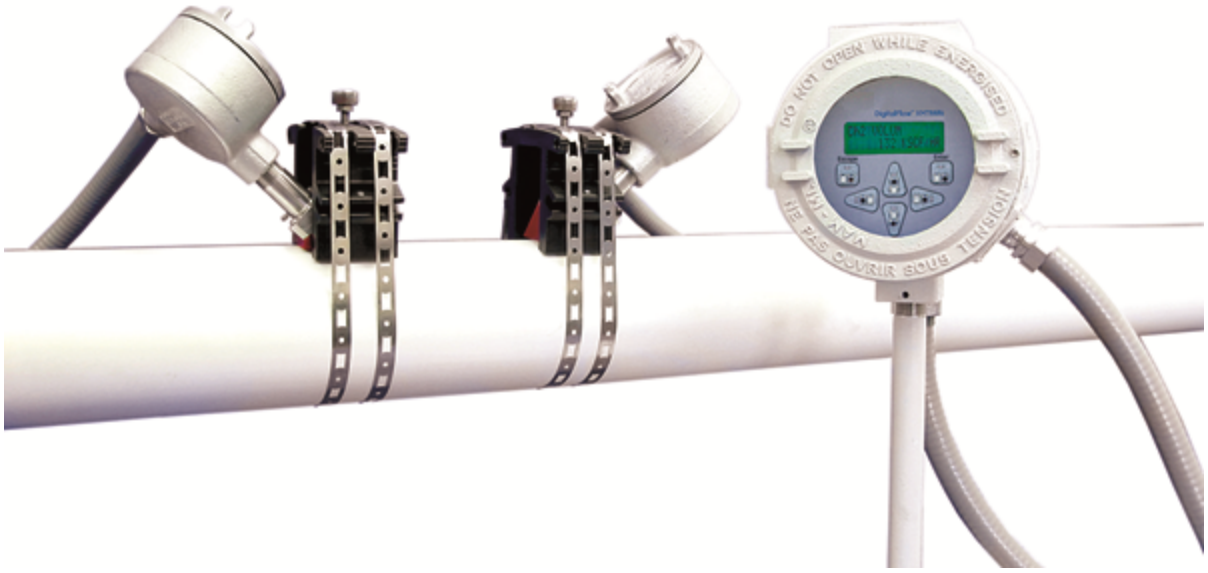
Panametrics
a Baker Hughes business

Panametrics Ultrasonic Flow Transducers for Liquids

Installation Guide



Panametrics
a Baker Hughes business

Panametrics Ultrasonic Flow Transducers for Liquids

Installation Guide

BH050C21 EN C
July 2023

panametrics.com

[no content intended for this page]

Warranty

Each instrument manufactured by Panametrics is warranted to be free from defects in material and workmanship. Liability under this warranty is limited to restoring the instrument to normal operation or replacing the instrument, at the sole discretion of Panametrics. Fuses and batteries are specifically excluded from any liability. This warranty is effective from the date of delivery to the original purchaser. If Panametrics determines that the equipment was defective, the warranty period is:

one year for general electronic failures of the instrument

one year for mechanical failures of the sensor

If Panametrics determines that the equipment was damaged by misuse, improper installation, the use of unauthorized replacement parts, or operating conditions outside the guidelines specified by Panametrics, the repairs are not covered under this warranty.

The warranties set forth herein are exclusive and are in lieu of all other warranties whether statutory, express or implied (including warranties of merchantability and fitness for a particular purpose, and warranties arising from course of dealing or usage or trade).

Return Policy

If a Panametrics instrument malfunctions within the warranty period, the following procedure must be completed:

Notify Panametrics, giving full details of the problem, and provide the model number and serial number of the instrument. If the nature of the problem indicates the need for factory service, Panametrics will issue a RETURN AUTHORIZATION number (RA), and shipping instructions for the return of the instrument to a service center will be provided.

If Panametrics instructs you to send your instrument to a service center, it must be shipped prepaid to the authorized repair station indicated in the shipping instructions.

Upon receipt, Panametrics will evaluate the instrument to determine the cause of the malfunction.

Then, one of the following courses of action will then be taken:

If the damage is covered under the terms of the warranty, the instrument will be repaired at no cost to the owner and returned.

If Panametrics determines that the damage is not covered under the terms of the warranty, or if the warranty has expired, an estimate for the cost of the repairs at standard rates will be provided. Upon receipt of the owner's approval to proceed, the instrument will be repaired and returned.

[no content intended for this page]

Chapter 1: General Information

Chapter 2: Wetted Transducers

Chapter 3: Clamp-On Transducers

Chapter 1: General Information

1.1 Introduction

This guide is for BakerHughes Panametrics flowmeters that measure liquid flow using ultrasonic transit-time and TransFlection® methods. It is important to note that this installation guide provides information for the most common installations only. However, it can be used for equipment not specifically mentioned here. BakerHughes Panametrics can accommodate many special installations by using different transducers and configurations. For special installations, BakerHughes Panametrics will supply drawings with the nominal dimensions based on the specific application.

Before you begin installation, you should familiarize yourself with the type of transducer you are using and the general guidelines for transducer position and location as described in this chapter.

If you have any questions or problems, contact Panametrics for assistance (see the back cover of this manual).

Upon request, Panametrics can set up in-plant or on-site, hands-on training seminars. For more information, contact your local sales representative or one of the main Panametrics manufacturing facilities (see the back cover of this manual).

1.1.1 Transducer Types

Flow Transducers fall into one of two major classes: wetted or non-wetted. Wetted transducers are inserted into the pipe so that they come in direct contact with the fluid being measured. Non-wetted transducers, commonly referred to as clamp-on transducers, are clamped onto the outside of the pipe and send their ultrasonic pulses through the pipe wall.

1.1.1.1 Wetted Transducers

BakerHughes Panametrics standard wetted transducers are typically flat-faced and send their ultrasonic longitudinal wave signals into the fluid with no refraction. BakerHughes Panametrics standard clamp-on transducers, on the other hand, use refraction to transmit sound through the pipe wall and into the liquid. Although 3/8″ (9.5 mm), 1/2″ (12.7 mm), 3/4″
(19.0 mm), and 1″ (25.4 mm) transducer diameters are most common, a variety of other sizes is available, depending on the application.

BakerHughes Panametrics has also developed hybrid transducers that consist of two parts: a fixed member and a removable, wetted transducer. The fixed member is a special wetted pipe plug called a PanAdapta® plug. This plug (fixed member) is mounted in the flowcell. The wetted transducer can be temporarily and repeatedly coupled to the outside face of the PanAdapta plug. In using the PanAdapta plug there is no need to interrupt the process when servicing the hybrid transducer.

For high-temperature applications, the Bundle Waveguide Technology™ (BWT™) system is available and consists of a PanAdapta plug and a transducer. The PanAdapta plug uses waveguide bundles to efficiently concentrate a greater amount of the transducer signal into the process. At the same time, it acts as a heat buffer that protects the transducer from high temperatures to ensure long life.

1.1.1.2 Clamp-On Transducers

The most common types of BakerHughes Panametrics clamp-on transducers are the weatherproof shear wave and the weatherproof/hazardous area shear wave transducers.

Each type of transducer has a flat face and is used for 2″ (50 mm) diameter pipes and larger. Pipes can be made of carbon steel, stainless steel, copper, brass, cast or ductile iron, glass, plastic (PVC or CPVC), or fiberglass. There are no thickness constraints on the pipe wall, as long as the wall can conduct sound adequately.

Transducers for pipes smaller than 2″ (50 mm) are also available. Transducers for small pipes are already installed into the clamping fixture prior to shipment. See *Using a Small Pipe Clamping Fixture - SPCF* in chapter 3.

Figure 1 below shows the most common types of transducers.

Figure 1: Four Types of Clamp-On Transducers

1.1.2 Transducer Position and Location

Whichever transducer type is selected for your installation, flowmeter accuracy depends on proper transducer location, spacing, alignment, and electronics programming. However, even though every transducer installation has specific location considerations, the following two location guidelines apply to all transducers, regardless of type:

CAUTION! **Flowmeter accuracy and performance depends on the location, spacing, and alignment of the transducers. The specific spacing of your transducers are unique to your installation.**

1. To help assure a uniform flow profile, locate the flowcell so that there are at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the point of measurement. Measure from the center of the transducer at the pipe wall ID. “Undisturbed flow” means avoiding sources of turbulence such as valves, flanges, elbows; avoiding swirl; and avoiding cavitation.
2. It is important to locate the transducers on a horizontal plane. This specifically applies to mounting transducers on a horizontal pipe. One transducer cannot be on top of the pipe and one on the bottom, because the top of the pipe tends to accumulate gas and the bottom tends to accumulate sediment. These can attenuate or block the ultrasonic signal. There is no similar restriction with vertical pipes. To ensure that the pipe remains full of liquid, however, you should avoid vertical downward flow. When using a wetted installation, extended-well type transducers are preferred to keep the transducer face free from gas or sediment that may tend to get trapped in the transducer port.

Chapter 2: Wetted Transducers

2.1 Introduction

Installing wetted transducers consists of creating a flowcell and then mounting the transducers into that flowcell. There are various types of flowcells and methods for creating them. In addition, there are several methods for mounting transducers, including the Panametrics BWT system.

This chapter discusses the most common installations. However, it can also be used for equipment not specifically mentioned here.

2.1.1 Types of Flowcells

There are two basic types of flowcell installations for wetted transducers:

- *Tilted Diameter* - for use with pipe sizes above 2" (50 mm)
- *Axial Offset* - for use with pipe sizes of 2" (50 mm) and below.

In both types of installations, the transducers are mounted into a section of pipe called a **flowcell**. The flowcell can be created either by mounting the transducers on the existing pipeline or on a **spoolpiece**. A spoolpiece is a precision-manufactured section of matching pipe that contains the ports where the transducers will be mounted. This setup allows more accurate transducer alignment before mounting the spoolpiece into the pipeline. If requested, the spoolpiece can be calibrated.

2.1.1.1 Tilted Diameter Flowcells

A tilted diameter flowcell is so named because the transducers send their signals at a typical 45° angle across the diameter (or other chord) of the pipe. This type of flowcell can be configured as a single- traverse or multiple-traverse installation.

Note: *The mounting angle for the transducer is typically 45°, but other angles (20°, 30°, or 60°) can be used as required.* Tilted Diameter *can also refer to paths that are offset from the diameter such as the* Mid-Radius *path.*

A single-traverse configuration consists of two transducers mounted on opposite sides of the pipe so that the signal they transmit passes through the fluid just once, at a typical 45° angle (see Figure 2 below).

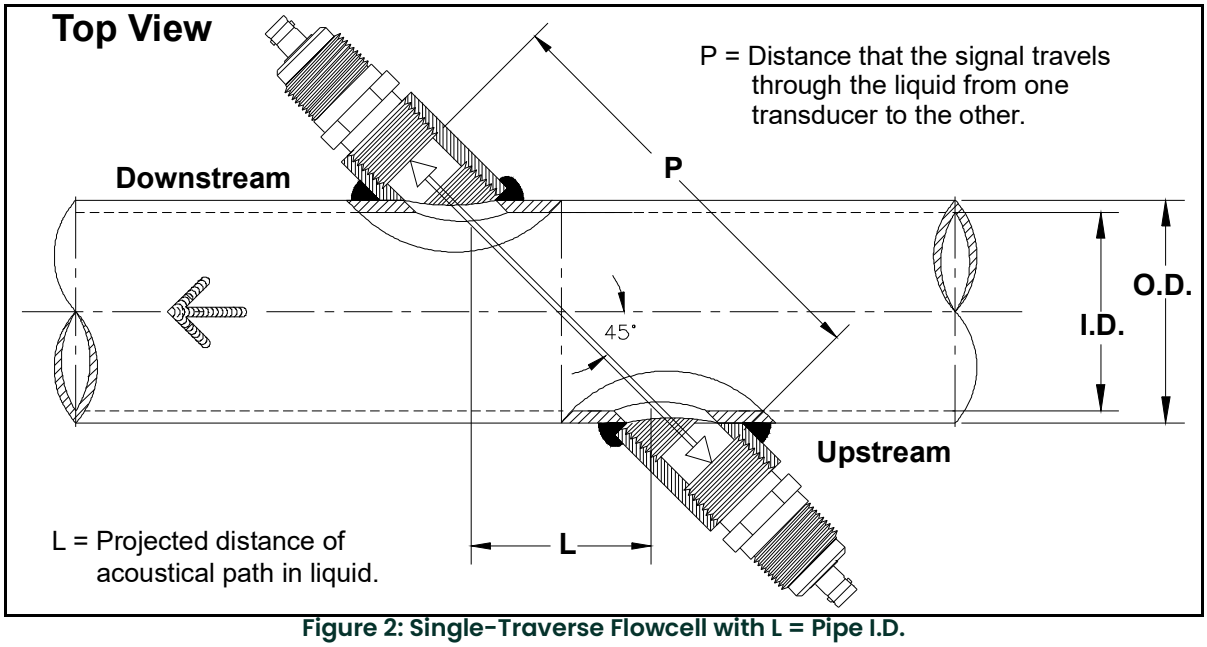


Figure 2: Single-Traverse Flowcell with L = Pipe I.D.

A multiple-traverse configuration consists of two transducers mounted on the pipe so that the signal traverses the fluid two or more times before reaching the other transducer. See Figure 3 to Figure 5 below for examples of commonly used installations.

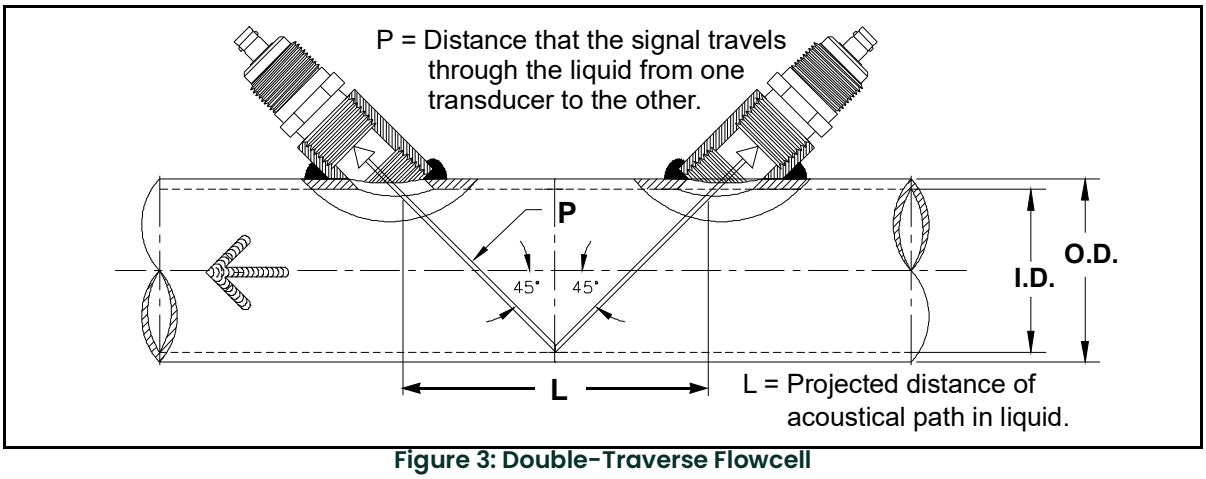


Figure 3: Double-Traverse Flowcell

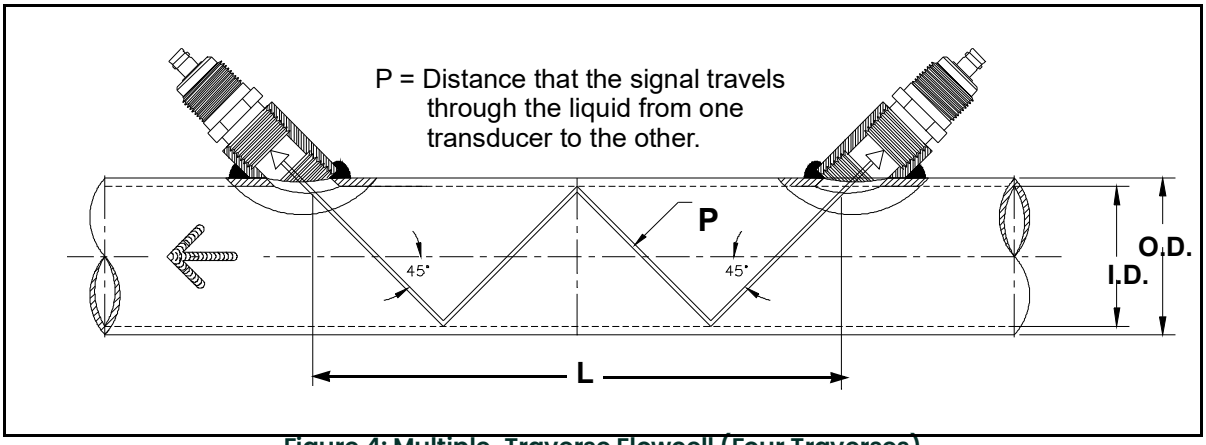


Figure 4: Multiple-Traverse Flowcell (Four Traverses)

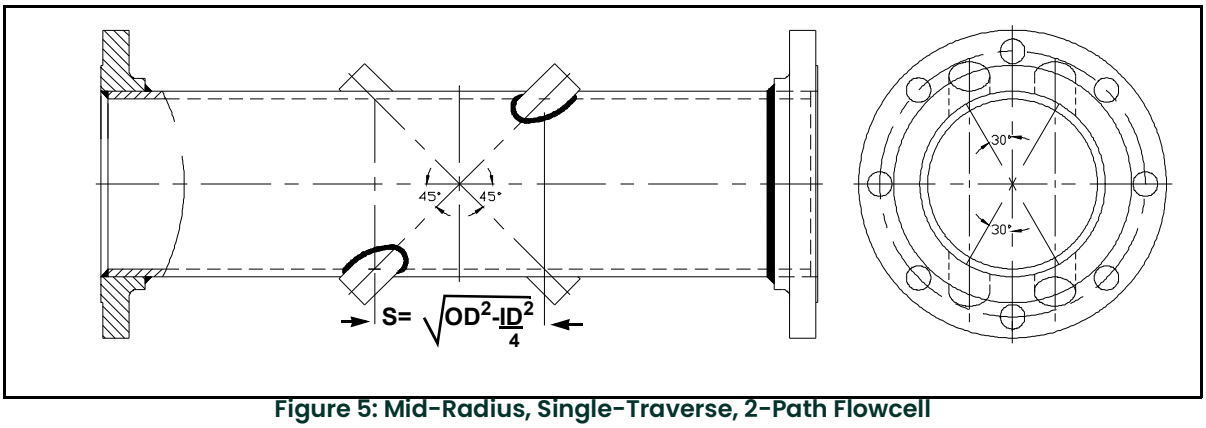


Figure 5: Mid-Radius, Single-Traverse, 2-Path Flowcell

2.1.1.1 Axial-Path Offset Flowcells

In *axial-path offset* flowcells, the walls of the pipe reflect the ultrasonic signal. This allows the signal to remain in the fluid longer, increasing the effective length L and path P of the signal, thus increasing accuracy. The number of times the signal can traverse the fluid depends on such factors as transducer frequency, pipe size, pipe wall condition, and the fluid being measured.

Axial-path offset flowcells can be made up as a spoolpiece, then mounted into the process pipeline, or they can be created by cold tapping the transducer ports directly into the existing pipeline.

Figure 6 below shows an axial-path offset flowcell that is used for 1/8" to 2" (3 mm to 50 mm) pipe sizes. This type of flowcell maintains a high accuracy of measurement on small diameter pipes because it provides a much longer path length and allows for 100% area averaging of the flow profile. An axial-path offset flowcell can be installed into the pipeline using flanges, welding, NPT threading, or quick-release methods. When installed, the flowcell should be positioned to avoid gas entrainment or sediment deposition in front of the transducers.

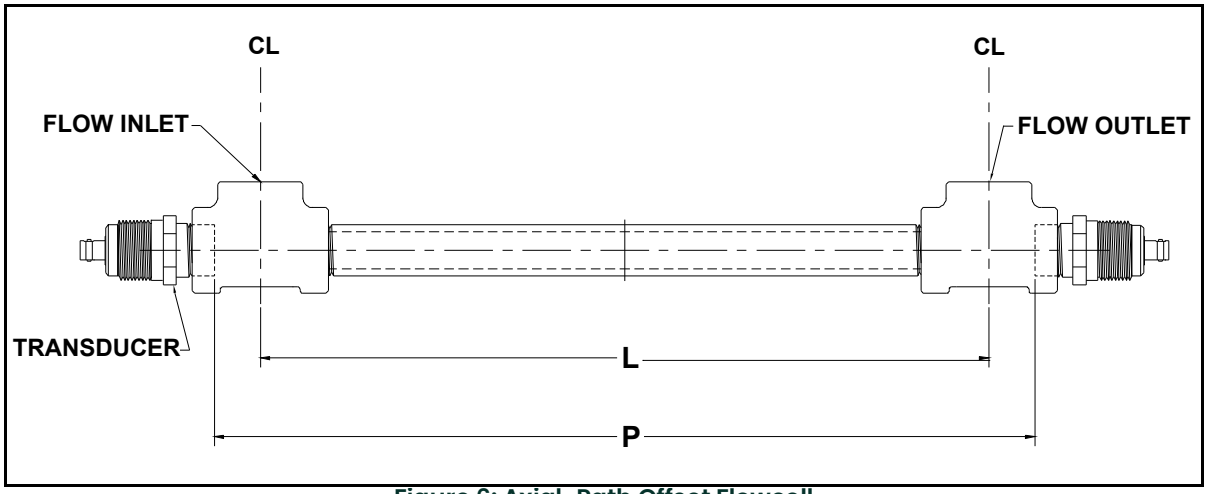


Figure 6: Axial-Path Offset Flowcell

2.1.2 Building a Wetted Flowcell

This section describes how to build a flowcell using one of the following methods:

- installing a spoolpiece
- cold tapping transducer ports into an existing pipeline

Note: *Hot tapping of pressurized pipe is also possible. Contact Panametrics for the required equipment and instructions.*

2.1.2.1 Installing a Spoolpiece

Spoolpieces can be inserted into the existing pipeline either with flanges or by welding. To position the spoolpiece into the pipeline, see Figure 7 below and complete the following steps:

1. Find the arrow mark and the word **TOP** marked on the tag plate on the spoolpiece. If the spoolpiece is flanged, two bolt holes should straddle the centerline.
2. Place the spoolpiece in the pipeline so that the arrow mark is in the direction of flow and the top is appropriately located. Be sure the transducer ports are located in a horizontal plane.
3. Bolt or weld the spoolpiece into place, as appropriate.
4. Go to the section that describes mounting the wetted transducers.

In general (including cases where the spoolpiece axis is not horizontal), be sure that the installation does not allow gas or sediment to deposit in the transducer ports. Otherwise the sound waves will be attenuated or blocked entirely.

