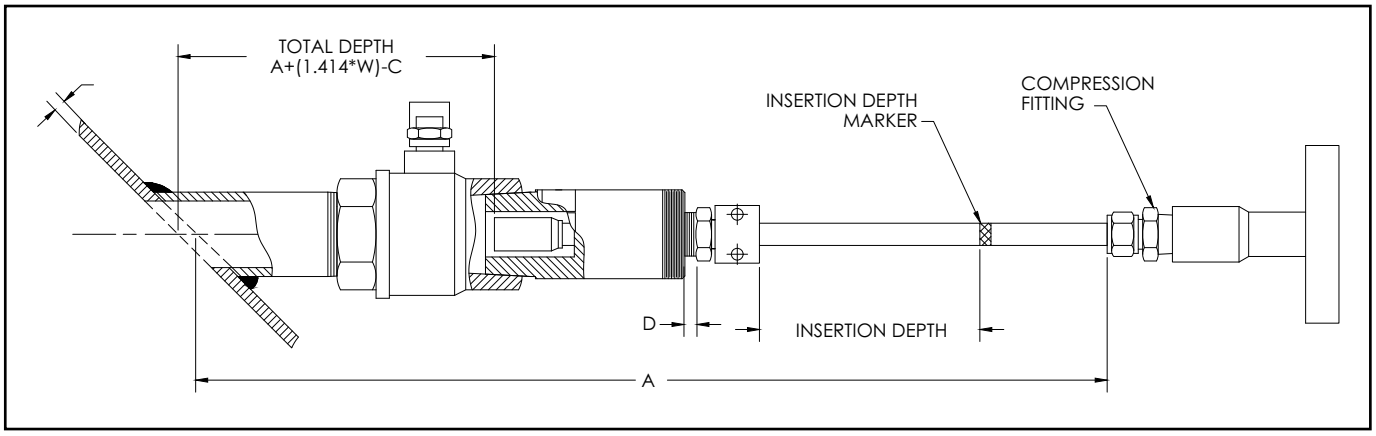
$$\text{Total Depth} = A + (1.414*W) - C$$

Where:

A = Dimension from the outside surface of the pipe to the front surface of the compression fitting

W = Wall thickness of the pipe

C = Distance from the face of the transducer to the front surface of the compression fitting, determined during the insertion mechanism preparation (See *Section 5.2*)



5. To estimate the insertion depth, subtract the distance between the exposed thread of the packing nut and the back surface of the packing gland or dimension "D" from the "Total Depth" calculated in step 5.

$$\text{Insertion Depth} = \text{Total Depth} - D$$

Where:

D = Distance between the exposed thread of the packing nut and the back surface of the packing gland.

(Approximately 1 thread turn, this distance is to loosen the friction between transducer tube/packing material and enable the transducer travel with less applied force)

6. Mark the insertion depth using electrical tape or equivalent by measuring the calculated "Insertion Depth" from the top of the split locking collar along the shaft of the transducer.

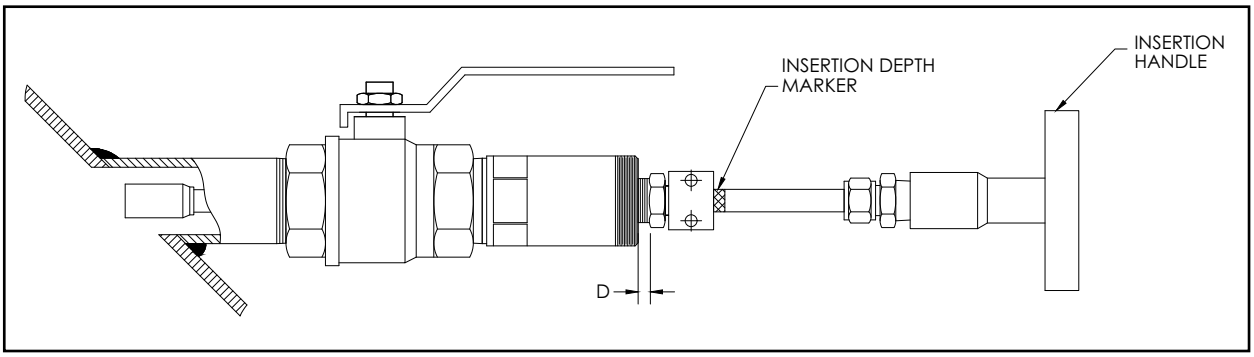
7. Loosen the screws of the split collar if needed.

IMPORTANT: Before you open the isolation valve, carefully verify the following:

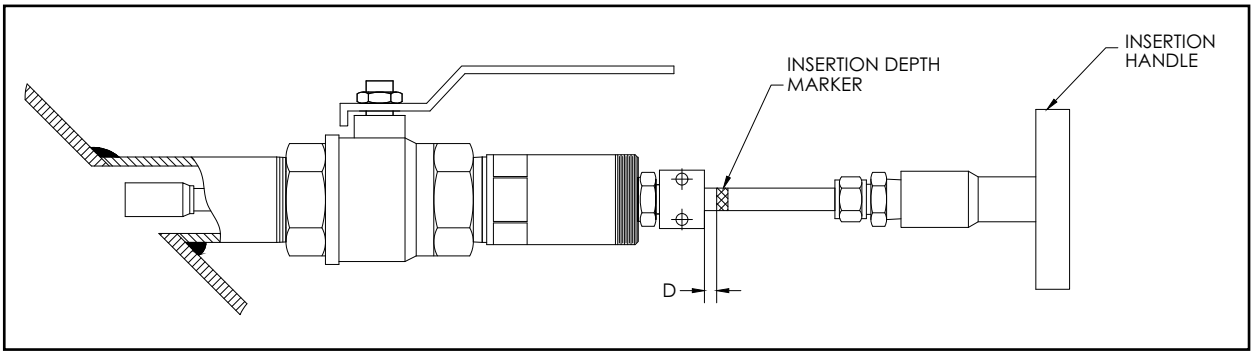
- The insertion mechanism is properly tightened.
- The transducer head is recessed in the packing gland.
- The pipe pressure is less than 50psi.