Note: *Use extended-well transducers or extended-well* PanAdapta *plugs for tilted diameter flowcells.*

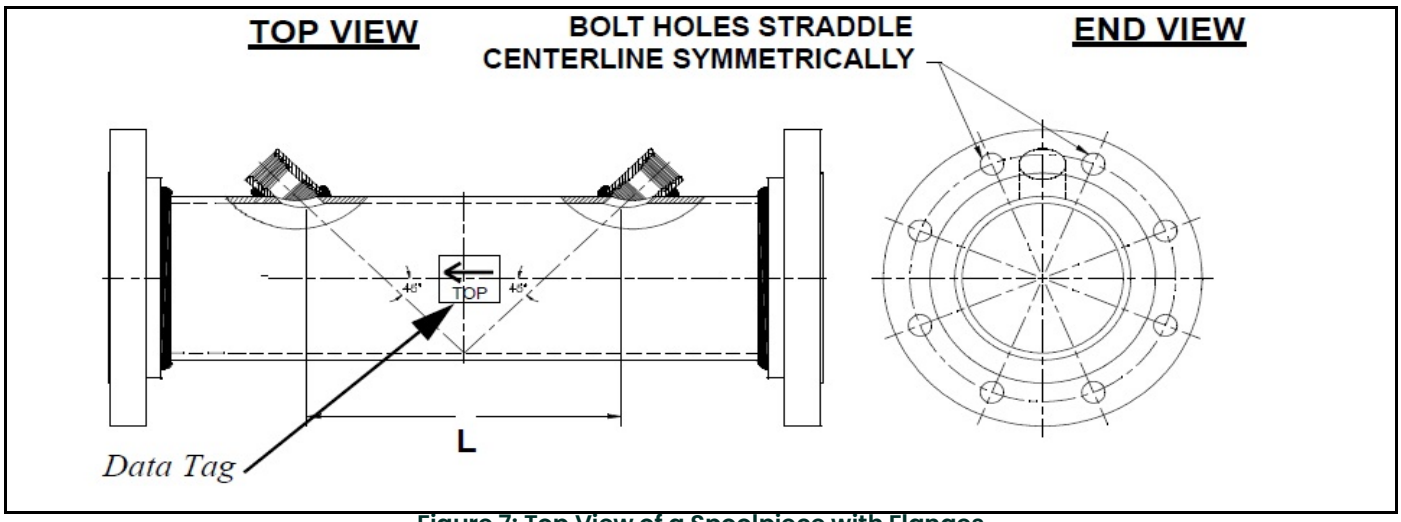


Figure 7: Top View of a Spoolpiece with Flanges

2.1.2.2 Cold Tapping into an Existing Pipeline

To cold tap the transducer ports into a pipe, the pipe must be empty and safe. Please note that reference drawings and kits for cold tapping are available from Panametrics. Standard kits provide alignment equipment for single-traverse installations only. Figure 8 below shows a typical cold tapping kit, which includes:

- 2 contoured couplings
- 2 rod support bushings
- 1 alignment rod
- 1 Allen wrench
- 1 detail drawing (not shown)

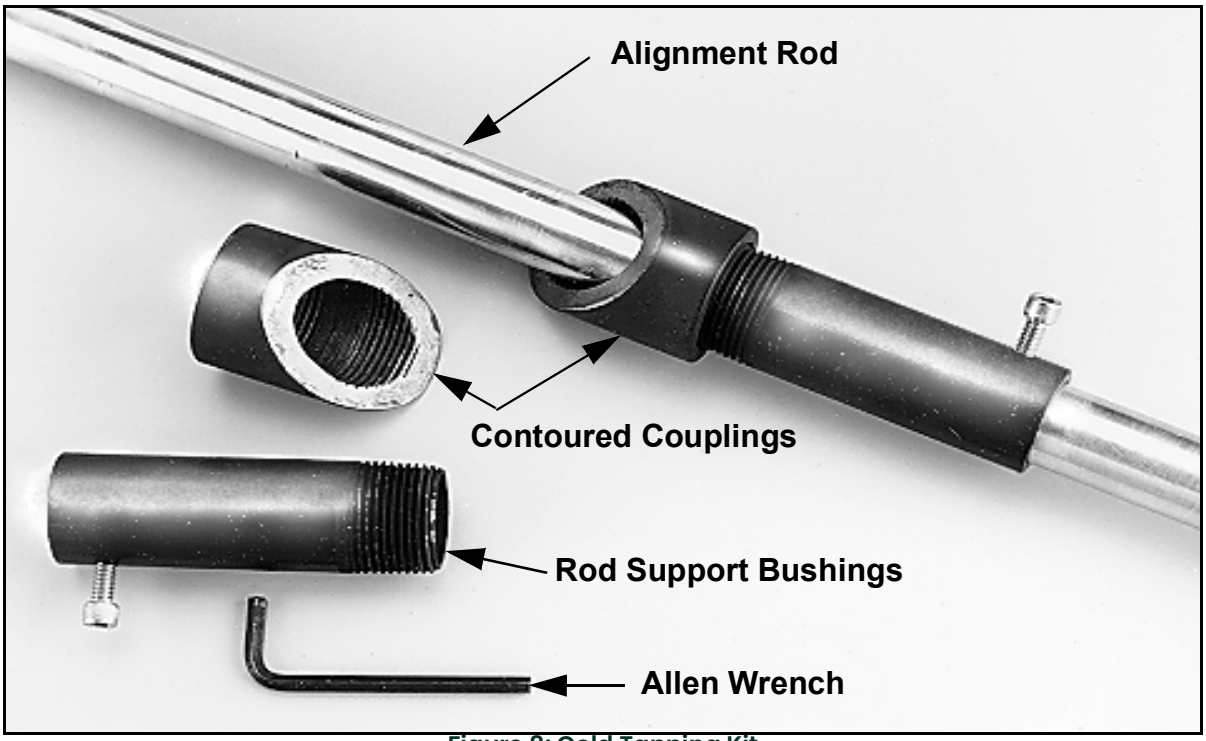


Figure 8: Cold Tapping Kit

Note: *Two flanged nozzles are available for cold tapping ports for flanged transducers or PanAdapta plugs. The kit for the nozzles includes two tapped flanges to accept the bushings (see Figure 9 below).*

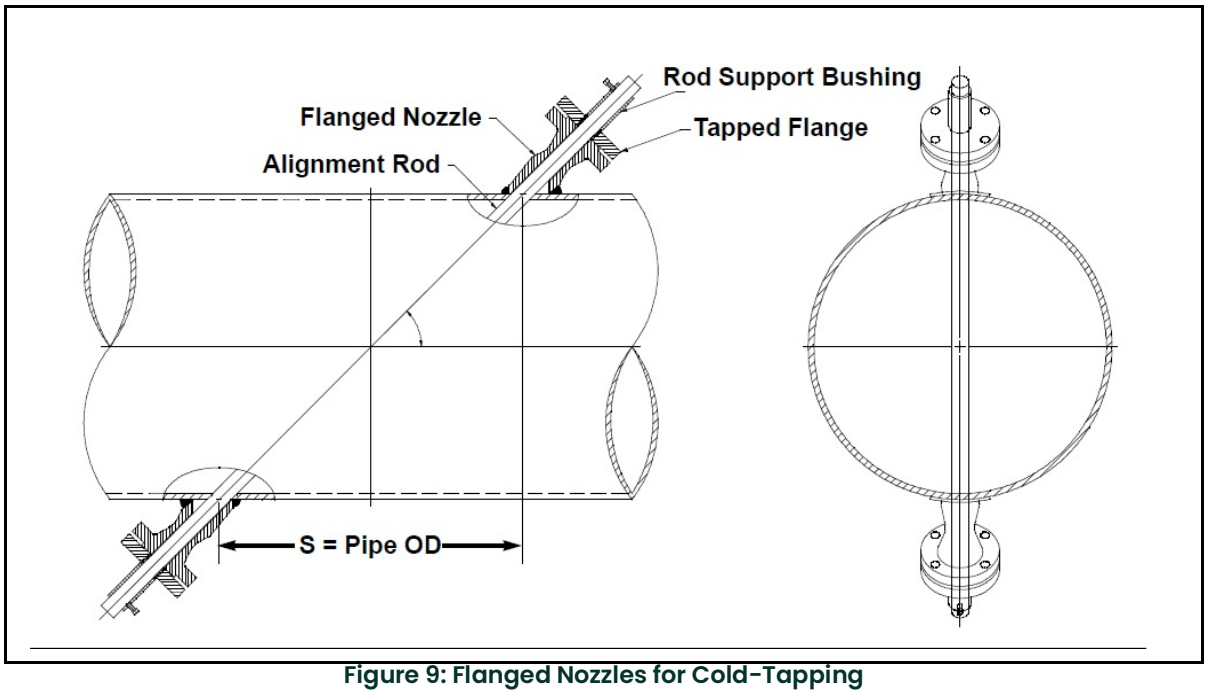


Figure 9: Flanged Nozzles for Cold-Tapping

The following sections present general guidelines for cold tapping a weldable or non-weldable pipe to install the transducer ports:

WARNING! **BE SURE TO FOLLOW ALL APPLICABLE LOCAL SAFETY CODES AND SAFETY PROCEDURES.**

Weldable Pipe

Refer to Figure 10 below and complete the following steps:

1. Measure and mark locations on the pipe where the transducer ports are to be installed.
2. Cut two holes into the pipe at the port locations. This usually requires a welding torch or specialized drilling equipment.
3. Place a rod through the two holes to help maintain the alignment while you attach a contoured coupling or nozzle to each hole. Use rod support bushings to hold the rod in the couplings or nozzle.
4. Weld the couplings to the pipe.
5. Remove the rod and bushings from the pipe. Then proceed to the section on installing the transducers into the flowcell.

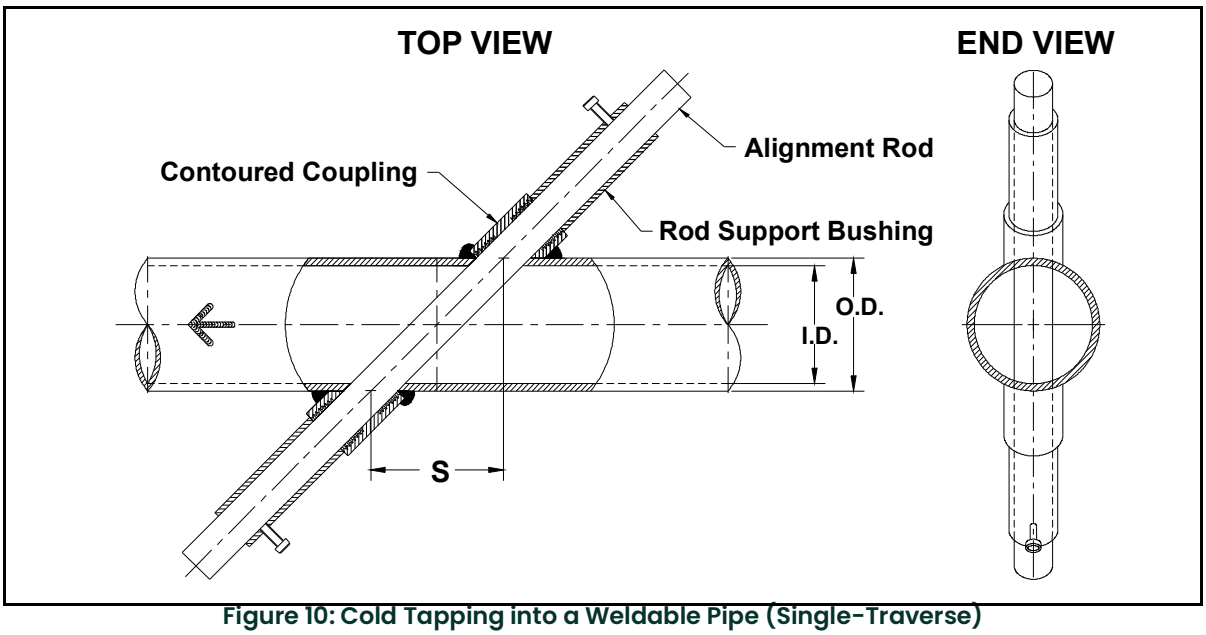


Figure 10: Cold Tapping into a Weldable Pipe (Single-Traverse)

Non-Weldable Pipe

Refer to Figure 11 below and complete the following steps:

1. A saddle is used to attach a coupling to non-weldable pipe such as wood, fiberglass, cement, concrete, cast iron, etc.
2. Measure and mark the locations on the pipe where the transducer ports are to be installed.
3. Cut or drill the two holes into the pipe at the port locations. This may require special equipment such as templates or drill guides.
4. Prepare the pipe surface around the hole so that the o-ring in the saddle will form a good seal. In many cases, this can be done by coating the pipe with epoxy.
5. Secure the saddle to the pipe.
6. Place a rod through the two holes to maintain the alignment while you attach a contoured coupling or nozzle to each port. Use rod support bushings to hold the rod in the couplings or nozzle.
7. To fully install the saddle, tighten the saddle bolts.
8. Remove the rod and bushings from the pipe. Then proceed to the section on installing the transducers into the flowcell.

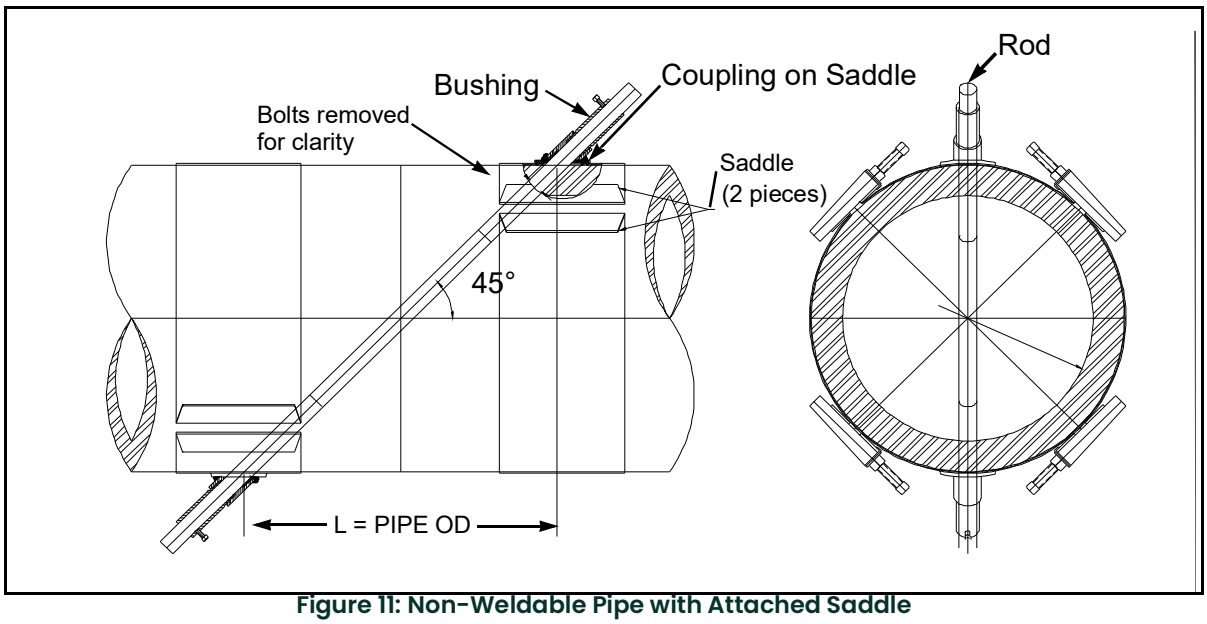


Figure 11: Non-Weldable Pipe with Attached Saddle

2.1.3 Wetted Transducer Types

Standard wetted transducers (see Figure 12 below) and extended-well transducers (see Figure 13 below) typically have 3/4" NPT or 1" NPT threads for connection to the spoolpiece and for the electrical junction box connection.

Note: *Transducers and PanAdapta Plugs are marked with a two-digit inspection number, a serial number, and a programming number. Make a note of the programming number, as it will be needed for programming the flowmeter.*

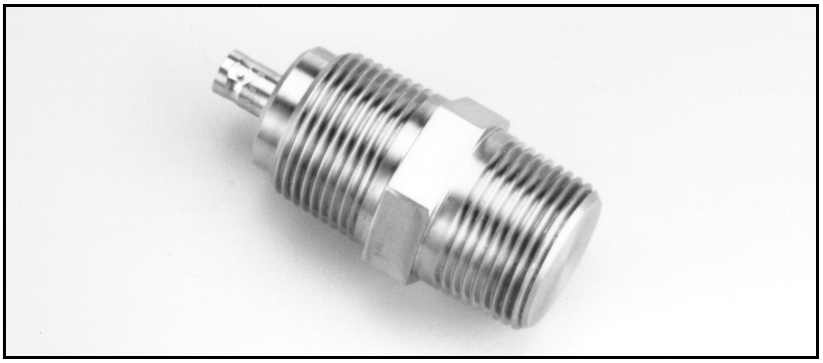


Figure 12: Standard Wetted Transducer

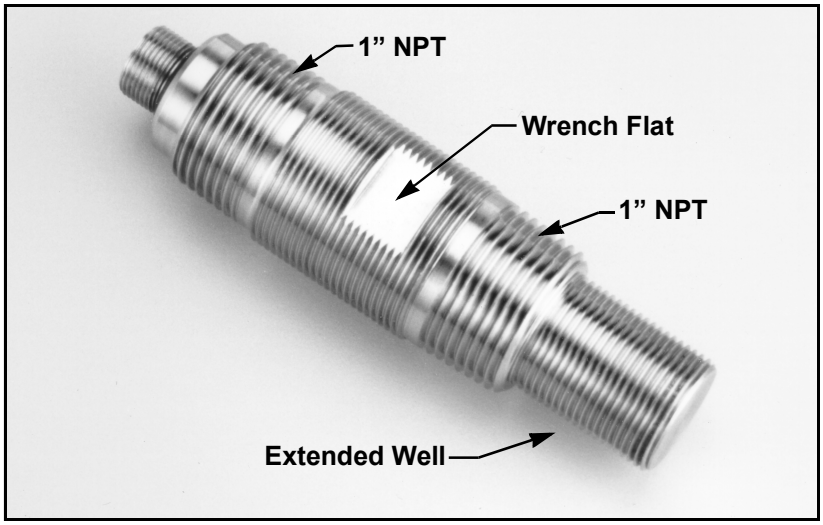


Figure 13: Extended-Well Transducer

Standard and extended-well wetted transducers are easily modified for hazardous areas by adding explosion-proof electrical junction boxes (see Figure 14 below). To weatherproof the transducers, you can use the same junction box with the supplied o-ring seal.

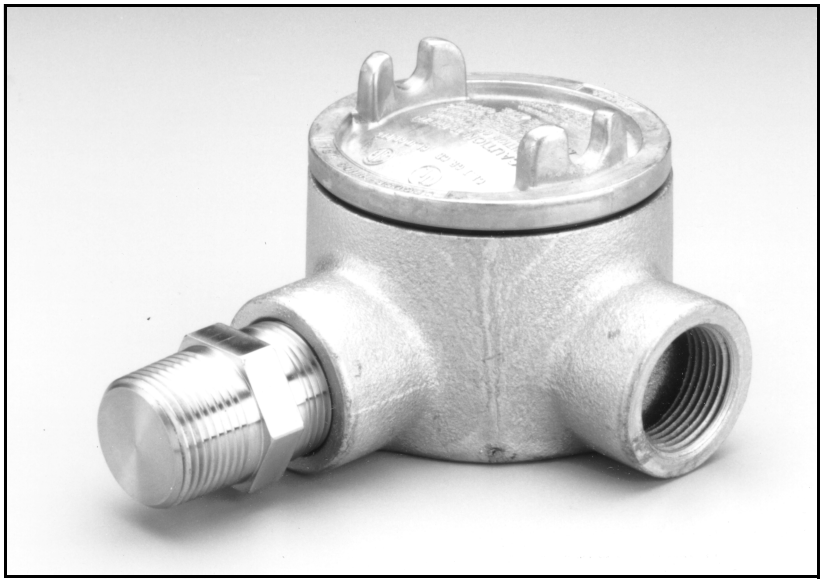


Figure 14: Transducer Installed in Junction Box

Buffer rod transducers are used in high-temperature or low-temperature applications and are typically 6” (150 mm) long and have a 1” NPT thread for the process connection. Figure 15 below shows a standard 6” (150 mm) buffer rod transducer.

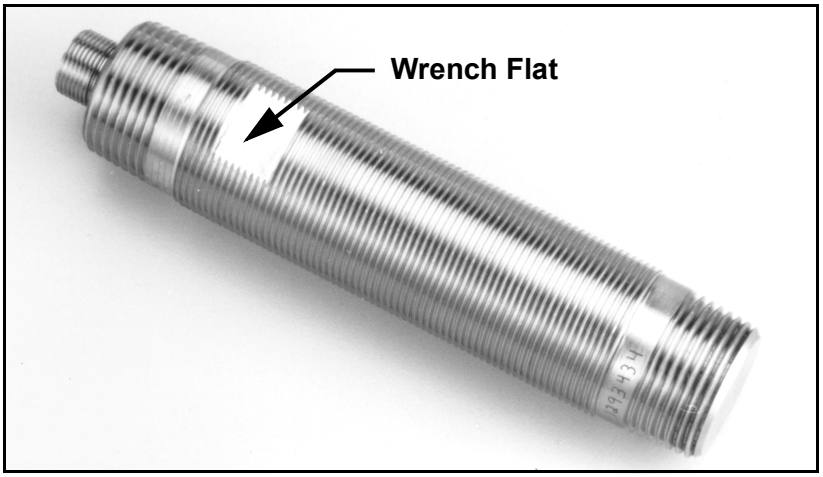


Figure 15: Buffer Rod Transducer

2.1.4 Installing Transducers Directly into the Flowcell

To mount the wetted transducers directly into the flowcell, proceed as follows:

WARNING! **BE SURE TO FOLLOW ALL APPLICABLE SAFETY CODES AND PROCEDURES WHEN INSTALLING TRANSDUCERS IN HAZARDOUS AREAS.**

1. Apply approximately three layers of PTFE tape or other appropriate thread sealant to the transducer mounting threads (see Figure 16 below). Then, screw the transducers into the transducer ports.
2. Tighten the transducers with a wrench to ensure a leak-proof seal. Be sure to apply the wrench only on the hex nut of a standard transducer or on the flats of a buffer rod transducer.

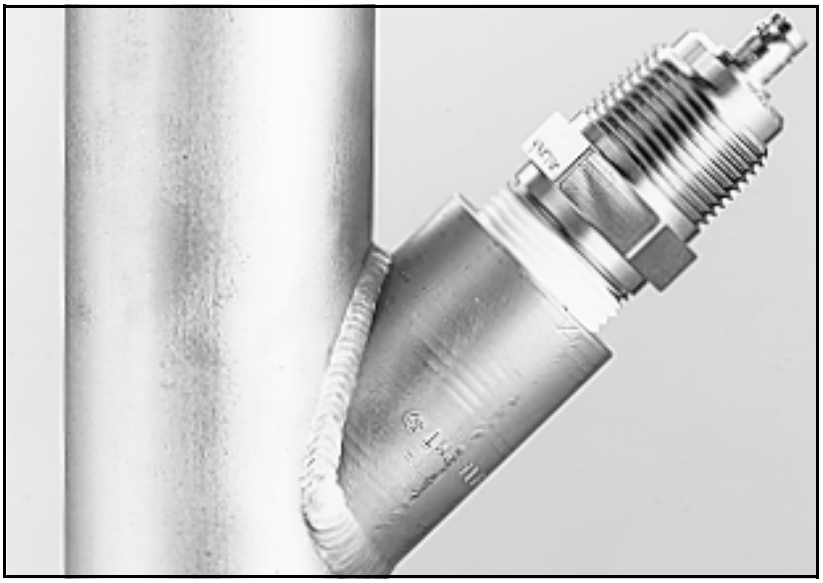


Figure 16: Installed Standard Transducer

2.1.5 Installing Transducers with PanAdapta Plugs

The **PanAdapta** plug (see Figure 17 below) is a special pipe plug and coupling assembly made of either metal (stainless steel, etc.) or plastic (CPVC, PVDF, PTFE, etc.). It may be mounted into pipe couplings, nozzles or tees, enabling you to easily install and remove transducers without emptying the pipe.

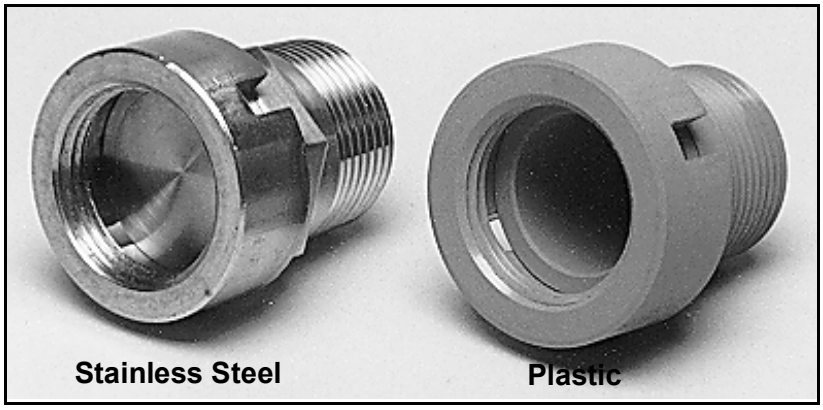


Figure 17: Standard Threaded PanAdapta Plugs

Stainless steel and other metal PanAdapta plugs are screwed, socket-welded, or flanged into the pipe coupling, nozzle or tee. *Plastic* PanAdapta plugs are mounted into a pipe coupling either by threading or fuse bonding. Plastic PanAdapta plugs are used when wetted parts cannot be metal. They have a thinner face than the stainless steel plugs and require the use of extended-well wetted transducers. Figure 18 below shows extended-well, threaded, stainless steel PanAdapta plugs.

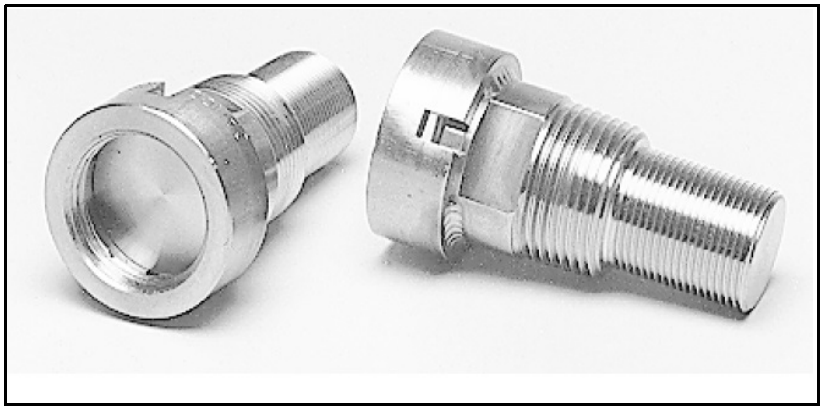


Figure 18: Extended-Well Threaded PanAdapta Plugs

PanAdapta plugs are available in three types. Go to the appropriate section to install your type of PanAdapta plug.

WARNING! All applicable safety codes and procedures must be followed when installing PanAdapta plugs.

2.1.5.1 Installing Threaded Type PanAdapta Plugs

To install the *threaded type* PanAdapta plug into the flowcell, complete the following steps:

1. Apply a thread sealant, such as PTFE tape, on the PanAdapta plug threads. Then, screw the plug into the flowcell transducer port (see Figure 19 and Figure 20 below) using the appropriate torque.

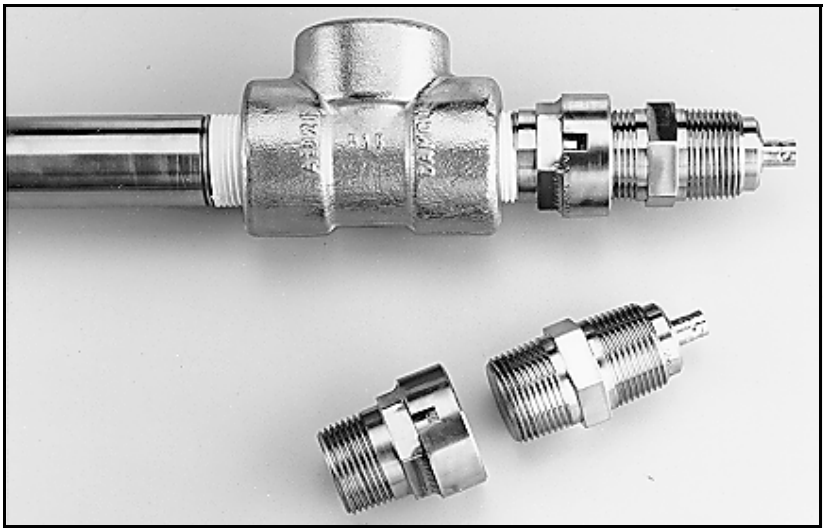


Figure 19: Threaded PanAdapta Plug and Transducer in an Axial Offset Flowcell Installation

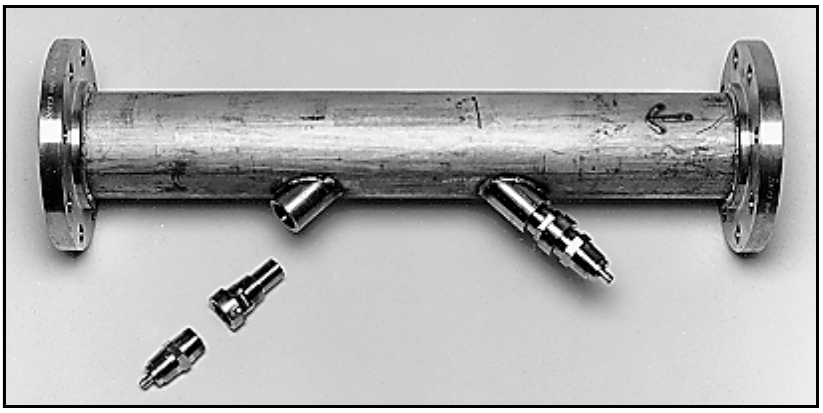


Figure 20: Threaded PanAdapta Plug and Transducer in a Tilted Diameter Flowcell Installation

2.1.5.2 Installing Welded Type PanAdapta Plugs

To install the *welded type* PanAdapta plug into the flowcell, proceed as follows:

1. Based on the material of your PanAdapta plug, do one of the following:
   - *Metal:* Socket-weld the PanAdapta plug into the port (see Figure 21 below).

   or

   - *Plastic:* Fuse bond or glue the PanAdapta plug into the port.

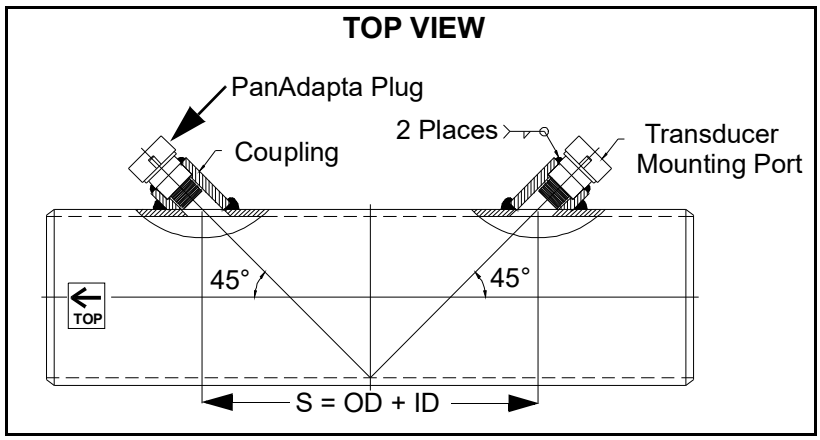


Figure 21: PanAdapta Plugs Socket-Welded into Spoolpiece Flowcell

2.1.5.3 Installing Flanged Type PanAdapta Plugs

To install the *flanged type* PanAdapta plug into the flowcell, proceed as follows:

1. Install the gasket on the flange.
2. Bolt the flanged PanAdapta plug to the nozzle (see Figure 22 and Figure 23 on the next page). Tighten the flange bolts using the appropriate torque for the installation.

Note: *If you are installing a BWT System, refer to the appropriate section later in this chapter.*

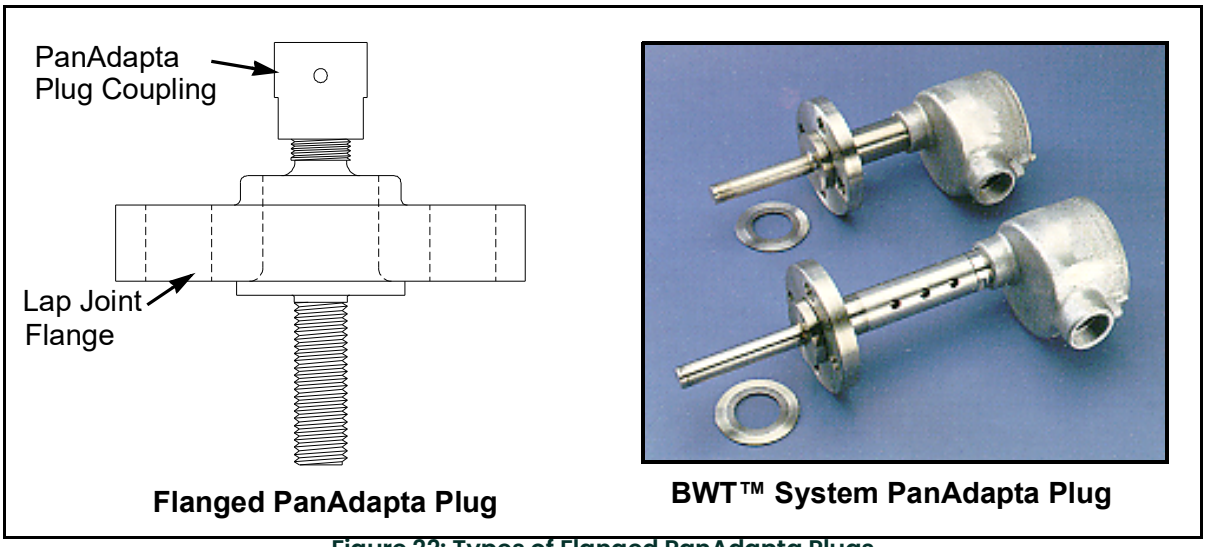


Figure 22: Types of Flanged PanAdapta Plugs

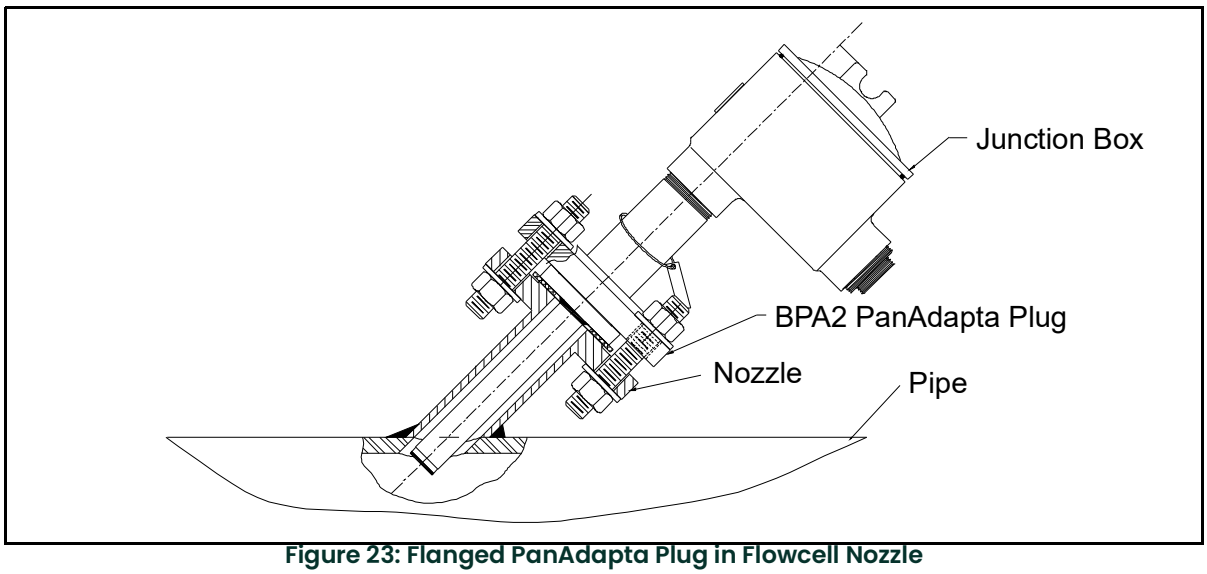


Figure 23: Flanged PanAdapta Plug in Flowcell Nozzle

2.1.5.4 Installing the Wetted Transducers

After you have installed the PanAdapta plugs into the flowcell, install the transducers into the PanAdapta plugs as follows:

1. Apply an ultrasonic couplant to the flat face of the transducer.

IMPORTANT: You must apply an ultrasonic couplant on the face of the transducer before installing it into the PanAdapta plug.

2. Screw the transducer into the PanAdapta plug by hand.
3. Torque the transducer to 50 ft-lb (67.8 N-m) for steel or 10 ft-lb (13.6 N-m) for plastic.

2.1.6 Removing Transducers from PanAdapta Plugs

After installation, the PanAdapta plug forms part of the pressure boundary between the process liquid and atmosphere. Therefore, extreme care must be taken when it is removed.

WARNING! **All applicable safety codes and procedures must be followed when removing transducers from the PanAdapta plugs.**

When removing the transducer from the PanAdapta plug, be sure the plug shield remains securely in place. Also, keep the immediate work area clear of insulation or other obstructions that may prevent you from clearly seeing the threaded components. Then, complete the following steps:

Note: *See Figure 19 and Figure 20 for two examples of threaded PanAdapta plugs and transducers.*

1. Verify that the PanAdapta seal is not leaking.
2. Hold the PanAdapta plug securely in place with a wrench.
3. Use a second wrench to unthread the transducer.

2.1.7 Installing the BWT System

Before you begin to install the *Bundle Waveguide Technology™* (BWT™) system make sure you have all the needed equipment on hand. Refer to Table 1 and Figure 24 below for the items needed for a one path installation.

Table 1: Required Equipment

Factory-Supplied	User-Supplied
2 Single (or Double Buffer) Bundle PanAdapta Plugs	Copperslip (SS316) or Molykote grease P47 (CS)
2 BWT transducers	Tape measure
2 Spiral wound gaskets	1" deep socket
2 Mating lap-joint flanges	12" (30 cm) adjustable wrench
3M epoxy for permanent bond	Steel wool
stud bolts, nuts and washers	Calipers
	Adjustable socket drive torque wrench with 20-148 ft-lb (27-200 N-m) range

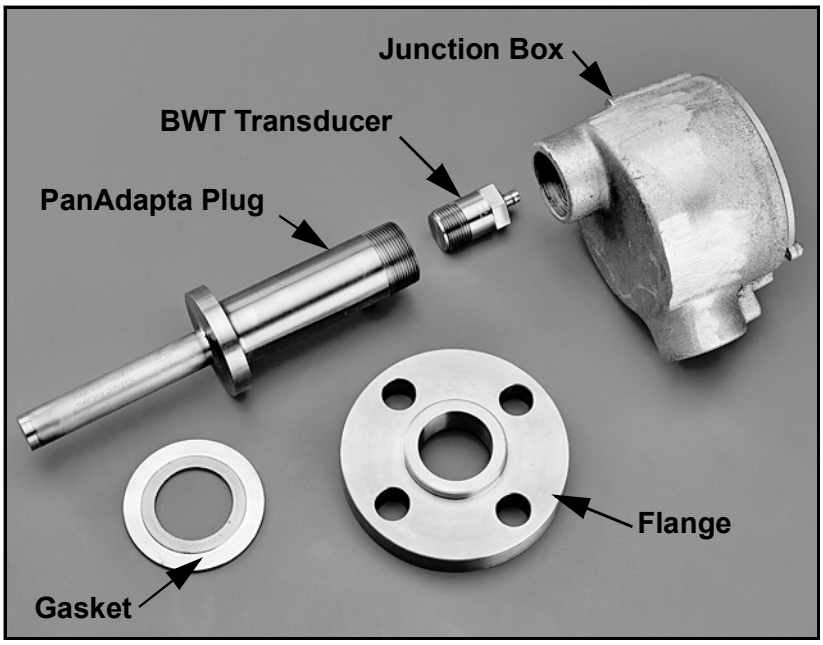
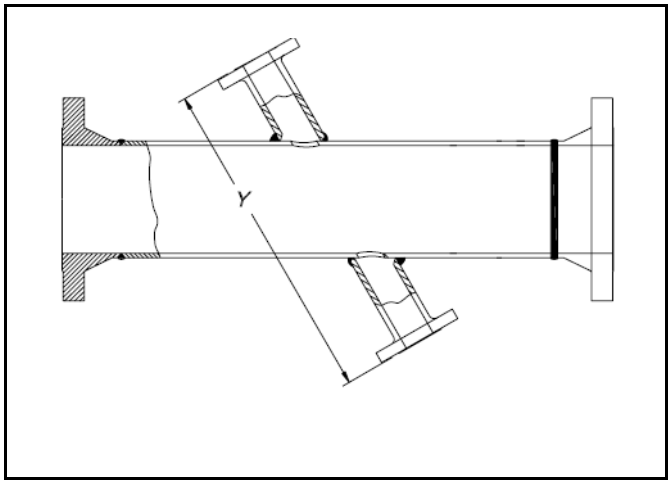


Figure 24: Components for BWT Installation

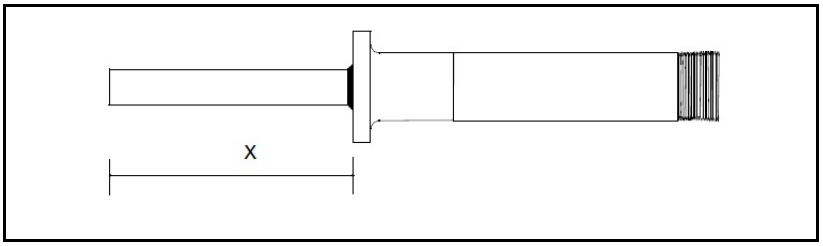
2.1.7.1 Assembling Bundle PanAdapta Plugs

Assemble a Bundle PanAdapta plug as follows:

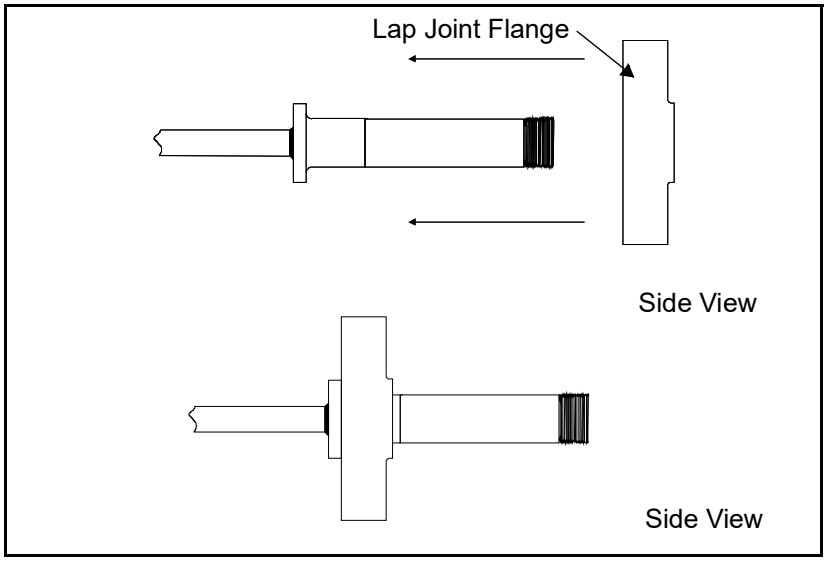
1. Using the tape measure, measure and record the distance from the raised face of one PanAdapta flange to the raised face of the other PanAdapta flange. This is the **Y** dimension for your installation.



2. Using the caliper, measure and record the distance from the head to the flange of the Bundle PanAdapta (BPA) plug. This is the **X** dimension for your installation.



3. Slide the lap joint flange over the Bundle PanAdapta Plug. Make sure to orient the flange as shown below.



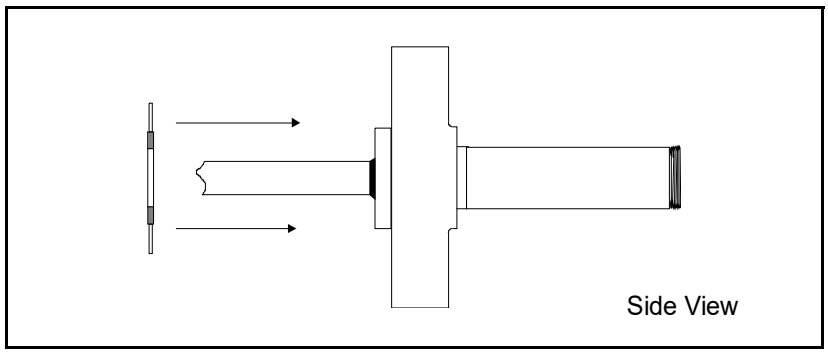
4. Check the raised face of the spool nozzle flange to make sure it is free from paint, rust, dirt, corrosion and damage. If necessary, clean the raised face with steel wool. In addition, clean the BPA if you are reusing it from a previous installation.