CAUTION! **Before opening the isolation valve verify the instructions above and follow all applicable safety codes and practices**

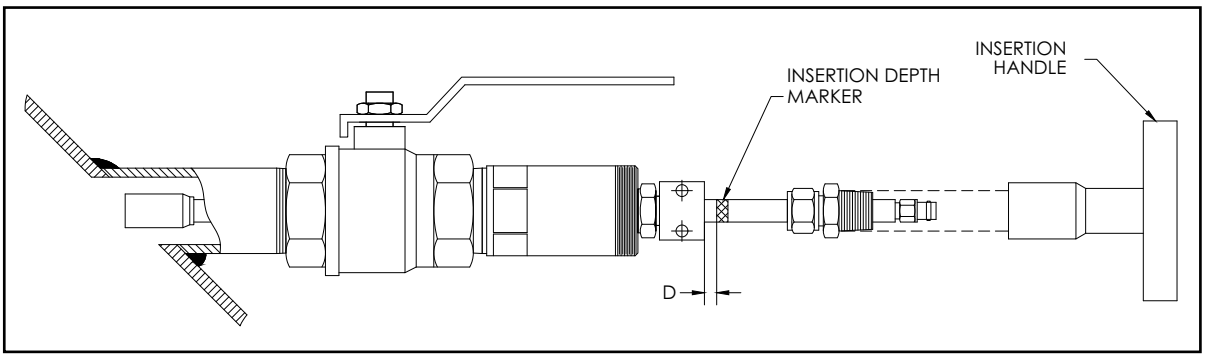
8. Set the valve to the fully open position.
9. Insert the transducer through the valve and nozzle until the insertion depth marker reaches the top of the split collar by pushing on the insertion handle.



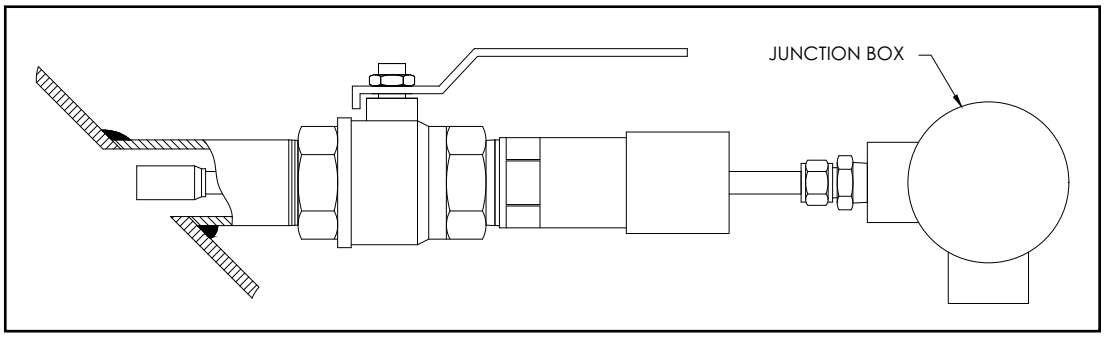
10. Tighten the packing nut until the packing nut touches the packing gland. Lock the split collar around the transducer tube by tightening the screws of the split collar to a minimum of 110 in-lb.



11. Unscrew the insertion handle from the compression fitting on the back of the transducer.



12. Screw protective sleeve into the packing gland and then the junction box to the compression fitting on the back of the transducer.



Note: *The following steps apply to both the upstream and downstream assemblies equally.*

13. Install the second insertion mechanism by repeating the steps in *Section 5.2 "Preparing the Insertion Mechanism for Installation"* and *Section 5.3.1 "Mounting the Insertion Mechanism for Threaded Valve Configuration"*. Confirm that the downstream transducer assembly is in the downstream port and the upstream transducer assembly is in the upstream port.