2.1.7.2 Inserting the Bundle PanAdapta Plug into the Nozzle

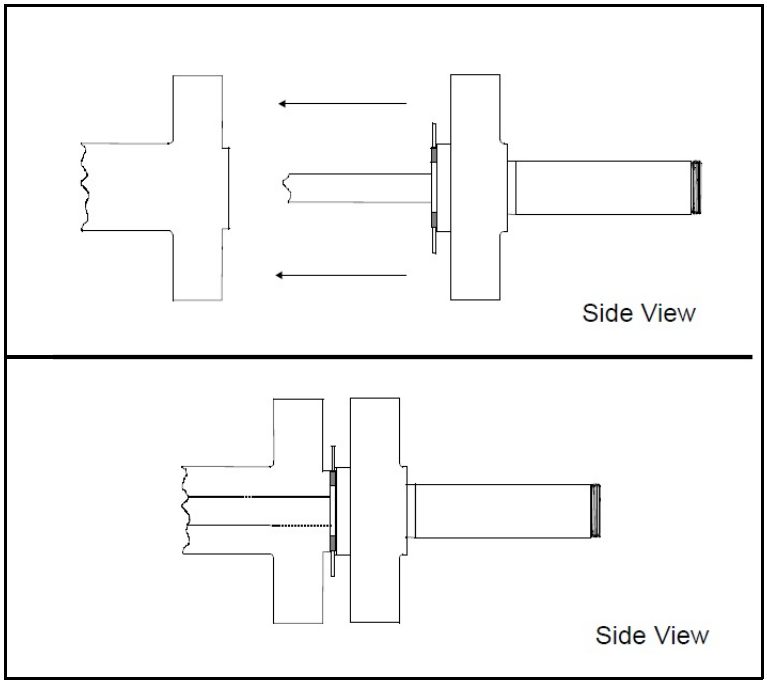
1. Inspect the gaskets supplied by Panametrics. They must not be used, warped, pitted or scratched.

IMPORTANT: Use only spiral-wound gaskets.

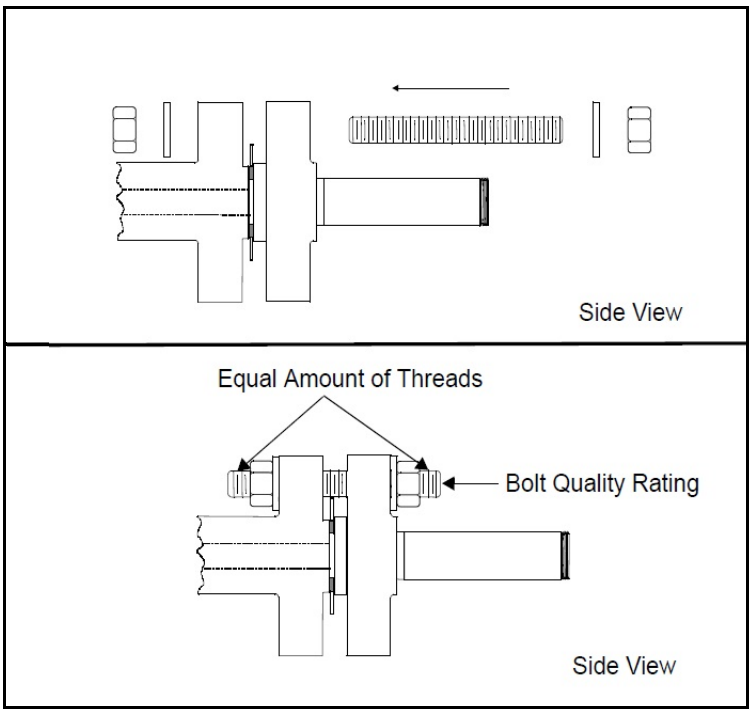
2. Place one gasket on the end of the Bundle PanAdapta Plug assembly.



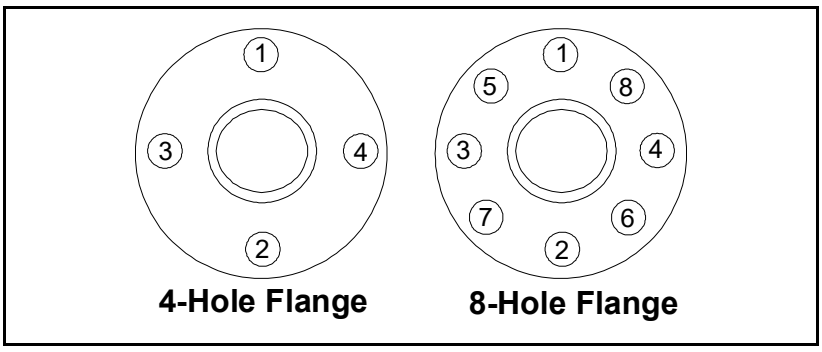
3. Inspect the pipe nozzle. Make sure it is free from dirt and rust. Use the steel wool to clean the pipe nozzle if necessary.
4. Insert the Bundle PanAdapta Plug assembly into the nozzle.



5. Coat the threads of each stud bolt with Copperslip or Molykote.
6. Insert one stud bolt into the flange. Make sure the bolt grade rating (e.g., B7) is facing away from the spoolpiece. Install the washers and nuts and hand-tighten. Make sure you leave an equal amount of threads on each end of the bolt.

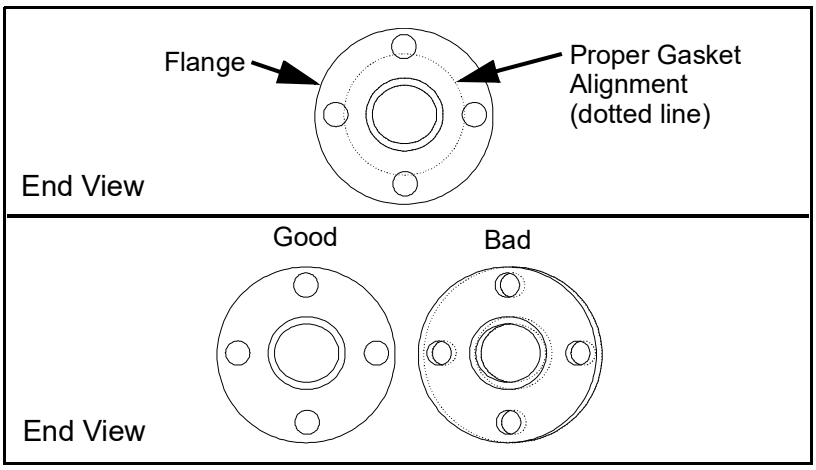


7. Using the numerical order shown below, repeat step 6 to install the remaining stud bolts.



8. Place your hands around the plug flange and the nozzle flange and feel that the flanges are aligned around the full circumference. If necessary, adjust the flanges until the Bundle PanAdapta plug is centered in the middle of the nozzle.

IMPORTANT: Make sure the gasket is in the center of the flanges.

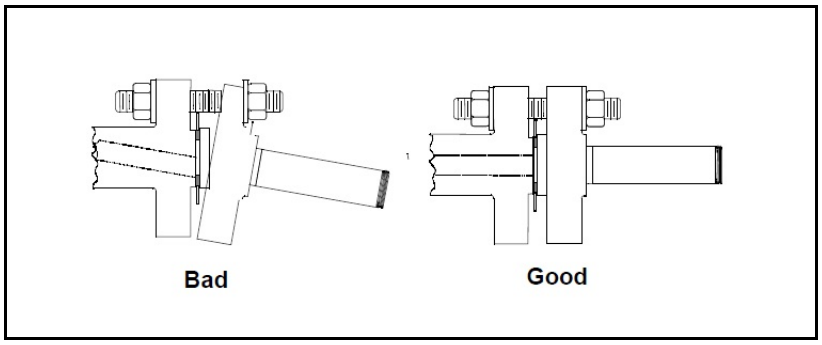


9. Once you have determined the PanAdapta plug is centered, tighten the nuts and bolts further by hand to maintain the centering. Visually confirm that the centering has not been disturbed by the tightening process.

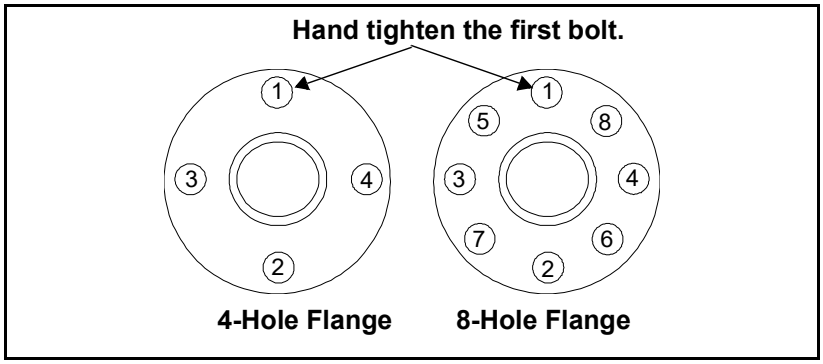
2.1.7.3 Tightening the Bolts

You must tighten the stud bolts to the proper torque to ensure a good seal. However, you should not overtighten them, as this would cause an acoustic short circuit or change the transducer alignment. To properly tighten the stud bolts, proceed in stages as follows:

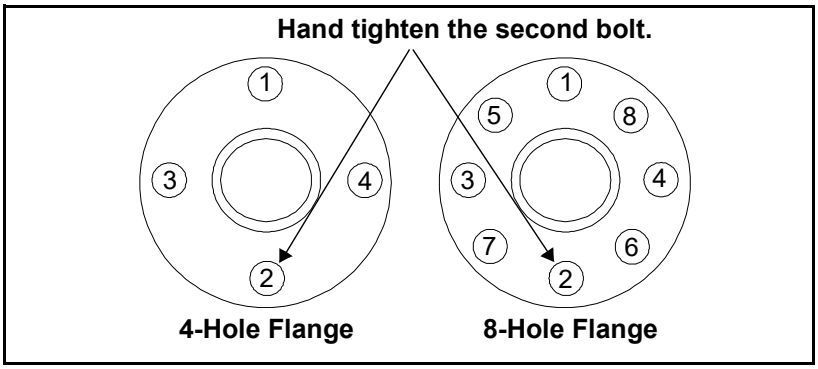
1. Check the flange and plug alignment again to make sure the flanges are parallel to each other.



2. Hand tighten the first bolt.



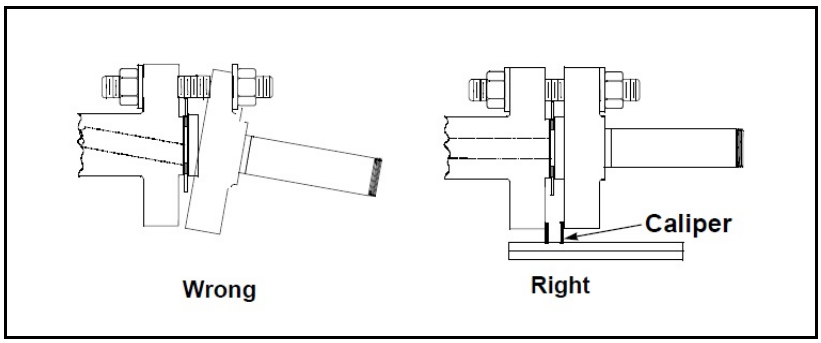
3. Hand tighten the remaining bolts in the order shown below or in a similar manner.



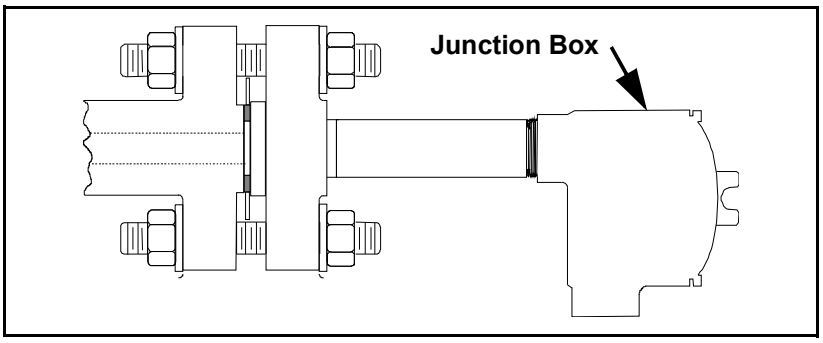
4. Using an adjustable wrench, firmly secure the stud bolts in the same order as described in the previous step.

IMPORTANT: Do not overtighten the stud bolts.

5. Check the flange alignment again to ensure that the flanges are parallel to each other. Measure the gap between the flanges with the caliper on at least four equally spaced points. The maximum tolerance is ±0.2 mm difference between the four measurement points. If you cannot achieve a tolerance of ±0.2 mm or less, replace the gasket with a new gasket and repeat the entire procedure.



6. Repeat the previous steps for any additional flanges.
7. Screw the electrical junction box onto the Bundle PanAdapta Plug.

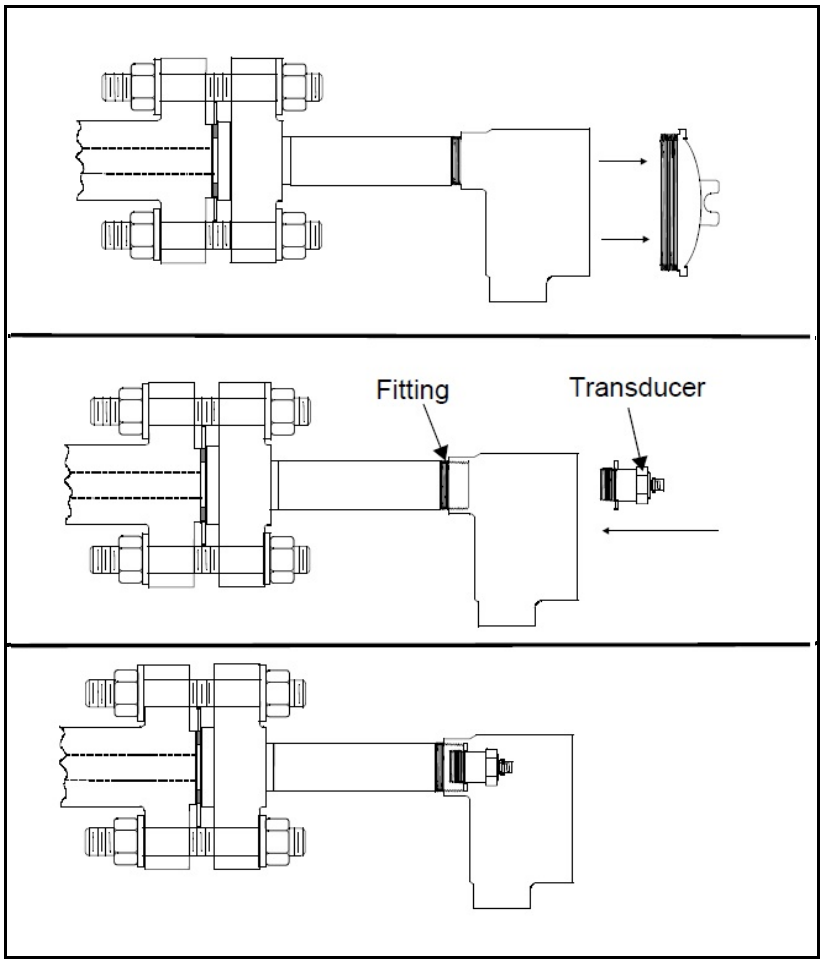


2.1.7.4 Installing the BWT Transducer

Please read this section completely before beginning the BWT transducer installation. After you understand the procedure, proceed with the following steps:

IMPORTANT: After you install the Bundle PanAdapta Plugs and BWT transducers, you must allow the 3M epoxy to cure for at least eight hours.

1. Place a small drop (about 2 mm in diameter) of the 3M Epoxy at the center of the end of the BWT transducer.
2. Screw the BWT transducer into the fitting in the junction box at the end of the buffer, as shown below. When the transducer is finger tight, stop turning it. Wait 5 seconds to allow the couplant to spread out evenly.



3. Using the deep socket and torque wrench, tighten the transducer to a torque value of 15 to 18 ft-lb (20 to 25 N-m).

IMPORTANT: Do not overtighten the transducer.

4. Wire the transducer to the preamplifier and electronics as described in your flowmeter user's manual.
5. Let the epoxy cure for at least 8 hours.

IMPORTANT: After you install the Bundle PanAdapta Plugs and BWT transducers, you must allow the 3M epoxy to cure for at least 8 hours. You can power up the electronics, but do not remove, re-torque or adjust the transducers during this waiting period.

CAUTION! **Do not place insulation on or around the flange or PanAdapta Plug. The flange and PanAdapta Plug act as a buffer that isolates and protects the BWT transducer from high process temperatures.**

Chapter 3: Clamp-On Transducers

3.1 Introduction

Clamp-on transducers can be installed using a number of configurations and clamping fixtures. However, the exact procedure depends on the measurement mode used by the flowmeter. Most BakerHughes Panametrics flowmeters have two possible measurement modes: **Transit-time** and **TransFlection**. Although both methods use transit time measurements to calculate flow rates, the manner in which the transit time is measured differs.

Note: *In both methods, the transducers require an acoustic couplant to provide reliable transmission of the ultrasonic signal between the transducer and the pipe surface.*

3.1.1 Transit-Time Method

When in Transit-time mode, the flowmeter transmits ultrasonic pulses through a moving liquid. The pulses that travel in the same direction as the fluid flow(downstream) travel slightly faster than the pulses that travel against the fluid flow (upstream). The flowmeter uses various digital signal processing techniques, including cross-correlation, to determine transit times and then uses these times to calculate flow velocity.

3.1.2 TransFlection Method

To measure flow, one transducer transmits a group of pulses (typically 16 pulses) at regular intervals (approximately 5,000 to 10,000 transmissions/sec). The ultrasonic pulses travel through the liquid, reflect off scatterers (i.e. bubbles, particulates) in the liquid, and the signal is then received by the second transducer.

In essence, these ultrasonic signals are "pictures" taken continuously at the same location in the pipe. The flowmeter compares these pictures to each other as the pictures are received. By comparing (averaging) these pictures, the flowmeter is able to eliminate stationary objects by subtracting signals that do not appear to move in all or most of the pictures. The flowmeter measures the time difference between the remaining "moving" objects on each successive picture. The time difference is called T_m and is used to calculate the flow velocity.

3.1.2.1 Couplants

Panametrics supplies an ultrasonic couplant for your clamp-on installation. The purpose of the couplant is to provide reliable transmission of ultrasound between two adjacent solid surfaces. Couplants perform this task by excluding air from the space between the adjacent surfaces. Accordingly, the clamp-on transducers should be pressed tightly against the pipe, using hand pressure on the set screw to squeeze the couplant to as thin a film as practical for the given pipe surface.

The most commonly used couplants in ultrasonic testing are ordinarily satisfactory for any short-term clamp-on flowmeter application. These couplants include, in order of preference: gels, grease, propylene glycol, oil, glycerine, and water. Long-term couplants include grease, epoxy adhesive, and solid rubber sheet couplants.

Panametrics provides couplants for both permanent and temporary use as well as for high-temperature and low-temperature applications. For long-term installations, make sure the couplant does not dry out or extrude. Standard couplants supplied from Panametrics are listed in Table 2 below.

Table 2: Standard Panametrics Couplants

Part No.	Type	Temp. Range	Use
CPL-1	Standard	-40 to +65°C	Semi-Permanent
CPL-2	High/Low Temperature	-160 to +260°C	Semi-Permanent
CPL-3	For Portables	-20 to +60°C	Temporary
CPL-4	Special	As Required	*Difficult Applications
CPL-7	Epoxy	-10 to +50°C	Permanent
CPL-8	Solid Sheet	-40 to +230°C	Permanent
* Installations involving hotter or colder temperatures than listed above, may require special couplants. Consult Panametrics for these applications.			

3.1.3 Transit-Time Installations

Installation of clamp-on transducers for transit-time measurements consists of mounting the clamping fixture to the pipe and then mounting the transducers into the clamping fixture. When installing transducers in non-wetted applications, you can use one of the following methods to hold the transducer against the pipe wall:

- universal clamping fixture
- general clamping fixture (permanent installation)
- magnetic clamping fixture
- small clamping fixtures - 6" (150 mm) or 12" (300 mm) long, with Velcro straps
- yoke and strap

Before beginning the transducer installation, you must determine the number of traverses for your configuration.

CAUTION! **The accuracy and performance of the flowmeter depends on the location, spacing, and alignment of the transducers. This manual provides general instructions for locating and installing most transducer types. However, the specific spacing of your transducers is unique to your installation.**

3.1.3.1 Determining the Number of Traverses

The first step in the installation is determining the number of traverses (see Figure 25 on the next page). The transducers can be mounted using one of two methods:

- *Double-traverse method* - the transducers are mounted on the same side of the pipe and the ultrasonic signal is transmitted from one transducer to the other by reflection off the opposite pipe wall.
- *Single-traverse method* - transducers are mounted diagonally across from each other. The ultrasonic signal is transmitted across the pipe directly from one transducer to the other.

For pipe diameters from 1" (25 mm) to 20" (500 mm), always try the double-traverse method first because it is easier to configure and yields greater accuracy. However, if the pipe has poor inside surface conditions or the fluid is highly attenuating, you may not be able to obtain a reliable signal. Therefore, you may have to use the single-traverse method in such applications. Typically, you should use the single-traverse method for pipe diameters greater than 20" (500 mm). The spacing of the transducers is calculated by the electronics after all the installation parameters have been programmed into the flowmeter.

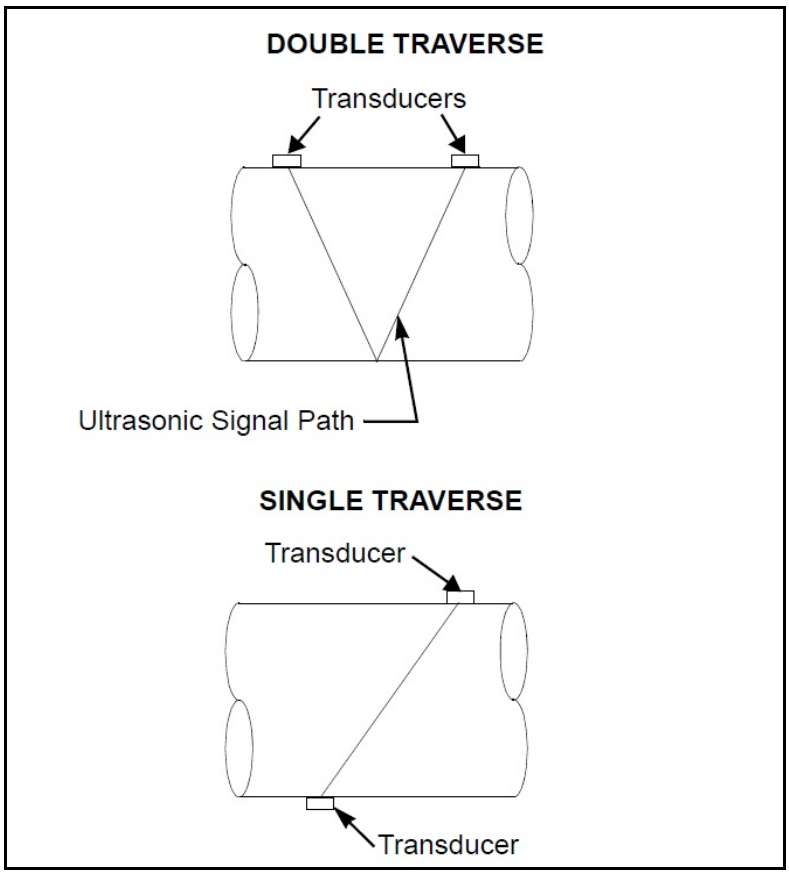


Figure 25: Double- and Single-Traverse Installations

3.1.3.2 Using the Universal Clamping Fixture -UCF

The *Universal Clamping Fixture* (**UCF**) (see Figure 26 below) acts as a spacing device and a transducer holder. The UCF includes one fixed short block and one adjustable short block Two slide tracks are included to connect the two short blocks. A ruler attached to one of these slide tracks helps to set the transducer spacing. For double-traverse installations, a long block is also used.

The UCF is chained or strapped around the pipe, and the blocks are used to hold the transducers in position for accurate measurements. The blocks must be positioned properly using the spacing dimension calculated by the flowmeter. Then, the transducers are mounted into the blocks.

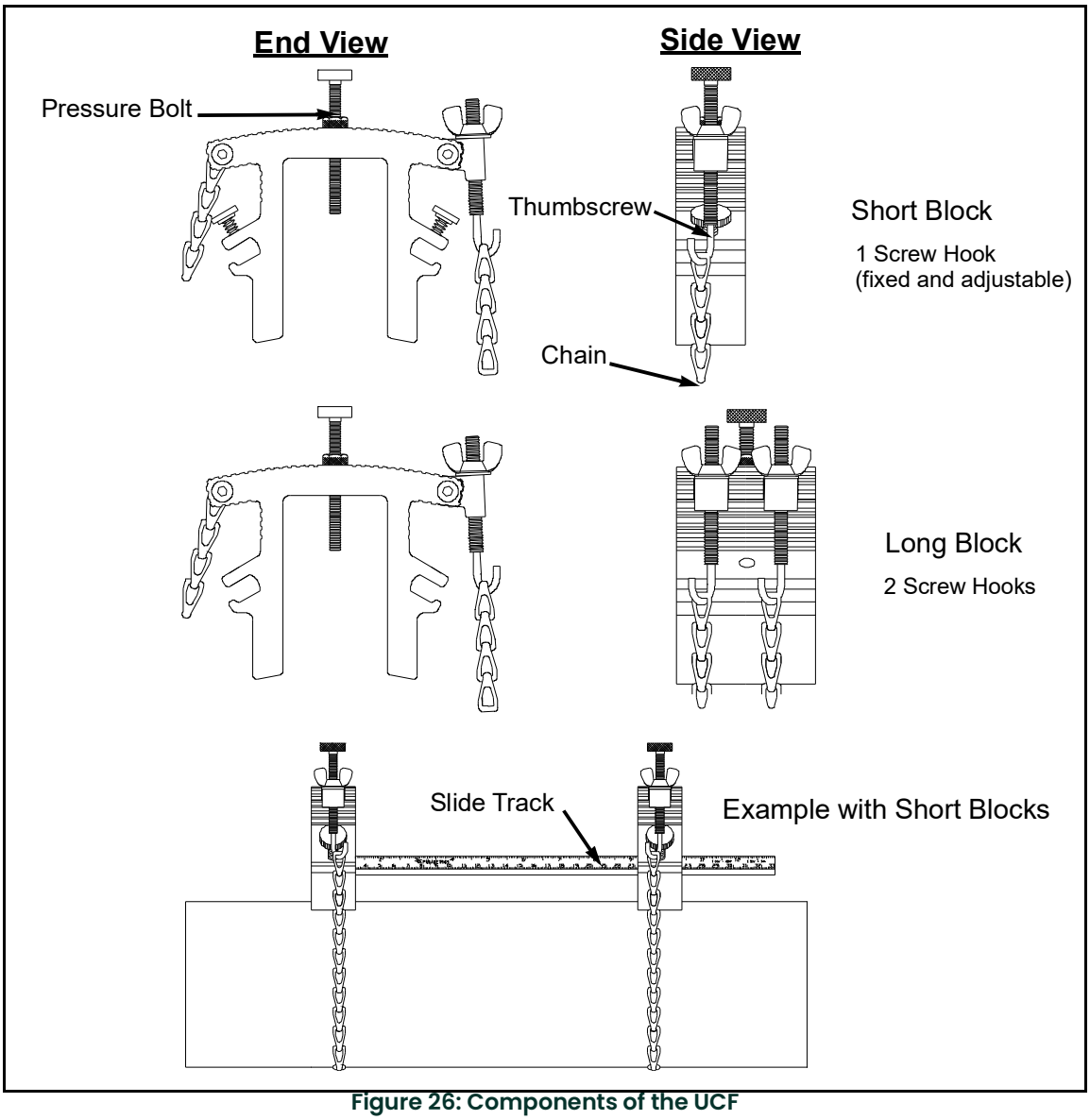


Figure 26: Components of the UCF

Before you begin the installation, make sure you note the application information in Table 3 below for your clamping fixture. The UCF is available in 12″ (300 mm) and 24″ (600 mm) lengths. Both lengths can be used for either single-traverse or double-traverse installations, but you must observe the pipe size ranges shown.

Table 3: UCF Pipe Size Ranges

Fixture Length	Single-Traverse Pipe Diameter	Double-Traverse Pipe Diameter
12″ (300 mm)	2 -24″ (50-600 mm)	2-12″ (50-300 mm)
24″ (600 mm)	24-48″ (600-1200 mm)	12-24″ (300-600 mm)

The transducer installation consists of mounting the UCF to the pipe and then mounting the transducers into the fixture. Refer to the appropriate section for instructions on either the double-traverse or single-traverse methods.

Double-Traverse Method

Note: *The instructions in this section can also be used for a multiple-traverse method. However, you must use an* **EVEN** *number of traverses. The distance the signal travels from one side of the pipe wall to the opposite side of the pipe wall is considered one traverse. For installations with more than two traverses, contact Panametrics for assistance.*

There are two advantages to using the double-traverse method:

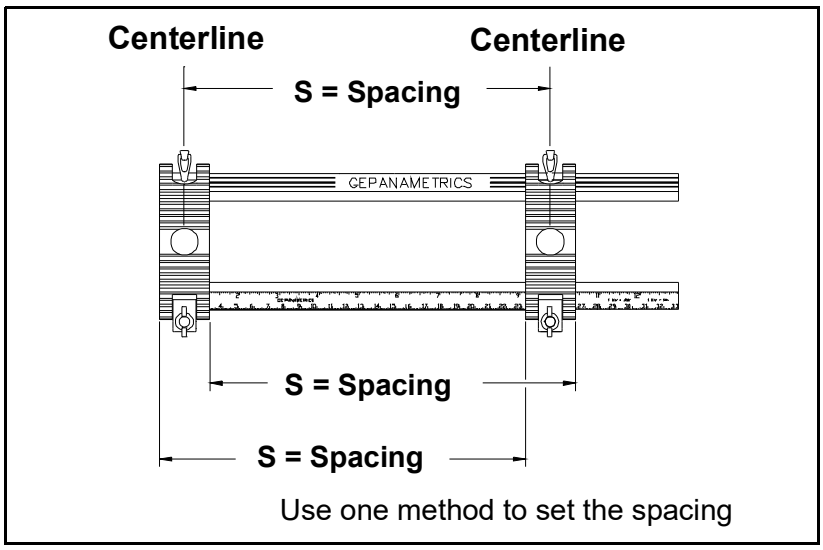
- Measurement accuracy is improved because the ultrasonic signal is in the fluid longer than with a single-traverse method.
- If there is enough pipe length available, the double-traverse fixture is easier to install.

The procedure for mounting the UCF involves setting the transducer spacing and fastening the fixture on the pipe.

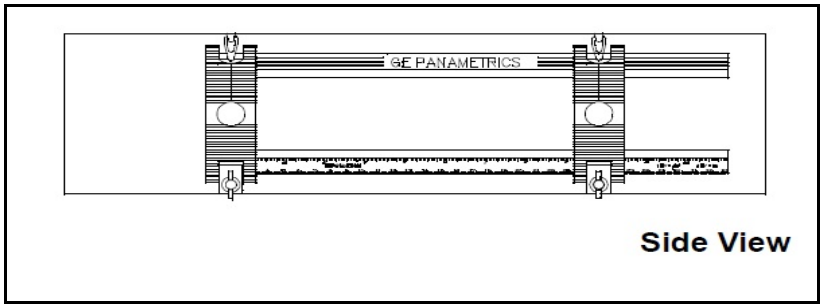
Note: *For a double-traverse installation, you will only need the short block assembly - the long block is not used.*

The installation procedure for transducers using the double-traverse method is as follows:

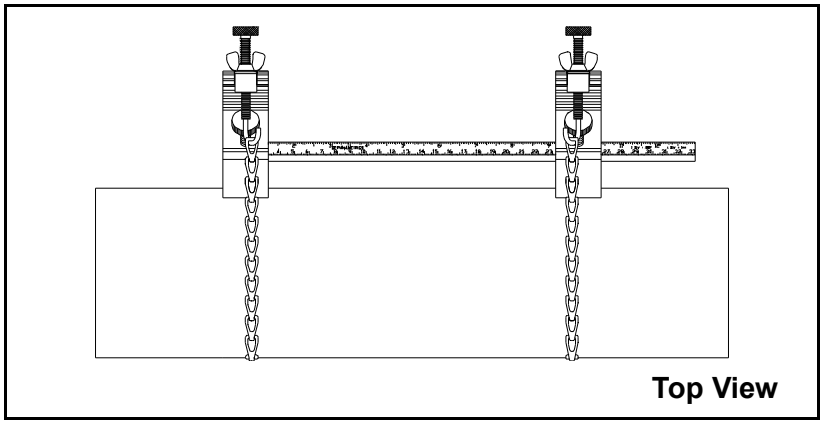
1. Be sure the location you have chosen for the installation has at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Obtain the transducer spacing dimension (**S**) as described in your flowmeter user's manual. Using the attached ruler on the slide bar as a guide, move the adjustable block so that the distance between the blocks equals the **S** dimension. Use the pressure bolts or the edges of the blocks as reference points, as shown below.



4. Position the clamping fixture along the **horizontal plane of the pipe. It must not be on the top or bottom of the pipe**. Make sure the chains on both blocks are on the side of the fixture opposite from the slide bar with the ruler.



5. Wrap one of the chains around the pipe and fasten it on the *J screw hook* on the opposite side of the block. Repeat this for the other chain.



6. Using the screw hook on the blocks, tighten both chains until the fixture is secured snugly to the side of the pipe.

IMPORTANT: Make sure the chains are perpendicular to the clamping fixture and are not twisted. If the chains are slanted, the slack may cause the fixture to move. Also the transducer spacing dimension may change after the transducers are mounted.

Figure 27 below shows a completed double-traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

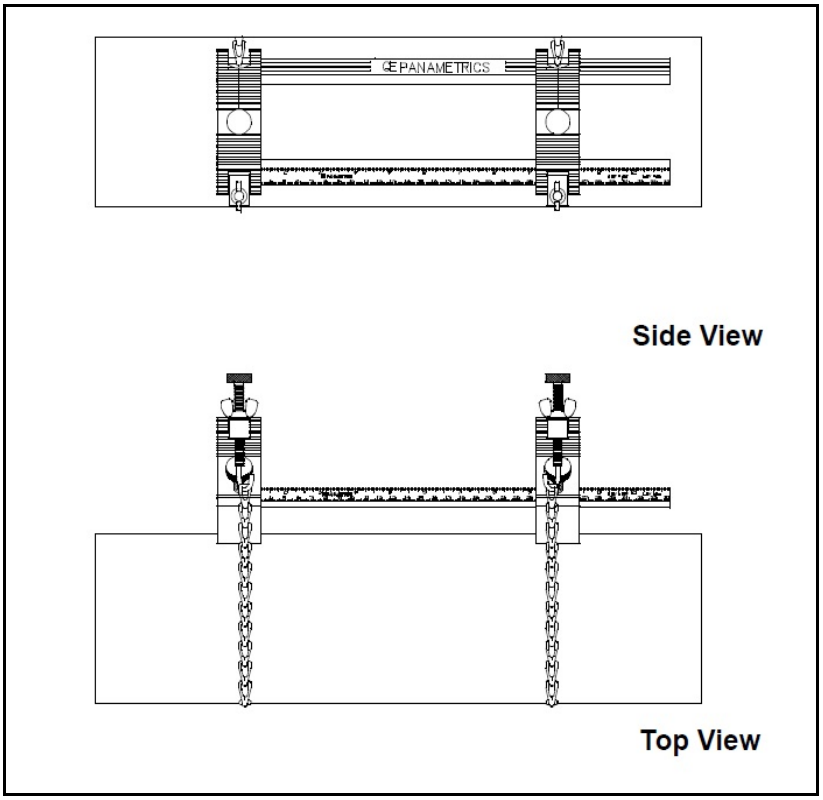


Figure 27: A Double-Traverse Clamping Fixture Installation without Transducers

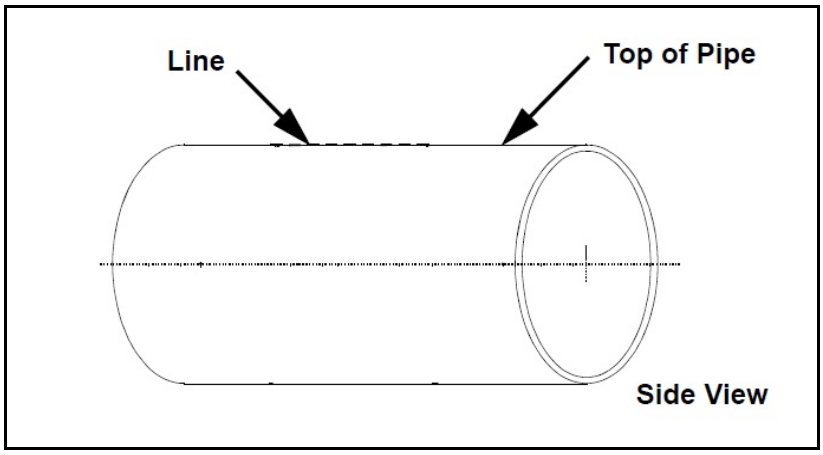
Single-Traverse Method

Note: *The instructions in this section can also be used for a multiple-traverse method. However, you must use an* **ODD** *number of traverses. The distance the signal travels from one side of the pipe wall to the opposite side of the pipe wall is considered one traverse. For installations with more than one traverse, contact Panametrics for assistance.*

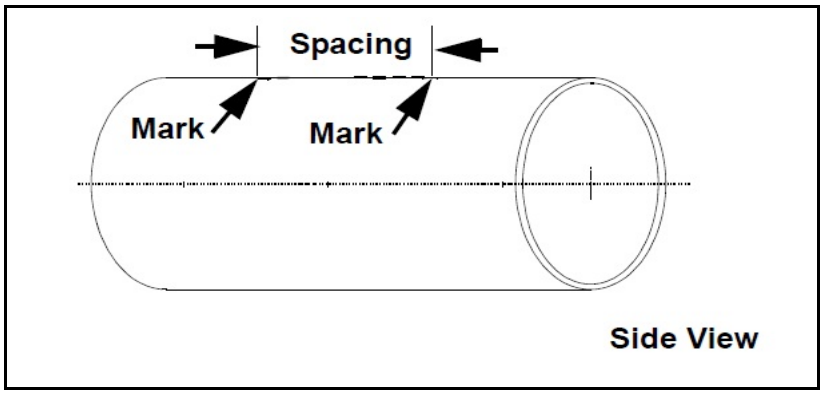
The procedure for mounting the UCF for the single-traverse method requires one long block and two short blocks. The long block is fastened to the pipe first and then the short block assembly is properly aligned and fastened 180° around the pipe from the long block.

To install the UCF, complete the following steps:

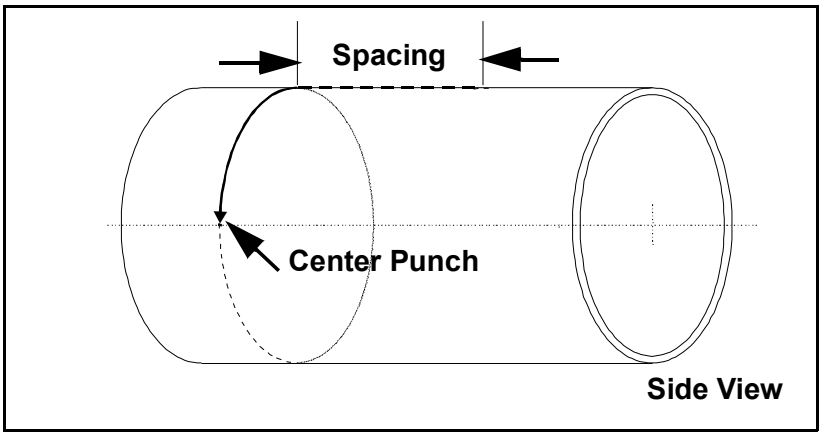
1. Choose a location for the installation that has at least 10 pipe diameters of straight, undisturbed flow upstream and at least 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the UCF by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.



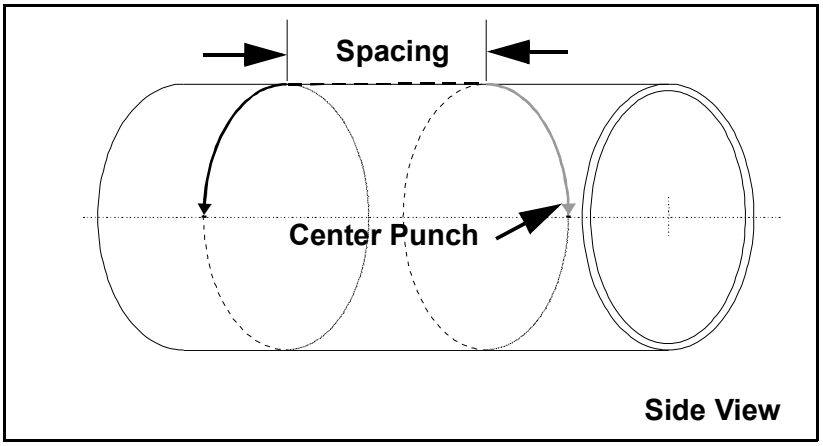
4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance **S**, as calculated by the flowmeter.



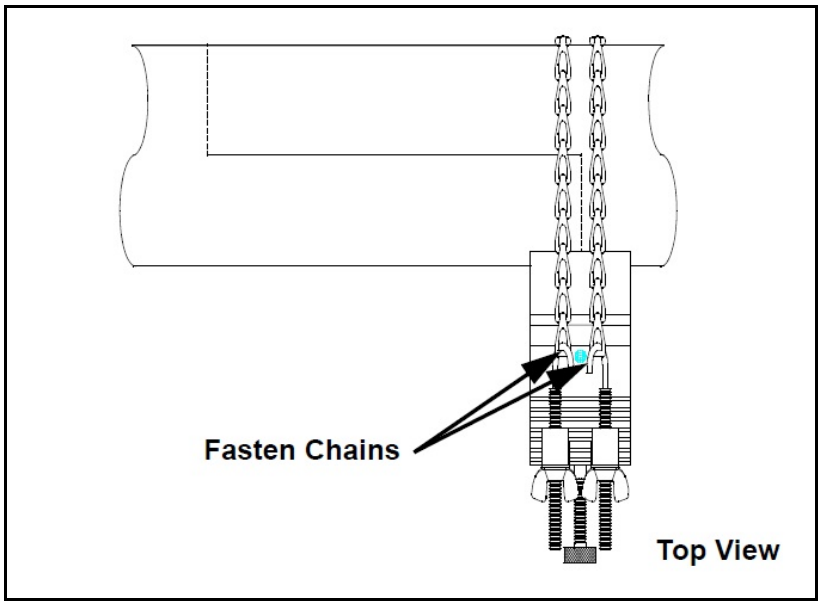
5. From one of the marks on the top of the pipe, measure around the pipe a distance equal to 1/4 of the pipe circumference. Use the center punch to make a mark at this point.



6. From the other mark on the top of the pipe, measure around the pipe in the opposite direction a distance equal to 1/4 of the pipe circumference. Use the center punch to make a mark at this point.

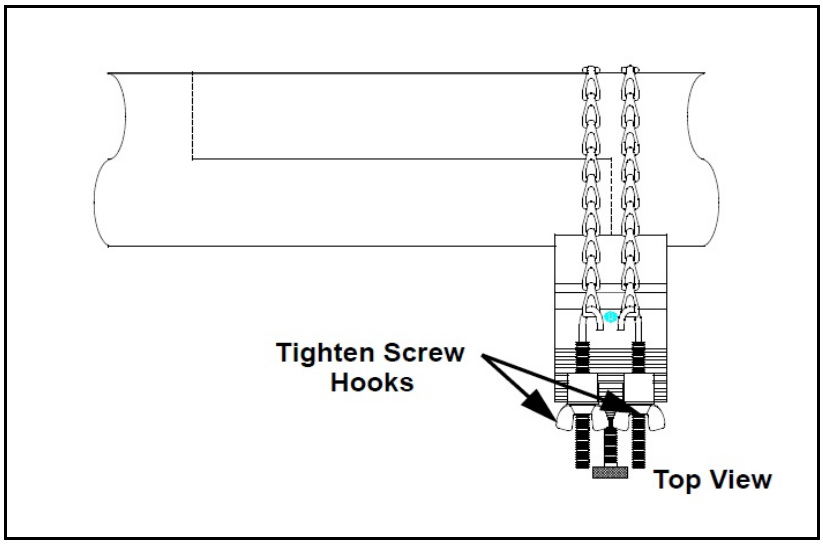


7. Center the long block over one of the center punch marks on the side of the pipe. Align the long block so that the pressure bolt is directly over the punch mark. Fasten the block to the pipe by wrapping both chains around the pipe and fastening the chains to the screw hooks on the opposite side of the block.