14. Place a tag on each isolation valve that came with the PanaFlow FLI assembly stating the following:

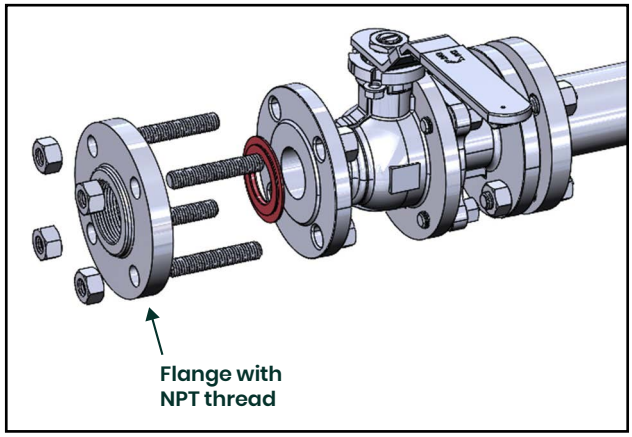
DO NOT OPERATE (CLOSE) WHEN TRANSDUCER IS INSERTED INTO PIPE

15. Refer to your transmitter Startup Guide/User's Manual to make the transducer electrical connections.

5.3.2 Mounting the Insertion Mechanism for Flanged Valve Configuration

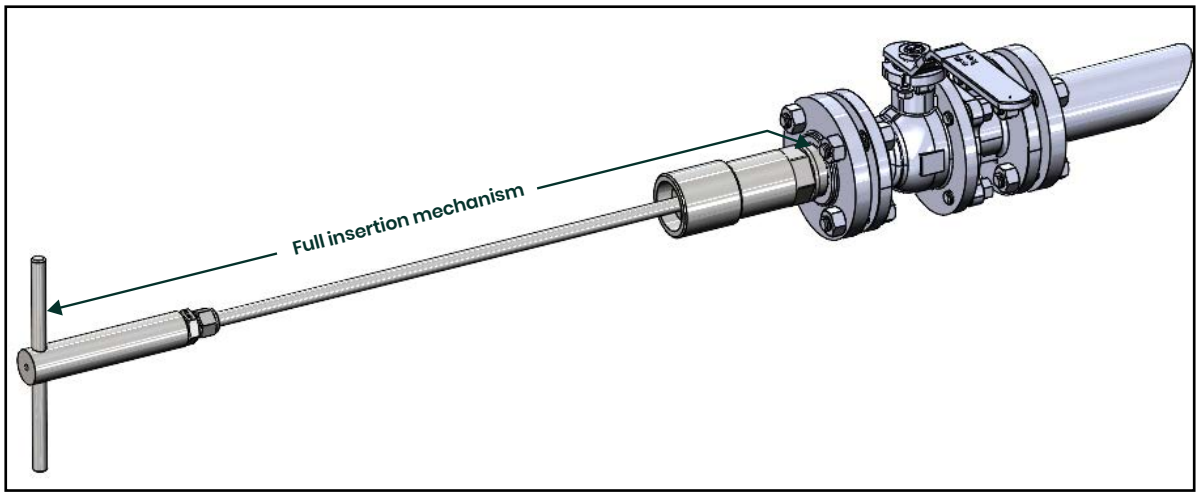
Once the insertion mechanism has been prepared, proceed with the installation to the flanged valve by following these steps:

1. Line up the flange holes and gasket, and bolt the flange with the internal NPT thread as shown in the figure below.



2. Wrap three layers (minimum) of teflon tape on the 1.5 NPTM threads of the insertion mechanism.

3. Thread the insertion mechanism to the flange with the internal NPT thread.



4. Tighten and secure all the bolts.
5. Measure dimension "A" from the outside surface of the pipe to the front surface of the compression fitting. For the dimension representations refer to the figure in step 6, *Section 5.3.1*
6. Use the following calculations to estimate the total depth:

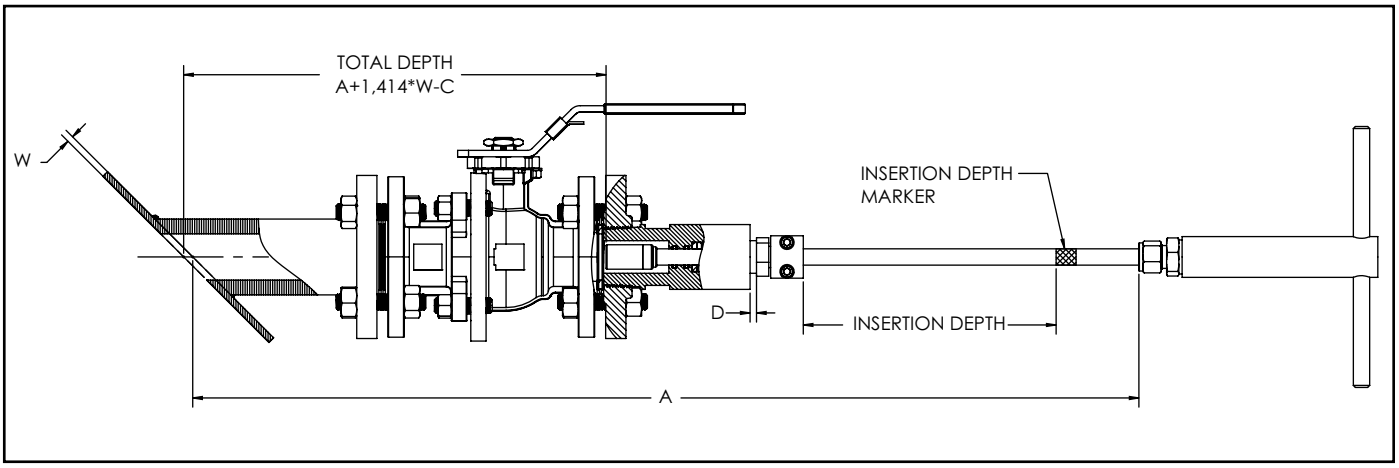
$$\text{Total Depth} = A + (1.414*W) - C$$

Where:

A = Dimension from the outside surface of the pipe to the front surface of the compression fitting

W = Wall thickness of the pipe

C = Distance from the face of the transducer to the front surface of the compression fitting, determined during the insertion mechanism preparation (See *Section 5.2*)



7. To estimate the insertion depth, subtract the distance between the exposed thread of the packing nut and the back surface of the packing gland or dimension “D” from the “Total Depth” calculated in step 7.

$$\text{Insertion Depth} = \text{Total Depth} - D$$

Where:

D = Distance between the exposed thread of the packing nut and the back surface of the packing gland.

(Approximately 1 thread turn, this distance is to loosen the friction between transducer tube/packing material and enable the transducer travel with less applied force)

8. Mark the insertion depth using electrical tape or equivalent by measuring the calculated "Insertion Depth" from the top of the split locking collar along the shaft of the transducer.

9. Loosen the screws of the split collar if needed.

IMPORTANT: Before you open the isolation valve, carefully verify the following:

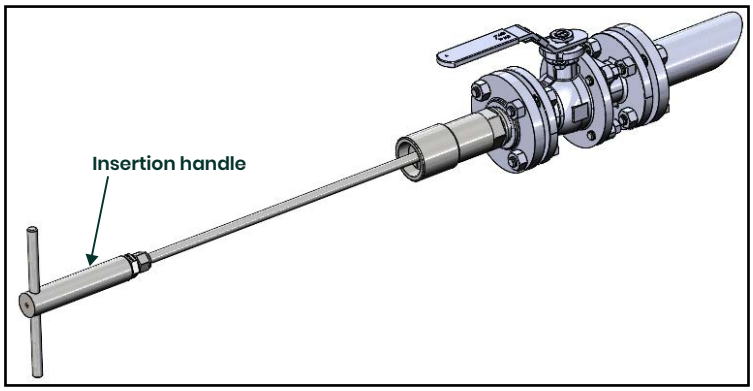
- The insertion mechanism is properly tightened.
- The transducer head is recessed in the packing gland.
- The pipe pressure is less than 50psi.

CAUTION! **Before opening the isolation valve verify the instructions above and follow all applicable safety codes and practices.**

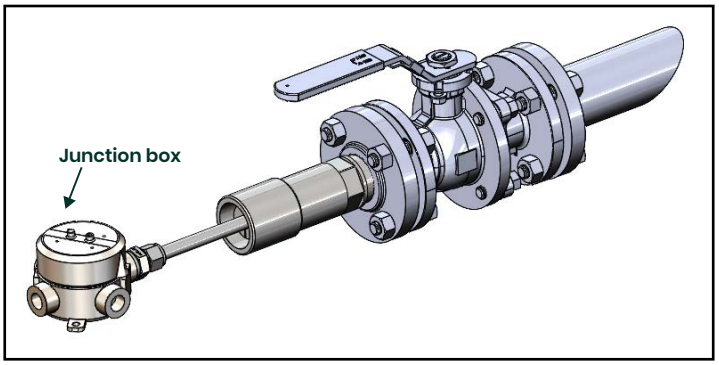
10. Set the valve to the fully open position.

11. Insert the transducer through the valve and nozzle until the insertion depth marker reaches the top of the split collar by pushing on the insertion handle. Tighten the packing nut until the packing nut touches the packing gland. Lock the split collar around the transducer tube by tightening the screws of the split collar to a minimum of 110 in-lb.

12. Unscrew the insertion handle from the compression fitting on the back of the transducer. Screw protective sleeve into the packing gland.



13. Screw the junction box to the compression fitting on the back of the transducer.



14. Install the second insertion mechanism by repeating the steps in *Section 5.2 "Preparing the Insertion Mechanism for Installation"* and *Section 5.3.2 "Mounting the Insertion Mechanism for Flanged Valve Configuration"*. Confirm that the downstream transducer assembly is in the downstream port and the upstream transducer assembly is in the upstream port.
15. Place a tag on each isolation valve that came with the PanaFlow FLI assembly stating the following:

    DO NOT OPERATE (CLOSE) WHEN TRANSDUCER IS INSERTED INTO PIPE

16. Refer to your transmitter Startup Guide/User's Manual to make the transducer electrical connections.

5.4 Connecting an XAMP

This section explains how to correctly install and assemble an XAMP into a transducer junction box. It applies to all three possible junction box options, but only one of the junction box options is used as an example in the steps below.

IMPORTANT: Field wiring and cable entry fittings shall be rated at least 10°C above ambient. Cable entries on the meter are 3/4" NPT. Suitably rated and certified Ex d or Class I Division 1 cable entry devices are required. These must be installed according to the manufacturer's instructions.

The use of suitably certified and rated threaded adapters is permitted. Adaptors with parallel threads are not permitted for Class & Division installations. For Class & Division installations, install conduit seals within 18 inches.

Only one adaptor may be fitted per entry. Any unused entry must be closed with a suitably rated and certified Ex d metal plug. The plug must be fitted directly into the enclosure entry without the use of an adapter. Connecting cables shall be mounted securely and protected from mechanical damage, pulling and twisting.

1. Place a 3/4 in. NPT compression fitting on the stem of the transducer closest to the BNC connector.
2. Torque the fitting into one of the 3/4 in. NPT ports of the junction box with at least 5 threads engaged. After the fitting is torqued into place, ensure that the BNC head of the transducer extends slightly past the ground screw bosses, as shown in *Figure 6* below:

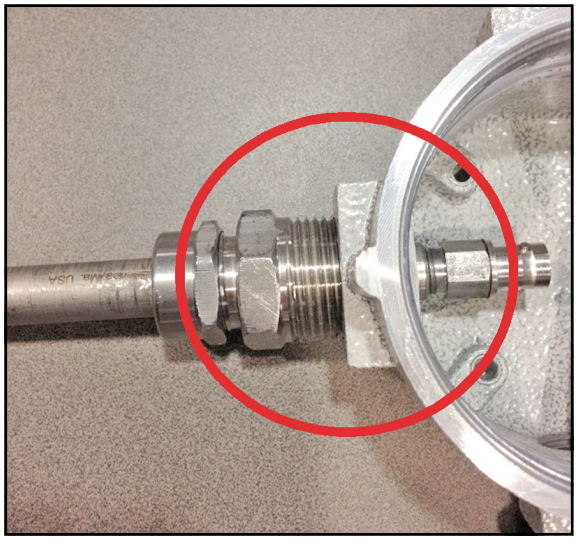


Figure 6: Torquing the NPT Reducer

3. If the BNC head extends too far into the junction box, it will make the assembly more difficult to install by reducing the amount of area needed to properly store the excess cable. If the BNC head is not positioned approximately where it is pictured in *Figure 6* above, loosen the compression fitting and adjust the transducer. Then, re-tighten the compression fitting.

4. Torque the cable gland coming from the flowmeter electronics main housing into the other 3/4 in. NPT port in the junction box until there are at least 5 threads of engagement (see *Figure 7* below).

Figure 7: Torquing the Cable Gland

5. Verify that, with the transducer and the cable gland assembled, the junction box looks like *Figure 8* below:

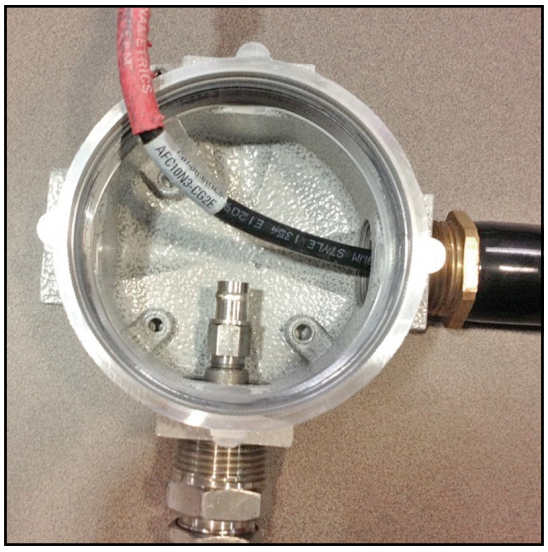


Figure 8: Assembled Transducer and Cable Gland

6. Connect the right angle male BNC plug to the exposed BNC cable from the cable gland assembly, as shown in *Figure 9* below.