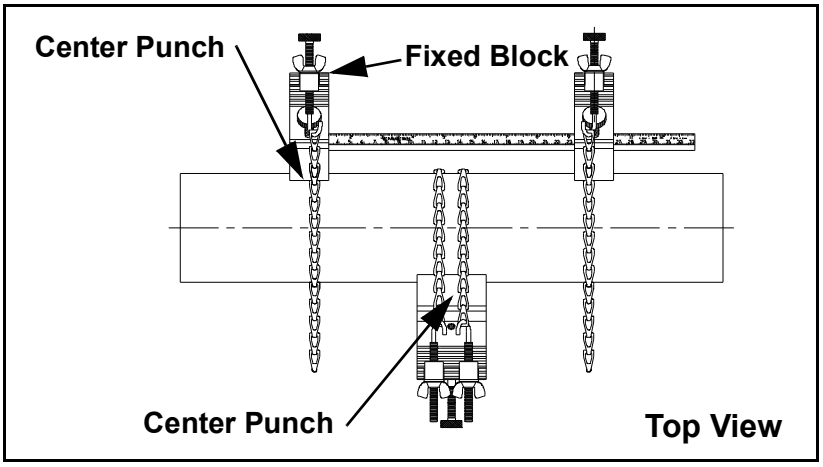


8. Use the wing nuts to tighten the chains on the long block until the block is tightly secured to the pipe.

IMPORTANT: Make sure both chains are perpendicular to the bottom of the block and are not twisted. If the chains are slanted, the slack may cause the block to move

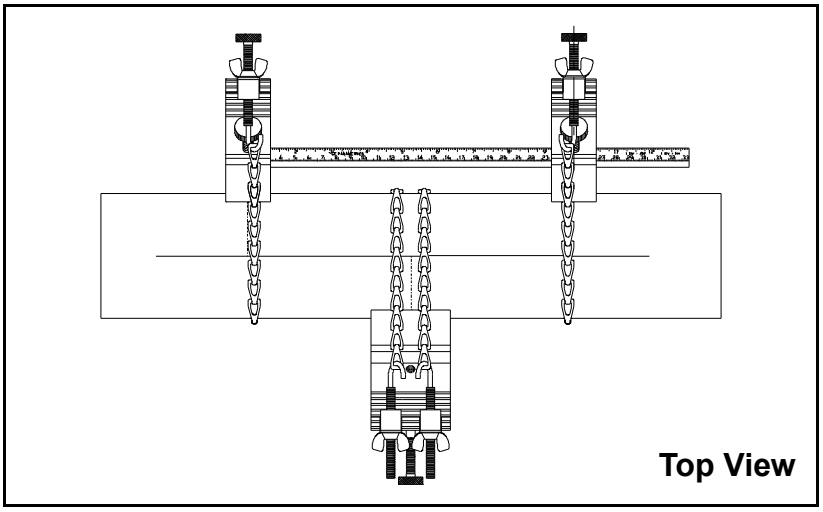


9. Position the clamping fixture rails so that the fixed short block is placed over the remaining center punch mark on the opposite side of the pipe and the pressure bolt is directly over the punch mark. Make sure the fixed short block is not positioned on top of the chains of the long block. The adjustable short block may be placed on either side of the long block chains.



10. Wrap on short block chain around the pipe and fasten the chain to the screw hook on the opposite side of the block. Repeat this for the other short block.

Note: *Make sure the chains on both blocks are on the same side of the fixture and are opposite the slide rail with the ruler.*



11. Use the screw hooks to tighten the chains on both the fixed and adjustable short blocks until both blocks are tightly secured to the pipe.

IMPORTANT: Make sure the chains are perpendicular to the clamping fixture and are not twisted. If the chains are slanted, the slack may cause the fixture to move. Also the transducer spacing dimension may change after the transducers are mounted.

Figure 28 below shows a completed single-traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

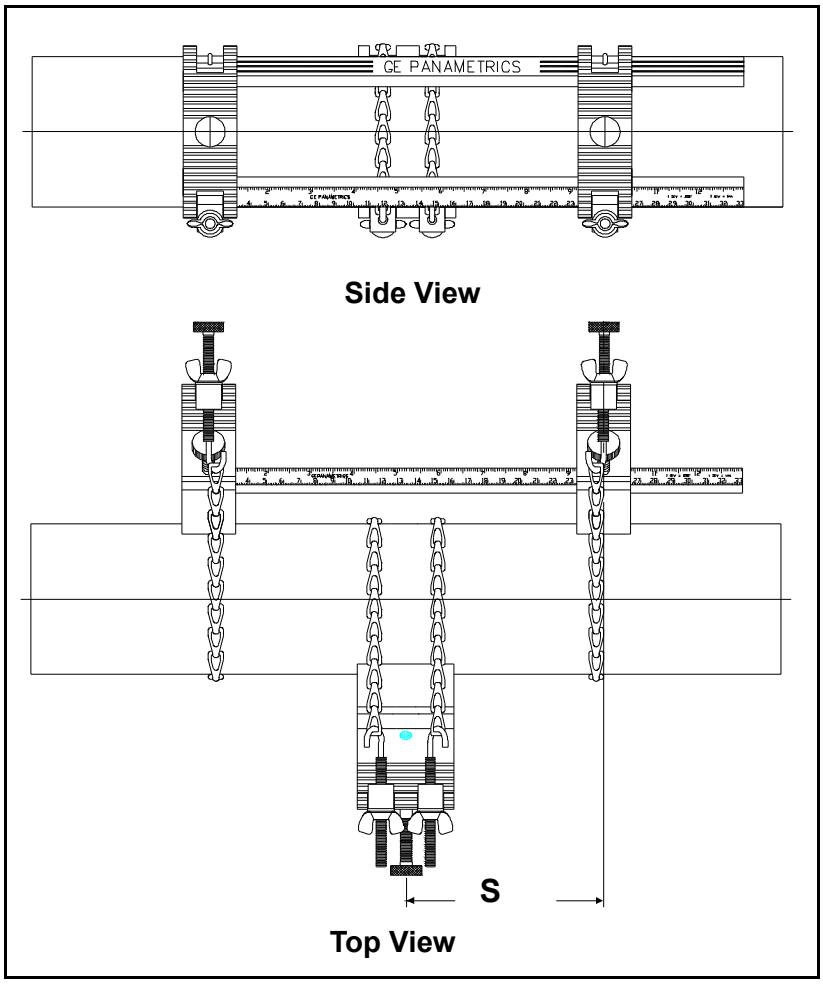


Figure 28: A Single-Traverse Clamping Fixture Installation without Transducers

Mounting Transducers into the UCF

The last step in the installation is mounting the transducers into the clamping fixture. Although not all transducer models are installed exactly the same way, the following information provides some general guidelines to help you.

The face of the transducer must be in contact with the pipe because this is where the ultrasonic signal is emitted. All Panametrics transducers include a dimple, depression, or drill point on the side opposite the face, for use as a guide in aligning and securing the transducer. In addition, some transducers have scribe marks on the side to assist in setting the transducer spacing. Figure 29 below shows the two most commonly used transducers.

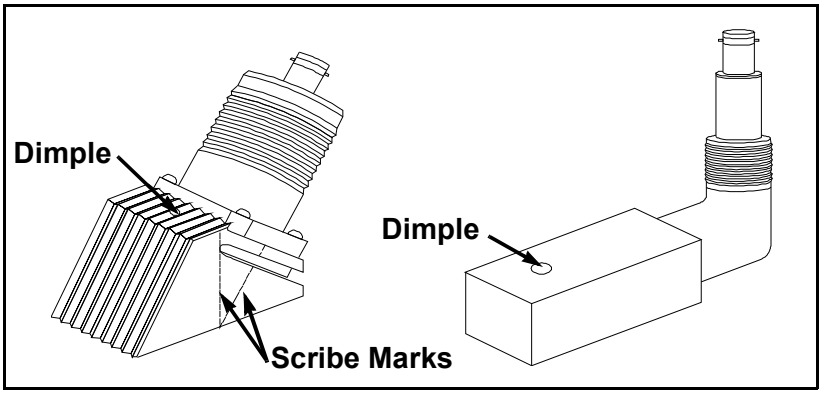
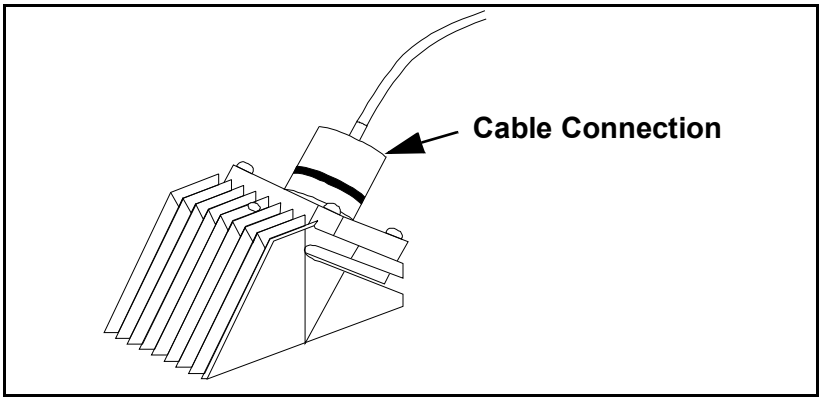


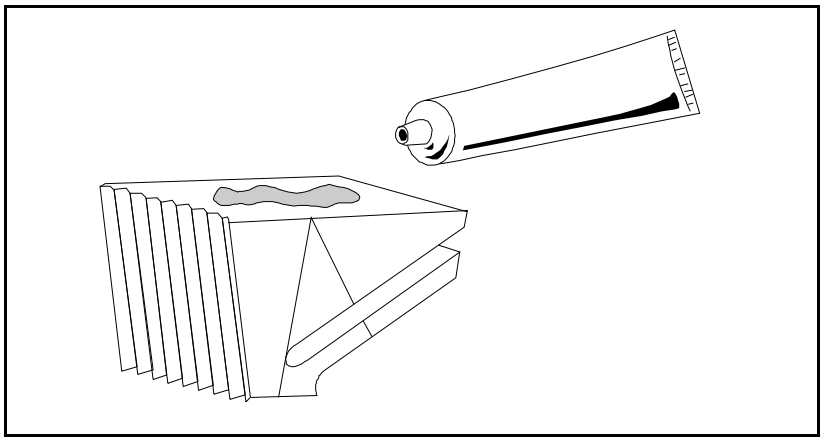
Figure 29: Transducer Dimples and Scribe Marks

To mount the transducers into the Universal Clamping Fixture, complete the following steps:

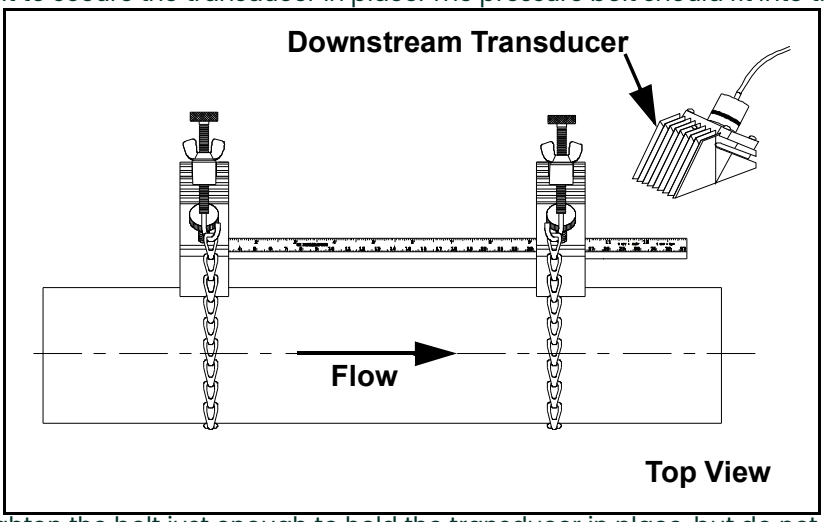
1. Connect the transducer cables to the BNC connectors on the transducers.



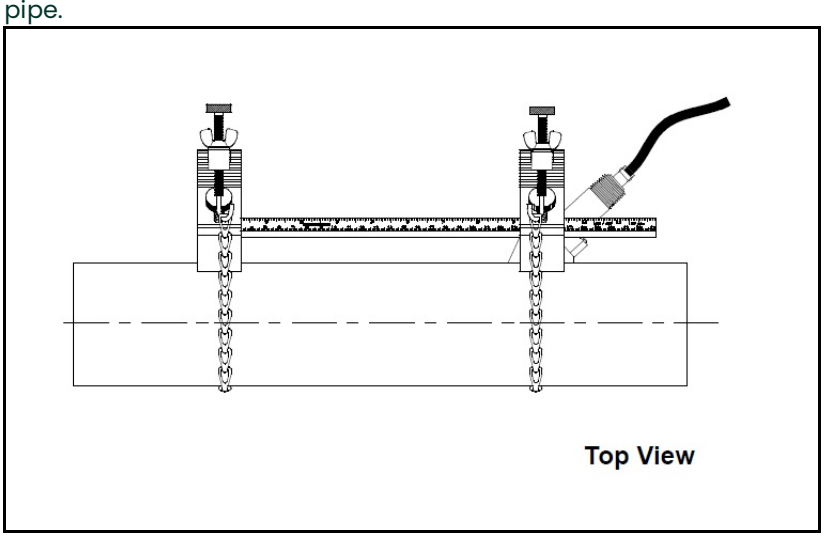
2. Apply a thin bead of couplant to one of the transducers. A bead approximately the size of a toothpaste bead should be placed down the center of the transducer face.



3. Determine the upstream and downstream ends of the pipe and place the appropriate transducer into the adjustable short block. Make sure the transducer cable connector faces away from the center of the installation.
4. Use the pressure bolt to secure the transducer in place. The pressure bolt should fit into the dimple on the



transducer. Hand tighten the bolt just enough to hold the transducer in place, but do not overtighten it or the fixture will lift off the pipe.



5. Repeat Steps 1-4 to mount the other transducer in the fixed short block. See Figure 30 on the following page for completed typical UCF installations.
6. Connect the other end of the transducer cables to the flowmeter electrical console (see your flowmeter manual for wiring instructions).

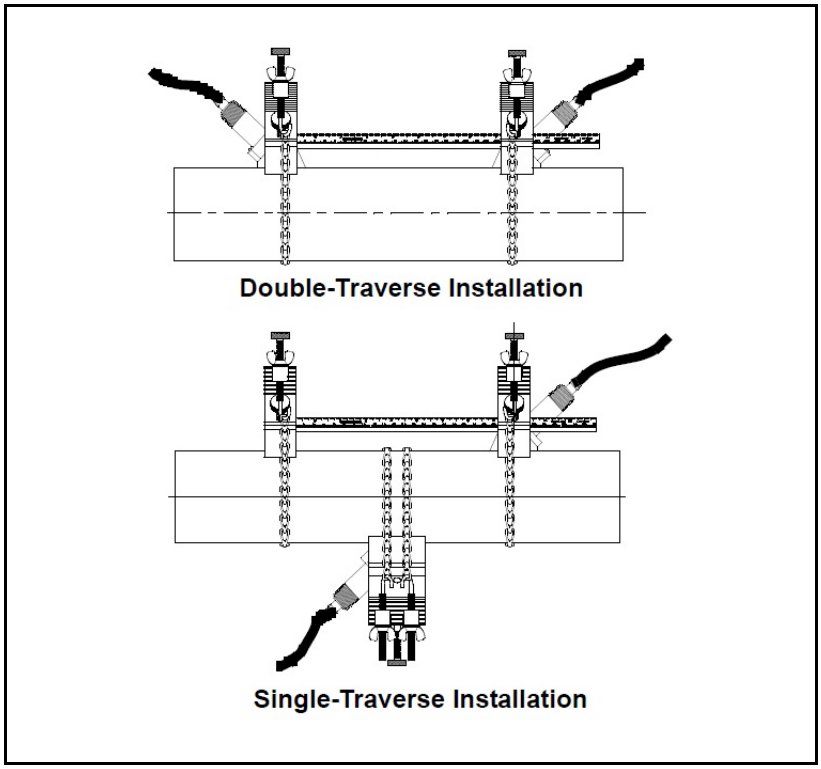


Figure 30: Completed UCF Installations with Transducers

Note: *If you have mounted the transducers into the UCF properly, the two transducer cable connectors will face away from each other as shown above.*

3.1.3.3 Using the General Clamping Fixture - GCF

The *General Clamping Fixture (GCF)* acts as a permanent transducer holder. The fixture has two blocks (see Figure 31 below) that are used for both double-traverse and single-traverse methods. Steel straps secure the blocks to the pipe for a permanent installation. To install the GCF, the blocks must first be positioned using the spacing dimension (**S**) calculated by the flowmeter. Then, the transducers are mounted into the blocks.

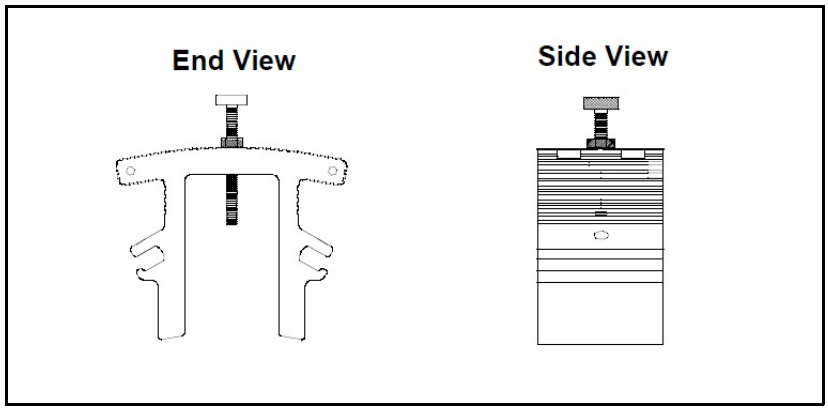


Figure 31: General Clamping Fixture Block

Proceed to the appropriate section for instructions on either the double-traverse or single-traverse method.

Double-Traverse Method

Note: *The instructions in this section can also be used for a multiple-traverse method. However, you must use an* **EVEN** *number of traverses. The distance the signal travels from one side of the pipe wall to the opposite side of the pipe wall is considered one traverse. For installations with more than two traverses, contact Panametrics for assistance.*

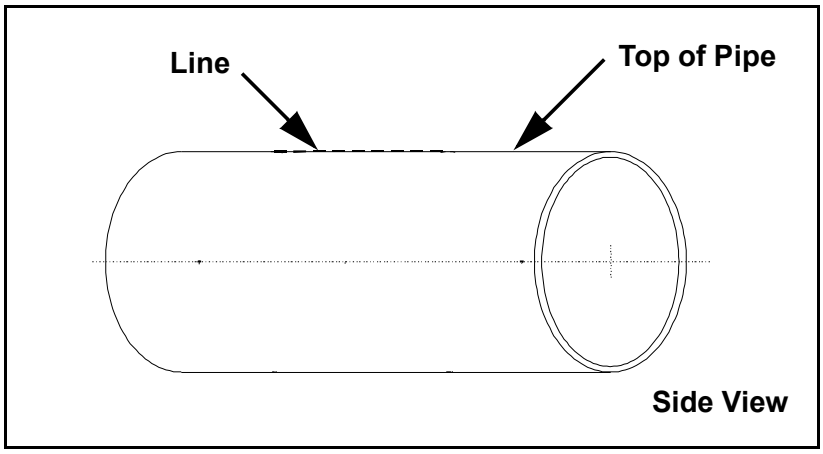
There are two advantages to using the double-traverse method:

- Measurement accuracy is improved because the ultrasonic signal is in the fluid longer than with a single-traverse method.
- If there is enough pipe length available, the double-traverse fixture is easier to install.

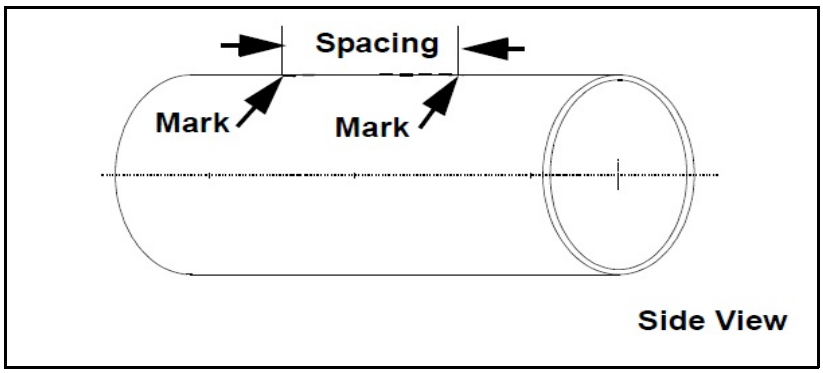
The procedure for mounting the GCF involves setting the transducer spacing and fastening the fixture on the pipe.

The installation procedure for transducers using the double-traverse method is as follows:

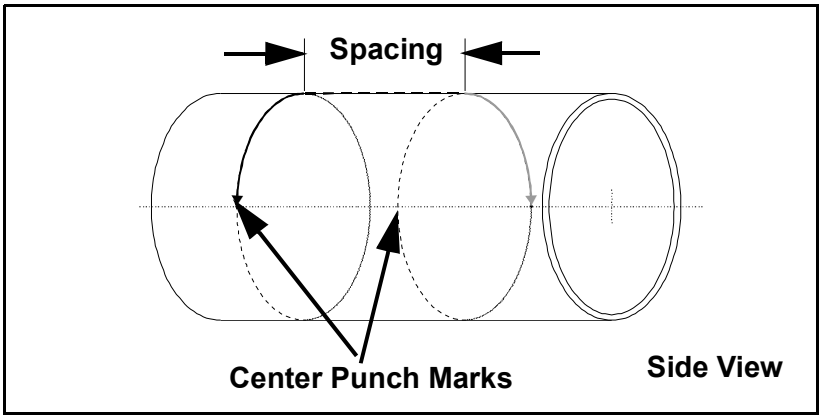
1. Be sure the location you have chosen for the installation has at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.



4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance **S**, as calculated by the flowmeter.

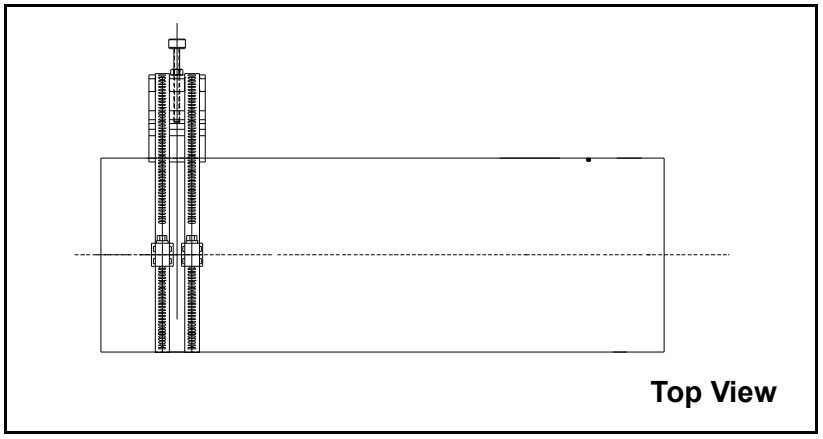


5. From each of the marks on the top of the pipe, measure around the pipe in the same direction a distance equal to 1/4 the pipe circumference. Use the center punch to make a mark at each location.