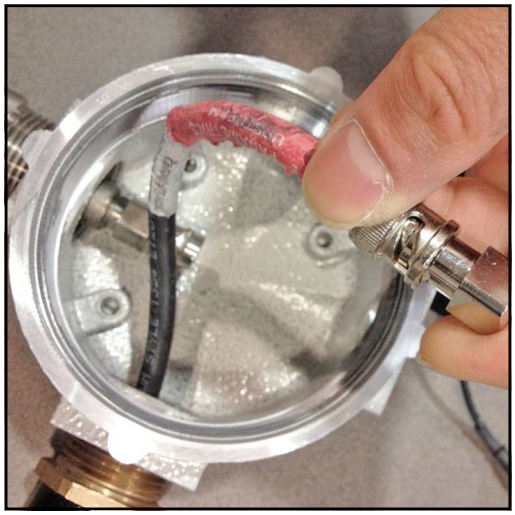


Figure 9: Connecting BNC Plug to the Cable

7. Connect the female BNC plug of the XAMP to the male BNC transducer head as shown in *Figure 10* below:

Figure 10: Female Plug to Male BNC Head

8. Wrap the extra length of cable around the inside of the junction box such that the BNC heads do not rest on other cables or on each other. The assembly should now look like *Figure 11* below.

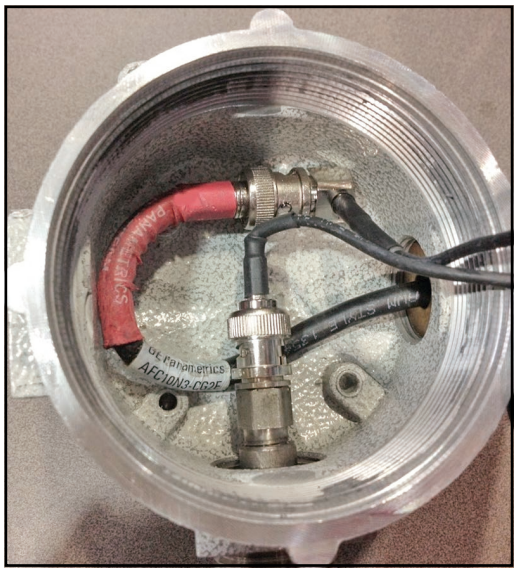


Figure 11: BNC Heads

9. Place the XAMP body into the junction box, resting the puck gently on the cables below it. To reduce stress and strain on the joint. ensure that the cables of the XAMP rest naturally according to the slant at which they exit the epoxy. The XAMP should remain still, and the cap of the junction box should rotate freely around the XAMP.

Figure 12: Junction Box Cap

10. Place the cap of the junction box over the XAMP and tighten the cap until the junction box is firmly closed. Engage the set screw (see *Figure 13* below) to secure the cap in place.

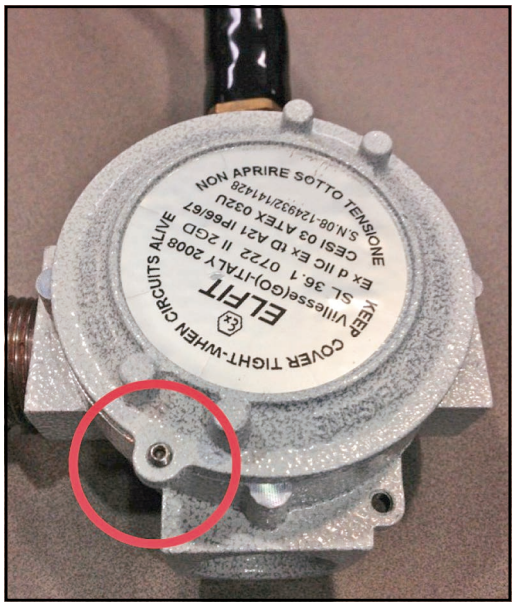


Figure 13: Junction Box Set Screw

To disconnect or uninstall the XAMP from the assembly, perform the above steps in reverse order.

Chapter 6. Transducer Extraction

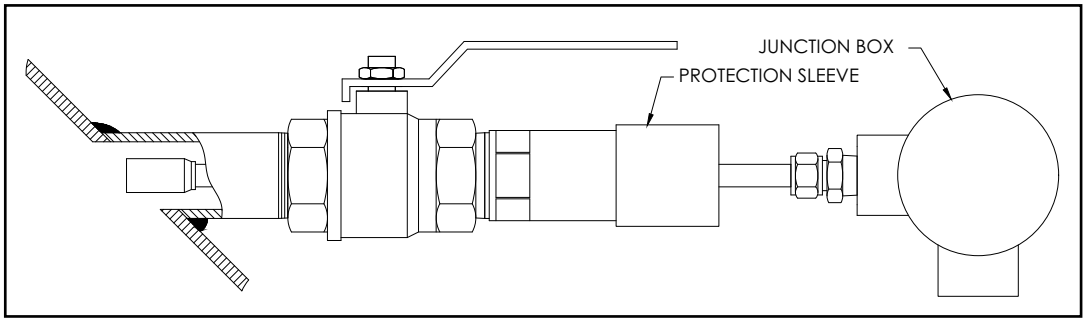
WARNING! **Residual process pressure remaining within the flowcell must be less than 50psi for transducer installation/removal. Gas leaks or injury could result if the internal pipe pressure is above this limit.**

CAUTION! **The standard transducers are made of titanium and are potential ignitions sources when subjected to impact or friction by a metal object e.g. a tool. This spark risk shall be taken into consideration during installation and all other assembly and disassembly operations.**

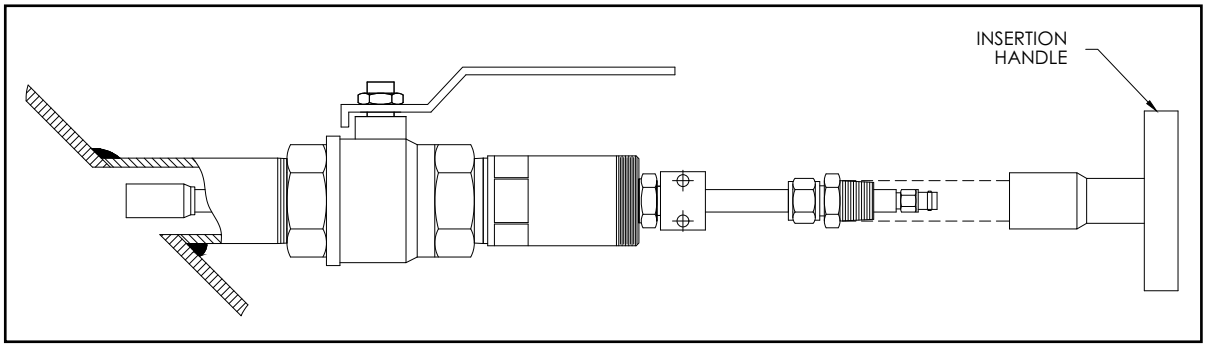
To correctly extract the transducers, the instructions below must be followed.

Note: *Threaded valve configuration only shown but the same procedure applies for the flanged version retraction.*

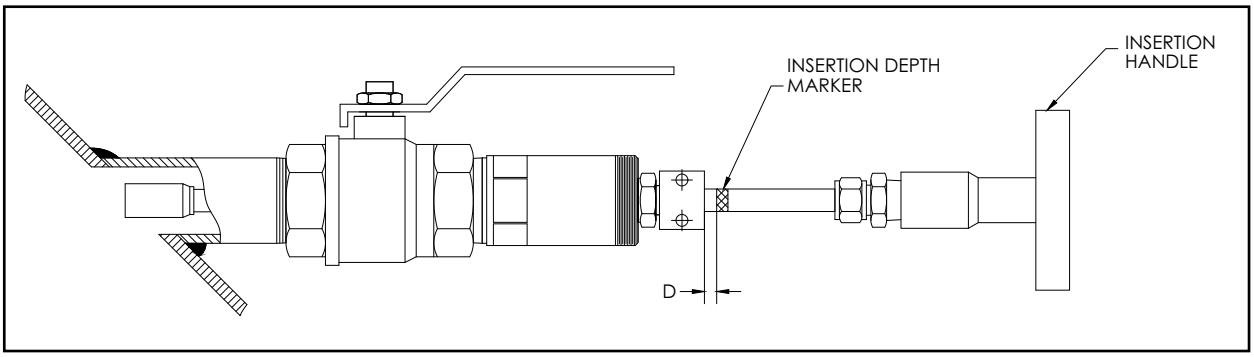
1. Disconnect the electric cable from the connector of the transducer and remove the junction box from the compression fitting at the back of the transducer.



2. Unscrew the protection sleeve from the back of the packing gland and slid it off the back of the transducer.
3. Screw the insertion handle onto the compression fitting on the back of the transducer.



4. Mark the insertion depth using electrical tape or equivalent. This is to allow positioning the transducer face at the same location when the transducer is reinstalled.



D = Distance between the exposed thread of the packing nut and the back surface of the packing gland.

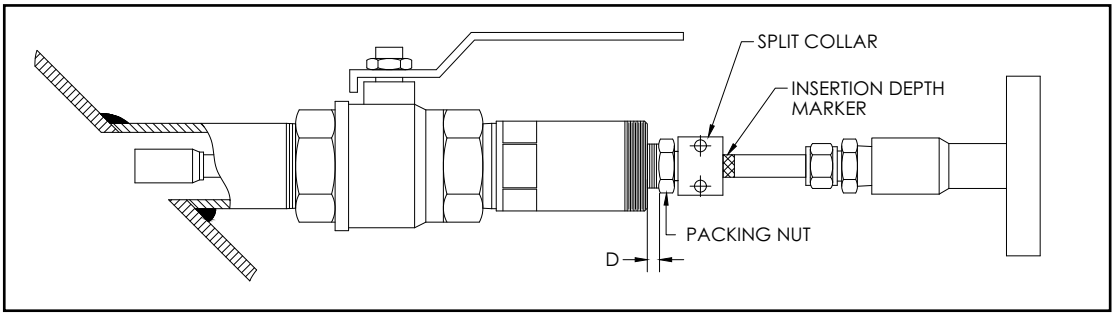
Note: *For details, see steps 5 and 6 of Section 5.3.1 or steps 7 and 8 of Section 5.3.2*

5. Unlock the split locking collar by loosening the two screws on the collar.

WARNING! **Process pressure remaining within the flowcell must be less than 50psi for transducer installation/removal.**

6. Slowly unscrew the packing nut one full rotation and allow the transducer to travel through the insertion mechanism. Do not unscrew completely.