6. Center one of the blocks over one of the center punch marks on the side of the pipe. Align the block so that the pressure bolt is directly over the punch mark. Secure the block by wrapping the two steel straps around both the block and the pipe and tightening the straps.

IMPORTANT: Make sure both straps are perpendicular to the bottom of the block. If the straps are slanted, the slack will cause the block to move. Also the transducer spacing dimension may change after the transducers are mounted.



7. Repeat Step 6 to install the other block.

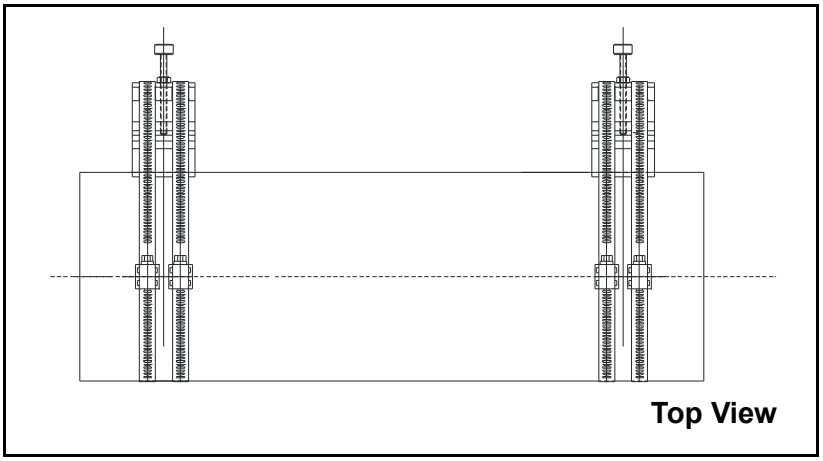


Figure 32 below shows a completed double-traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

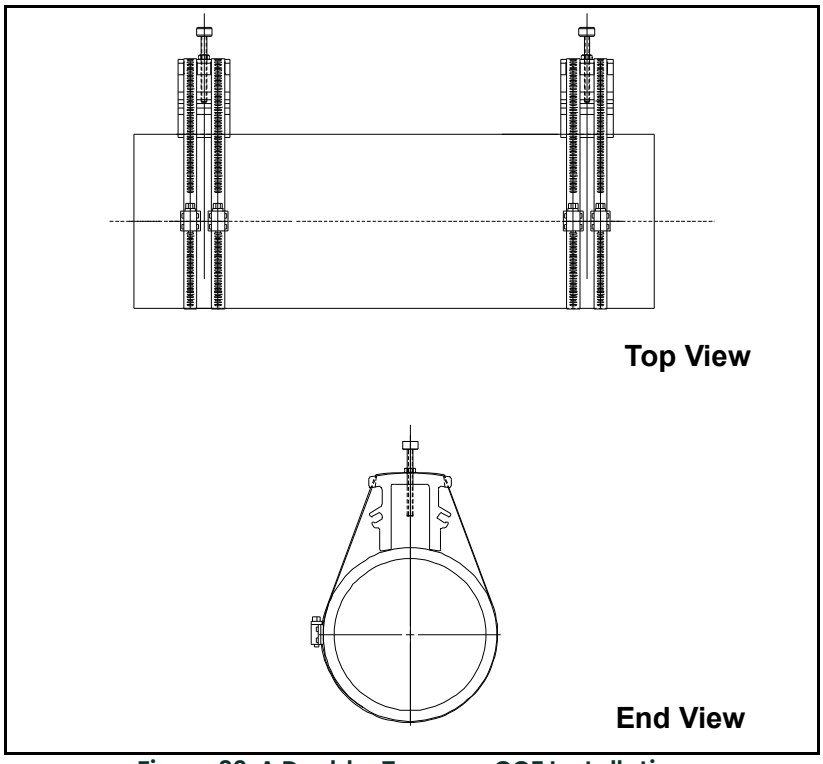


Figure 32: A Double-Traverse GCF Installation without Transducers

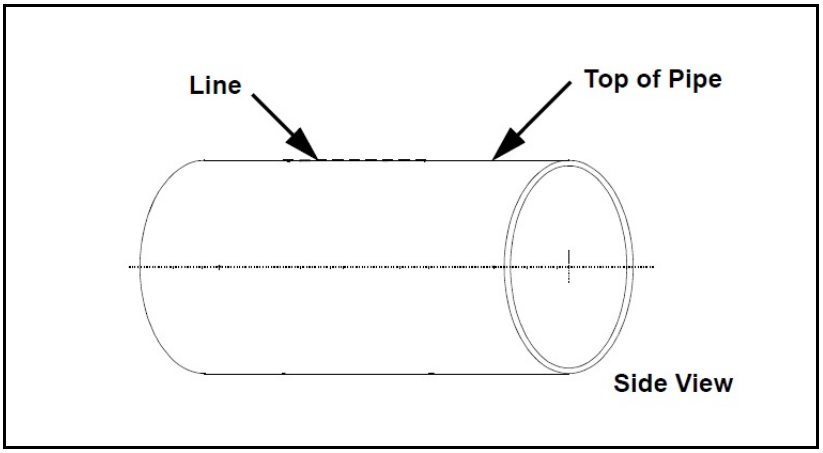
Single-Traverse Method

Note: *The instructions in this section can also be used for a multiple-traverse method. However, you must use an* **ODD** *number of traverses. The distance the signal travels from one side of the pipe wall to the opposite side of the pipe wall is considered one traverse. For installations with more than one traverse, contact Panametrics for assistance.*

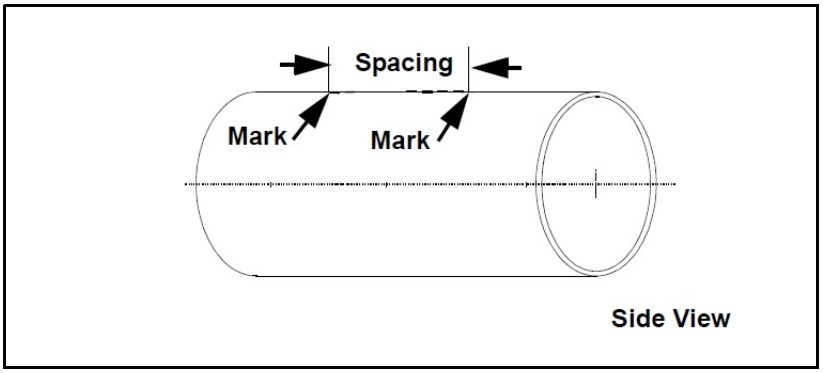
The procedure for mounting the GCF for the single-traverse method includes marking the pipe for the required transducer spacing, fastening the fixture to the pipe, and then mounting the transducers into the fixture.

To install the GCF, complete the following steps:

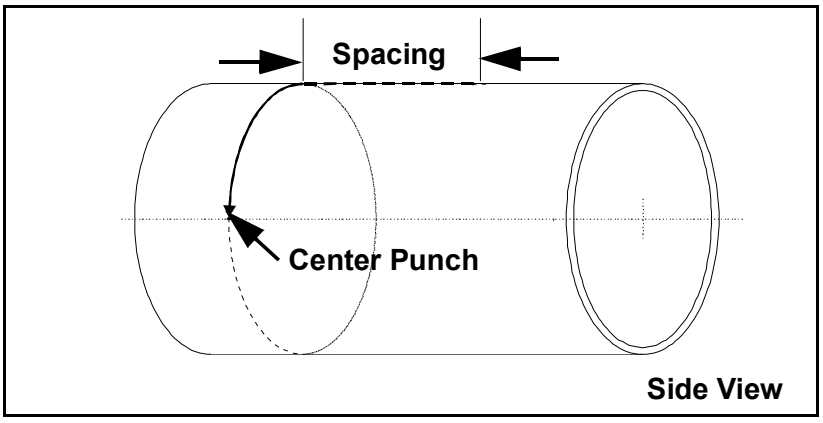
1. Choose a location for the installation that has at least 10 pipe diameters of straight, undisturbed flow upstream and at least 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the GCF by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.



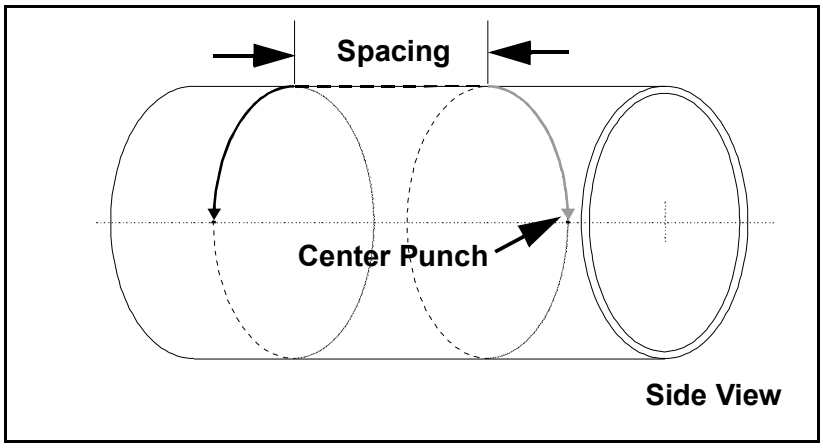
4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance **S**, as calculated by the flowmeter.



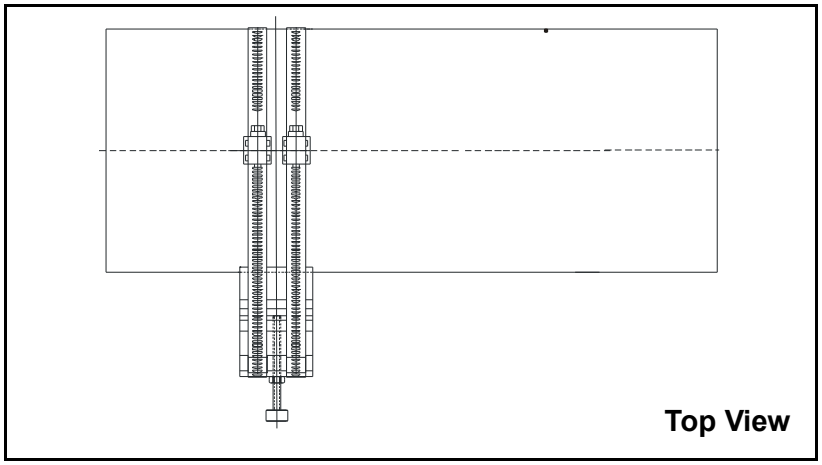
5. From one of the marks on the top of the pipe, measure around the pipe a distance equal to 1/4 of the pipe circumference. Use the center punch to make a mark at this point.



6. From the other mark on the top of the pipe, measure around the pipe in the opposite direction a distance equal to 1/4 of the pipe circumference. Use the center punch to make a mark at this point.



7. Center one of the blocks over one of the center punch marks on the side of the pipe. Align the block so that the pressure bolt is directly over the punch mark. Secure the block by wrapping the two steel straps around both the block and the pipe and tightening the straps.



8. Repeat Step 7 to install the other block on the pipe.

IMPORTANT: Make sure both straps are perpendicular to the bottom of the block. If the straps are slanted, the slack will cause the block to move. Also the transducer spacing dimension may change after the transducers are mounted.

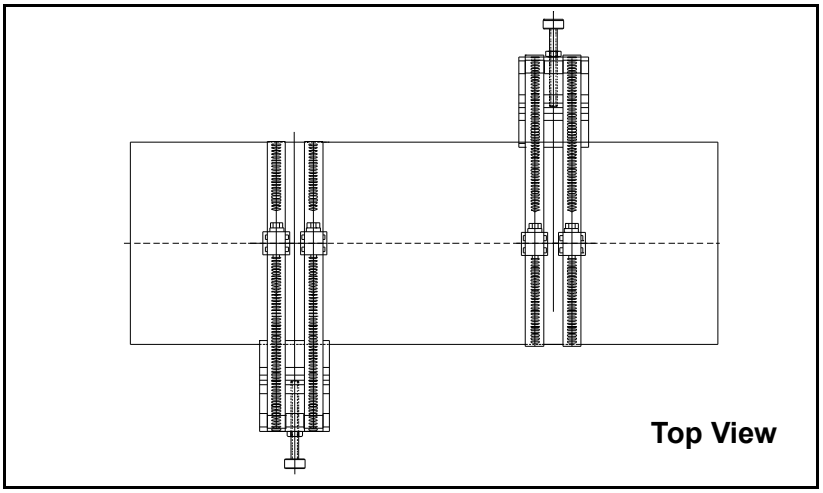


Figure 33 below shows a single-traverse installation without the transducers. Proceed to the section on mounting the transducers later in this chapter.

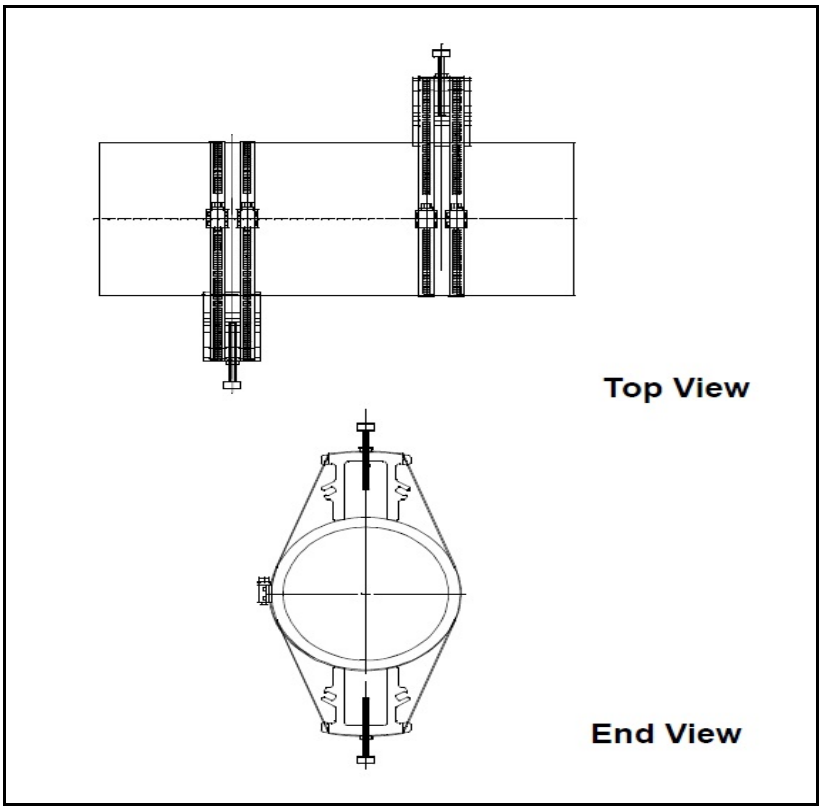


Figure 33: A Single-Traverse GCF Installation without Transducers

Mounting Transducers into the GCF

The last step in the installation is mounting the transducers into the clamping fixture. Although not all transducer models are installed exactly the same way, the following information provides some general guidelines to help you.

The face of the transducer must be in contact with the pipe because this is where the ultrasonic signal is emitted. All Panametrics transducers include a dimple, depression, or drill point on the side opposite the face, for use as a guide in aligning and securing the transducer. In addition, some transducers have scribe marks on the side to assist in setting the transducer spacing. Figure 34 below shows the two most commonly used transducers.

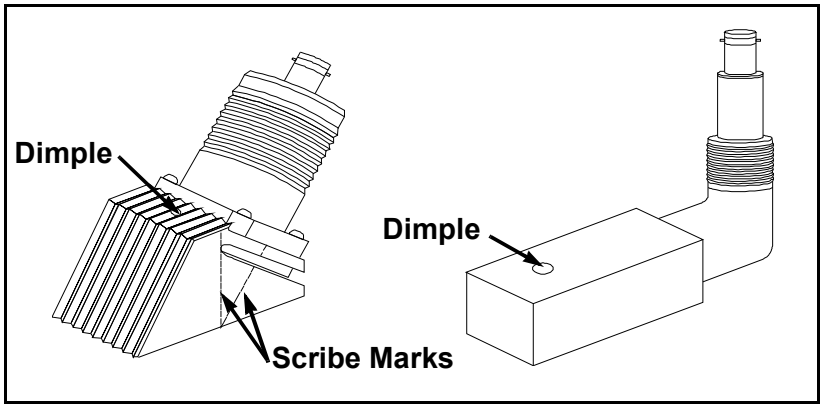
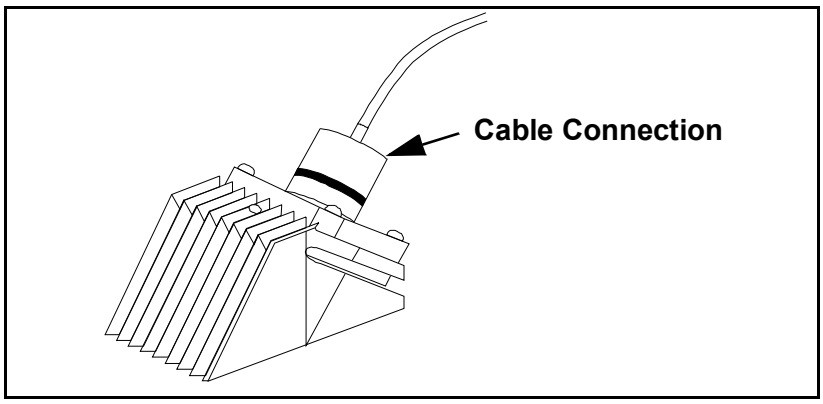


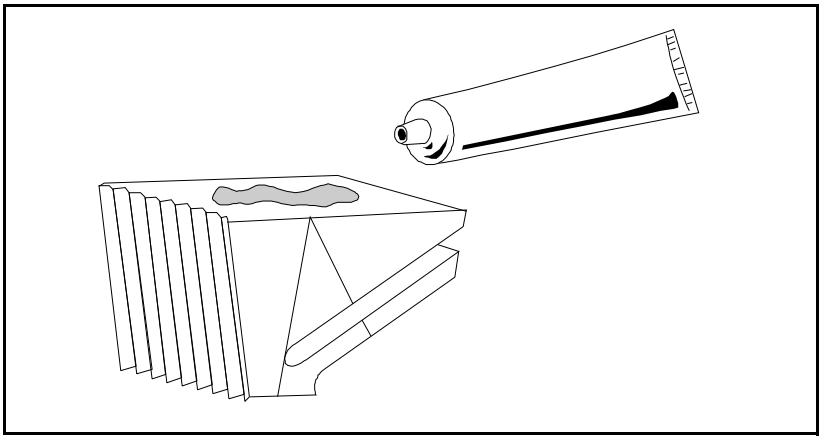
Figure 34: Transducer Dimples and Scribe Marks

To mount the transducers into the general Clamping Fixture, complete the following steps:

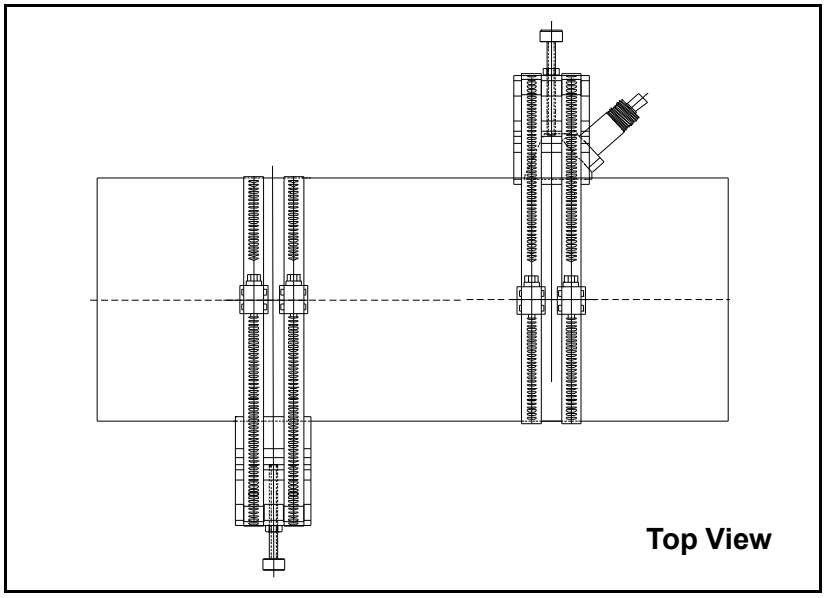
1. Connect the transducer cables to the BNC connectors on the transducers.



2. Apply a thin bead of couplant to one of the transducers. A bead approximately the size of a toothpaste bead should be placed down the center of the transducer face.



3. Determine the upstream and downstream ends of the pipe and place one of the transducers into one of the blocks. Make sure the transducer cable connector faces away from the center of the installation.



4. Use the pressure bolt to secure the transducer in place. The pressure bolt should fit into the dimple on the transducer. Hand tighten the bolt just enough to hold the transducer in place, but do not overtighten it or the fixture will lift off the pipe.
5. Repeat Steps 1-4 to mount the other transducer in the remaining block. See Figure 35 below for completed typical GCF installations.
6. Connect the other end of the transducer cables to the flowmeter electrical console (see your flowmeter manual for wiring instructions).

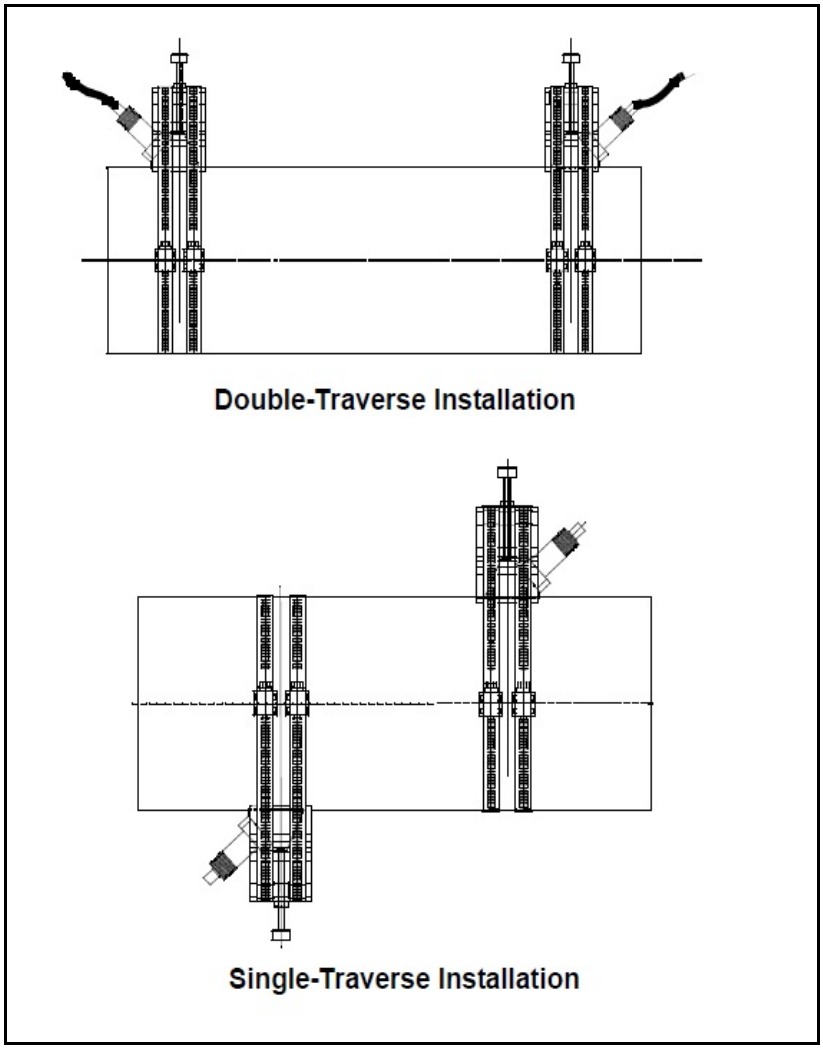


Figure 35: Completed GCF Installations with Transducers

Note: *If you have mounted the transducers into the GCF properly, the two transducer cable connectors will face away from each other as shown above.*

3.1.3.4 Using the Magnetic Clamping Fixture - MCF

The *Magnetic Clamping Fixture (MCF)* is used to fasten transducers to the pipe at the proper spacing **without** chains or straps. Different fixtures are used for the single-traverse and double-traverse methods. Each type of MCF has magnets located in the two blocks at the ends of the fixture. When the magnets are turned **ON**, the fixture is magnetically clamped to the pipe wall.