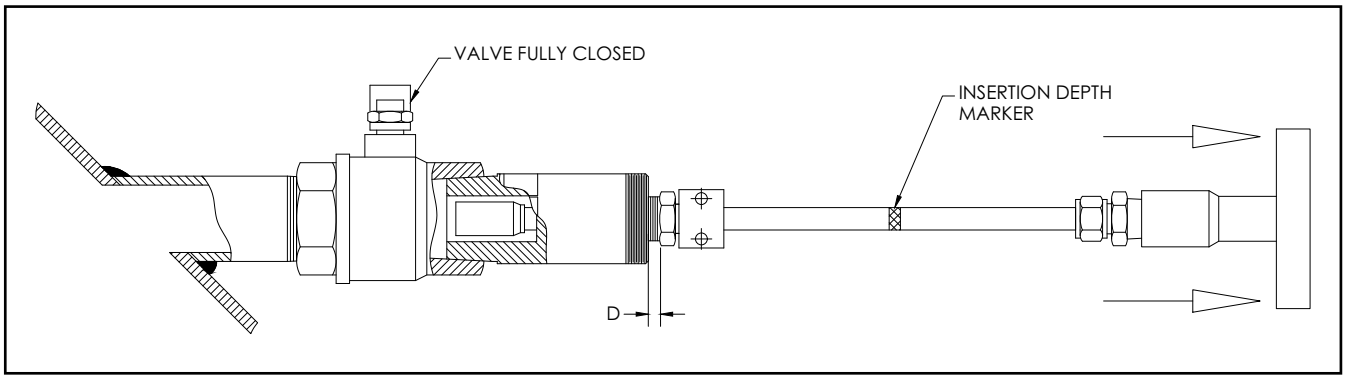
CAUTION! **Once the split collar and/or packing nut have been loosened, the transducer may be forced backward into the retracted position due to line pressure.**



7. Pull on the insertion handle to retract the transducer. The transducer head will come against a stop as the transducer reaches the retracted position.

WARNING! **Ensure transducer is fully retracting prior to proceeding. Failure to fully retract the transducer may result in damage and potential gas leaks once the valve is closed.**

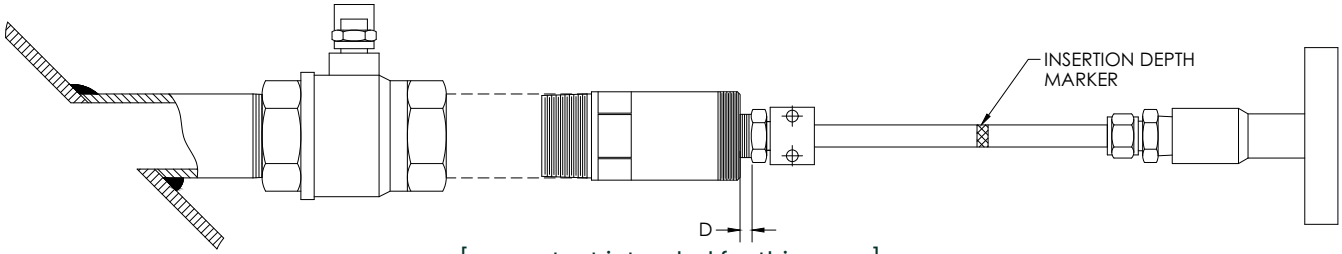
8. Set the valve to the fully closed position.


VALVE FULLY CLOSED
INSERTION DEPTH
MARKER
D

CAUTION! **After transducer has been fully retracted, apply proper LOTO (Lockout/Tagout) to the valve handle per local accepted procedures.**

9. Loosen and remove the FLI insertion mechanism from ball valve.

Note: *Gas in insertion mechanism will be under pressure, use caution.*



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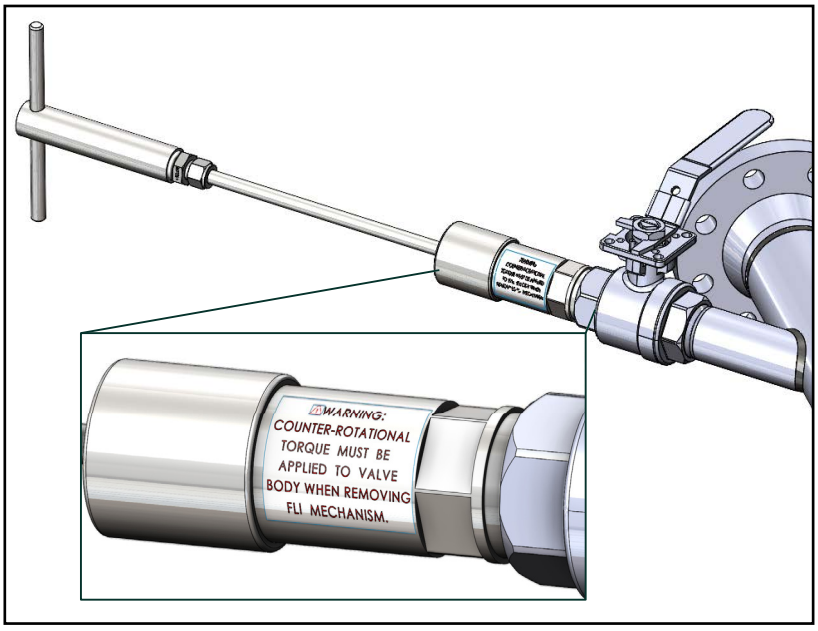
WARNING! **Please see tag: Counter-rotational torque must be applied to valve body when removing FLI mechanism.**



Chapter 7. Maintenance and Service

Local requirements may or may not allow field replacement of any components in this flow metering system without a proper calibration of the entire system at an approved calibration facility. Check with your local Panametrics & Panametrics Flow meter representative to determine if field replacement of components is allowed.

a. Spare Parts

If a fault is found with the flow meter electronics, the entire measurement head can be replaced to ensure hardware and firmware compatibility or possibly specific electronic boards. To ensure that the correct part numbers are ordered, provide your local Panametrics & Panametrics Flow meter representative with the serial number of the meter, located as shown on the "Part String and Serial Number Tag Plate".

b. Installing Replacement Parts

If it is appropriate to replace any component of the flow metering system, the Panametrics & Panametrics Flow meter field service team is trained and equipped to perform the replacement on-site. Installation of these field replaceable parts by a Baker Hughes field service team member will maintain the accuracy of the system and any applicable warranty. Please consult Panametrics to order the appropriate components and to schedule installation in the field

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Chapter 8. Specifications

8.1 Operation and Performance

Fluid types	Gases
Flow measurement	Patented Correlation Transit-Time™ mode
Meter sizes	3 in. to 16 in. (DN80 to DN400) standard Optional: Different sizes may be available upon request
Accuracy	±1.5% of reading (flowcell, standard cal) ±1.0% of reading (flowcell, enhanced cal) ±1.5 to ±2.5% of reading (nozzle system) Velocity of 1.5 m/s (5 ft/s) or greater to Qmax ±0.02m/s (0.075 ft/s) of reading Velocities of 0.15 to 1.5 m/s (0.5 to 5 ft/s) Final installation assumes a fully developed flow profile (typically 20 diameters upstream and 5 diameters downstream of straight pipe run) without CFD analysis. Applications with piping arrangements that induce swirl (e.g., two out-of-plane elbows) may require additional straight run or flow conditioning. Shorter straight runs with CFD possible and consult Panametrics for details.
Repeatability	±0.5% of reading
Measurement Range	0 – 100 m/s (328 ft/s) Based on transmitter selected

8.2 Transmitter Specifications

Based on XGM868i, XGS868i, or XGS868 transmitters. Visit https://www.bakerhughes.com/panametrics/panametrics-services/literature-library to view datasheets with specifications for each of these transmitters, such as hazardous area location, power requirements, input/output capability, physical dimensions and characteristics.

8.3 Transducer Specifications

Temperature ranges	Normal Temperature (NT): -55°C to 150°C High Temperature (HT): -50°C to 250°C
Pressure range	Maximum allowable operating pressure 285 psig (19.65 barg); Retraction at 50 psig (3.45 barg or less)
Transducer materials	Standard: Titanium Optional: Monel or Hastelloy alloys or SS316
Hazardous Area classifications	Explosion-proof Class I, Div. 1, BCD Ex d IIC T6...T1 Gb, IECEx & ATEX (II 2G) Other certifications available upon request. An integrated XAMP preamplifier may be installed in the certified assembly.

8.4 Insertion Mechanism

Material	1.5 in. stainless steel NPT threaded mounted with packing gland Optional: 1.5 in. 150# flange adapter
Temperature Rating	Stainless steel with Viton: -17°C to 205°C
Pressure Rating	MAOP: 285 psig Retraction Pressure: <50 psig

8.5 Isolation Valve

Insertion Materials	1.5 in. stainless steel NPT threaded mounted with packing gland Optional steel NPT or flanged mounted, stainless steel mounted

8.6 Flowcell

Paths	One or two paths
Meter Body Sizing	3 in. to 16 in. (DN80 to DN400) standard
Meter Body Materials	Carbon Steel Other materials such as stainless steel, hastelloy, and inconel are available upon request
Meter Body Process Flange	150# (standard schedule)
Meter Body Design	ASME B31.3 or PED CRN / In Process NACE MR0103

8.7 Nozzles (PFLINZ)

Nozzle Flange	1.5 in. NPT or 1.5 in. 150#
Nozzle Material	Carbon steel or stainless steel

8.8 Temperature & Pressure Sensor (Optional)

Contact Panametrics for details.

8.9 Specific Conditions of Use

8.9.1 Specific Conditions of Use for the Transducer

Consult the manufacturer if dimensional information on the flameproof joints is necessary.

It is end-user's responsibility to ensure that the ambient around the transducer assemblies does not exceed the permitted ambient of -40°C to +60°C, regardless of process temperature.

The standard transducers made of titanium (Option F = Ti) and are potential ignitions sources when subjected to impact or friction, which shall be taken into consideration during installation.

The transducer's junction box has a non-conducting coating which may generate an ignition-capable level of electrostatic charge under certain extreme conditions. The user shall take the necessary precautions to minimize the risk from electrostatic discharge e.g. avoiding a direct airflow of dry air. Cleaning should be done with a damp cloth. The temperature classification rating of the installed transducer assembly is dependent upon the maximum process temperature (see table below).

Table 2: Temperature classification rating and maximum process temperature of the transducers.

Model	Max Process temperature	T-Class
T5-LT T5MAX-LT	+85°C	T6
	+100°C	T5
T5-NT T5MAX-NT	+85°C	T6
	+100°C	T5
	+135°C	T4
	+150°C	T3
T5-HT T5MAX-HT	85°C	T6
	+100°C	T5
	+135°C	T4
	+200°C	T3
	+250°C	T2
T5-XT T5MAX-XT	85°C	T6
	+100°C	T5
	+135°C	T4
	+200°C	T3
	+300°C	T2

8.9.2 Specific Conditions of Use for the Meter

The meter shall be mounted with the cylindrical section horizontal and the mounting boss pointing downwards with the cylindrical enclosure in a horizontal position. (See clause 26.5.1.1 of IEC 60079-0).

Contact the manufacturer if dimensional information of flameproof joints is needed. All installed accessories shall be rated for the intended hazardous area classification requirements.

The meter's enclosure has a non-conducting coating which may generate an electrostatic charge under extreme conditions. The user shall take the necessary precautions to minimize the risk of an electrostatic discharge' e.g. avoiding a direct airflow of dry air. Cleaning should be done only with a damp cloth.

Contact the manufacturer for genuine replacement fasteners for the following joints:

a. Meter Body to Adapter flange: M10x1.5 x 35 mm socket head screws, zinc plated steel (A574) or better, with a minimum yield strength of 135,000 PSI.

b. Local Mount Bracket: M6x1 x 16.0 mm socket head screws, stainless steel (A4-70 SS) or better, with a minimum yield strength of 65,257 PSI.

The hazardous locations temperature classification of both local mount version and remote mount version of the meter is contingent upon the process temperature, as follows. At process temperatures higher than 85°C, remote mounting of the meter is necessary.

Table 3: Temperature classification of the meters for local and remote configurations

Mounting configuration	Process temperature	T-Class
Local	-40°C to +80°C	T6 (85°C)
Local	-40°C to +85°C	T5 (100°C)
Remote	-40°C to +80°C	T6 (85°C)
Remote	-40°C to +95°C	T5 (100°C)
Remote	-40°C to +130°C	T4 (135°C)
Remote	-40°C to +150°C	T3 (200°C)

Scan here or use the link below for
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or Service Information:
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Technical Support email:
panametricstechsupport@bakerhughes.com

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