WARNING! **Do not use the MCF at temperatures that exceed 120°F (49°C),or the fixture will fall off the pipe.**

The transducer installation consists of mounting the MCF to the pipe and then mounting the transducers into the fixture. To properly mount the MCF, you should first become familiar with the components of the fixture (see Figure 36 below). Then, refer to the appropriate section for instructions on either the double-traverse or single-traverse method.

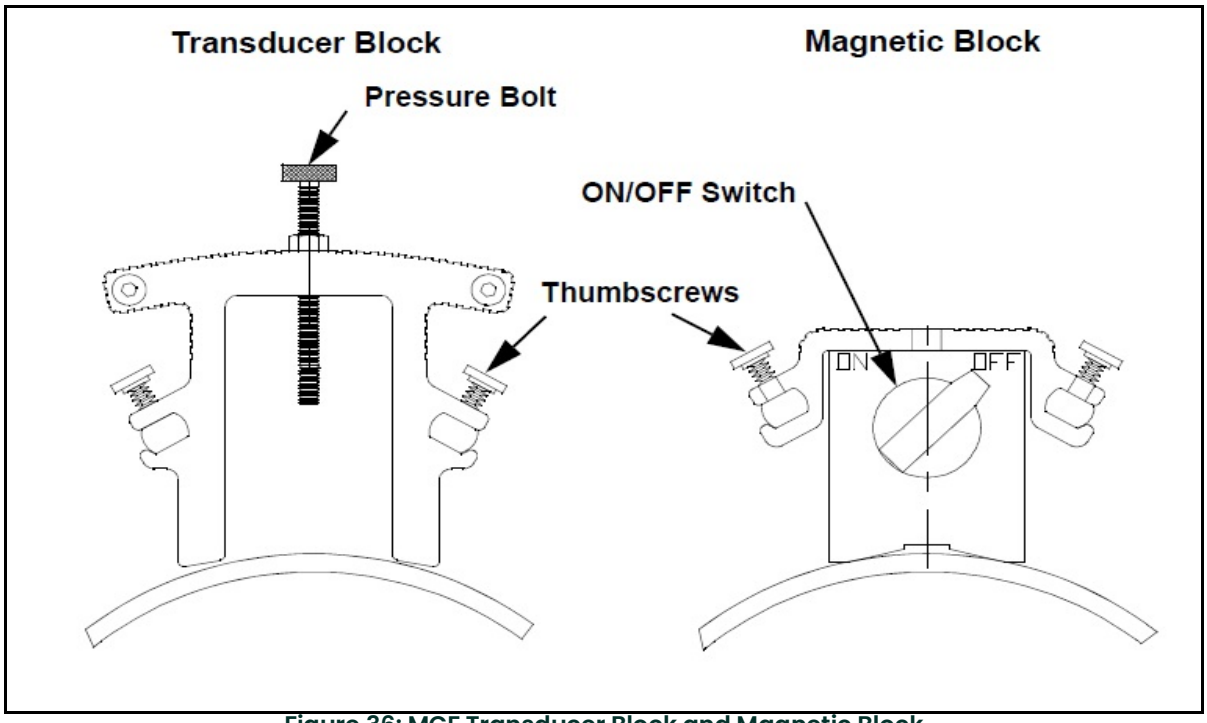


Figure 36: MCF Transducer Block and Magnetic Block

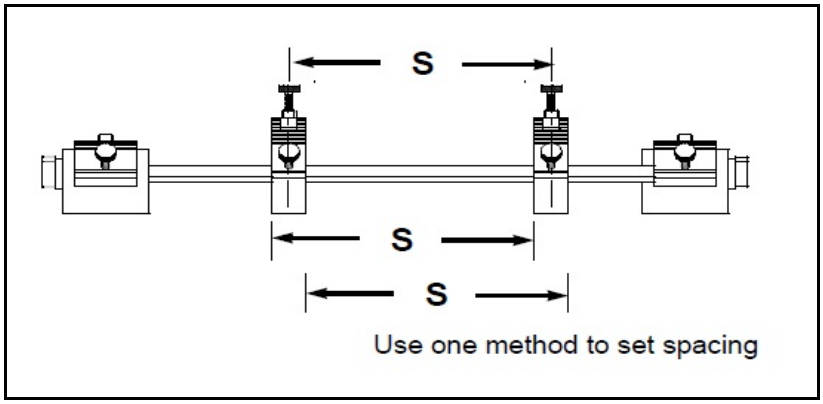
Double-Traverse Method

Note: *The instructions in this section can also be used for a multiple-traverse method. However, you must use an* **EVEN** *number of traverses. The distance the signal travels from one side of the pipe wall to the opposite side of the pipe wall is considered one traverse. For installations with more than two traverses, contact Panametrics for assistance.*

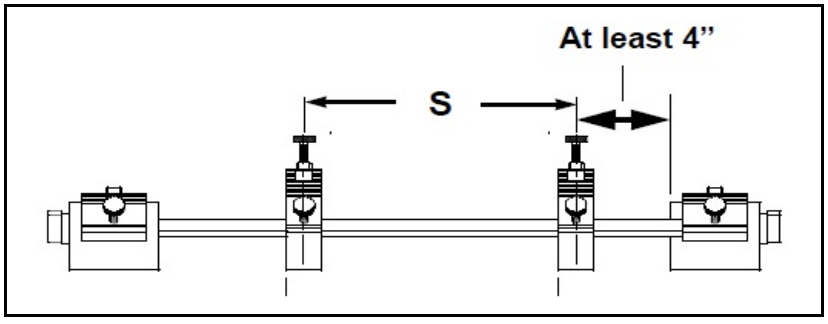
The double-traverse MCF consists of a fixed magnetic block and an adjustable magnetic block, which are connected by two rods (one of the rods acts as a scale to help you properly space the transducers). In addition, a fixed transducer block and an adjustable transducer block are included. To install the MCF in a double-traverse configuration, complete the following steps:

1. Be sure the location you have chosen for the installation has at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Obtain the transducer spacing dimension (**S**) as described in your flowmeter user's manual. Using the ruler on the MCF rod as a guide, loosen the red thumbscrews and move the transducer blocks so that the distance between them equals the **S** dimension. Then, tighten the thumbscrews. Use the pressure bolts or the edges of the blocks as reference points, as shown below.

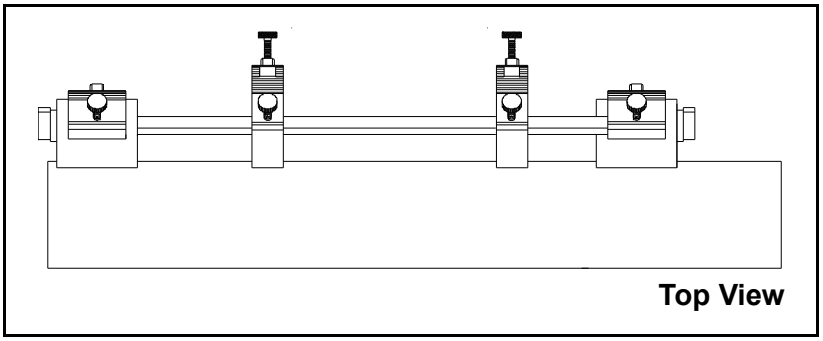
IMPORTANT: Make sure there is at least 4" (100 mm) of clearance between the fixed magnetic block and the nearest transducer block.



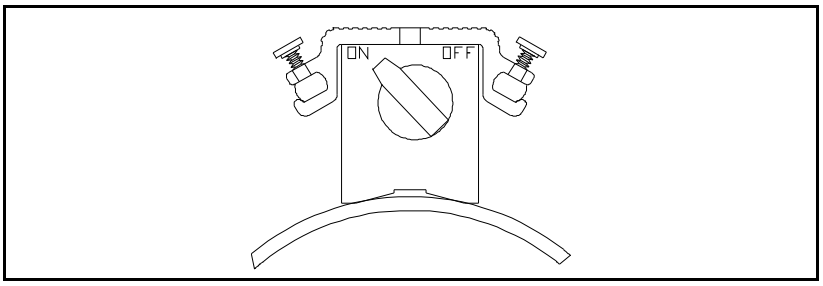
4. To ensure that there is enough clearance to mount the transducers in the blocks, move the adjustable magnetic block so that it is at least 4" (100 mm) away from the nearest transducer block. Then, secure the block to the rods with the thumbscrews.



5. Position the clamping fixture along the **horizontal plane of the pipe. It must not be on the top or bottom of the pipe**.



6. Turn the switches on both magnets to the **ON** position.



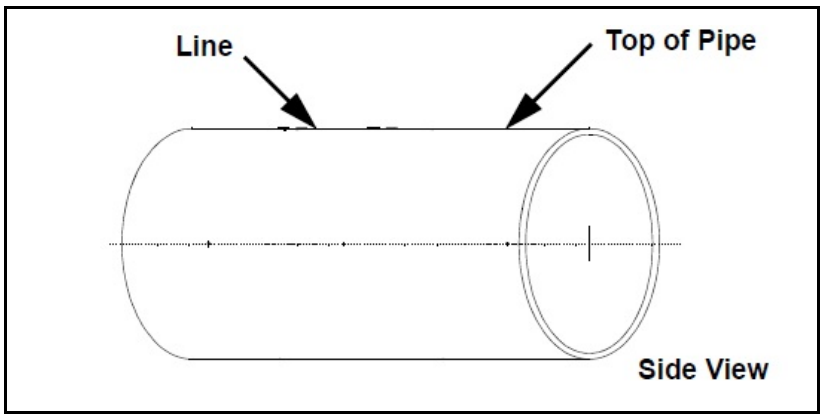
Proceed to the section on mounting the transducers later in this chapter.

Single-Traverse Method

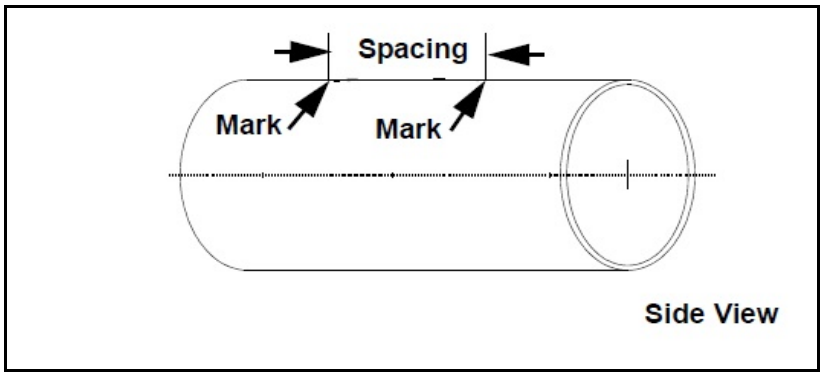
Note: *The instructions in this section can also be used for a multiple-traverse method. However, you must use an* **ODD** *number of traverses. The distance the signal travels from one side of the pipe wall to the opposite side of the pipe wall is considered one traverse. For installations with more than one traverse, contact Panametrics for assistance.*

The single-traverse MCF consists of two sub-assemblies. Each sub-assembly is made up of one adjustable transducer block, two magnetic blocks and two connecting rods. The two sub-assemblies must be installed on opposite sides of the pipe. To install the MCF in a single-traverse configuration, complete the following steps:

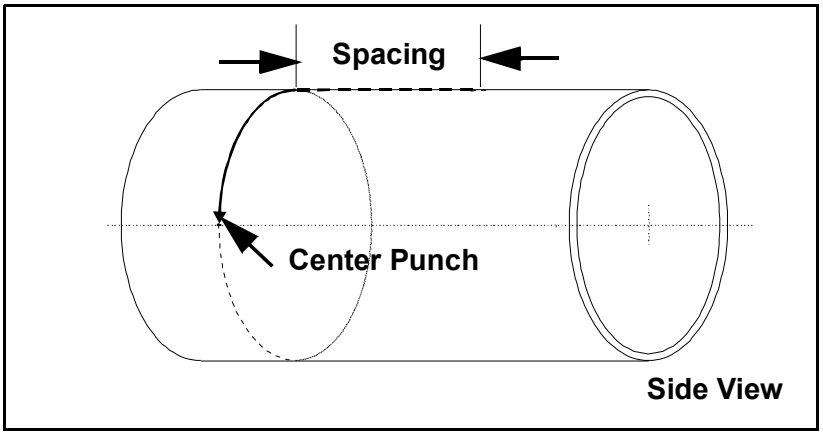
1. Be sure the location you have chosen for the installation has at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Use a level to find the top of the pipe and then draw a line parallel to the centerline of the pipe.



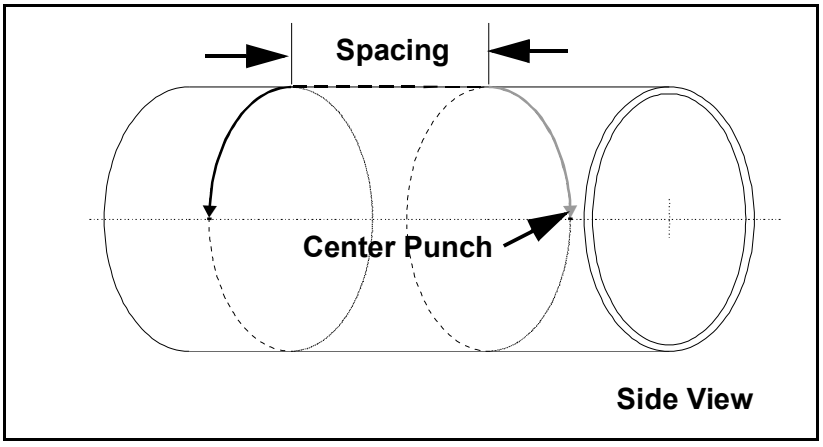
4. Using a level and center punch, make two marks on the line drawn in step 3. These marks must be separated by the transducer spacing distance **S**, as calculated by the flowmeter.



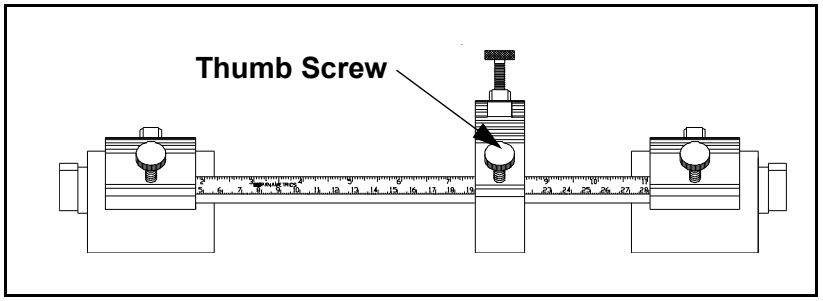
5. From one of the marks on the top of the pipe, measure around the the pipe a distance equal to 1/4 of the pipe circumference. Use the center punch to make a mark at this point.



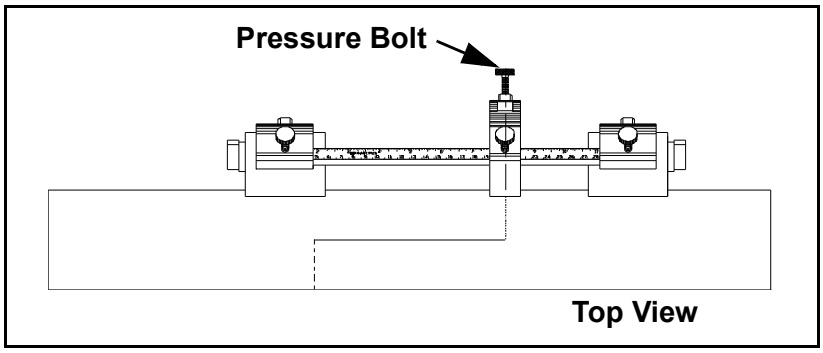
6. From the other mark on the top of the pipe, measure around the pipe in the opposite direction a distance equal to 1/4 of the pipe circumference. Use the center punch to make a mark at this point.



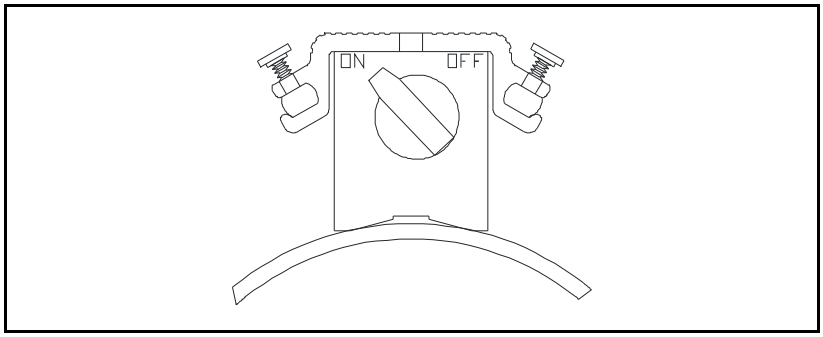
7. On one of the MCF sub-assemblies, position the adjustable transducer block anywhere along the rods, being sure to leave enough room on both sides to easily insert the transducer. To move the block, loosen the red thumbscrews, slide the block to the desired location and tighten the thumbscrews. Use the pressure bolt and the scale on the rod to position the block at the desired location. Repeat the procedure for the other sub-assembly.



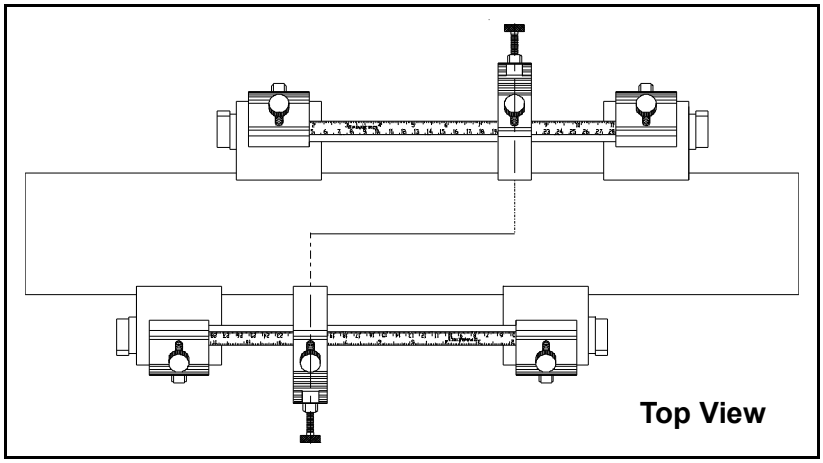
8. Center the transducer block of one sub-assembly over one of the center punch marks on the side of the pipe. Align the block so that the pressure bolt is directly over the punch mark.



9. Turn the switches on both magnets to the **ON** position.



10. Repeat Steps 8 and 9 to mount the other sub-assembly on the opposite side of the pipe.



Proceed to the section on mounting the transducers later in this chapter.

Mounting Transducers into the MCF

The last step in the installation is mounting the transducers into the clamping fixture. Although not all transducer models are installed exactly the same way, the following information provides some general guidelines to help you.

The face of the transducer must be in contact with the pipe because this is where the ultrasonic signal is emitted. All Panametrics transducers include a dimple, depression, or drill point on the side opposite the face, for use as a guide in aligning and securing the transducer. In addition, some transducers have scribe marks on the side to assist in setting the transducer spacing. Figure 37 below shows the two most commonly used transducers.

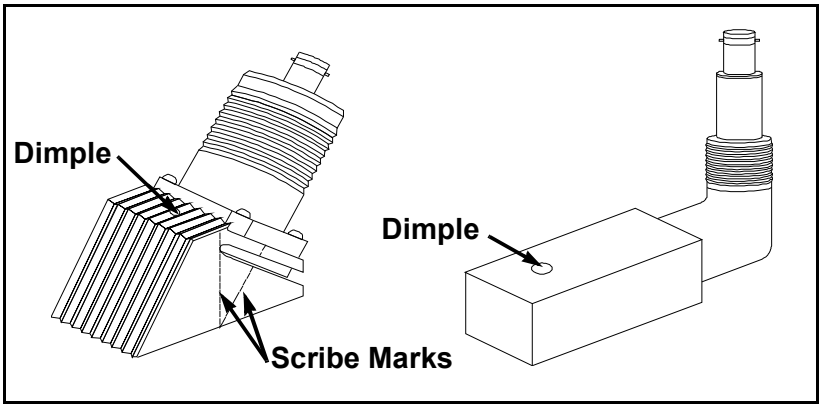
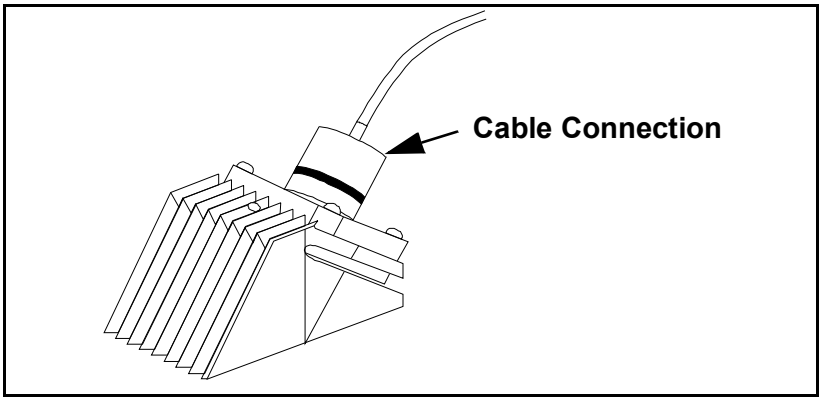


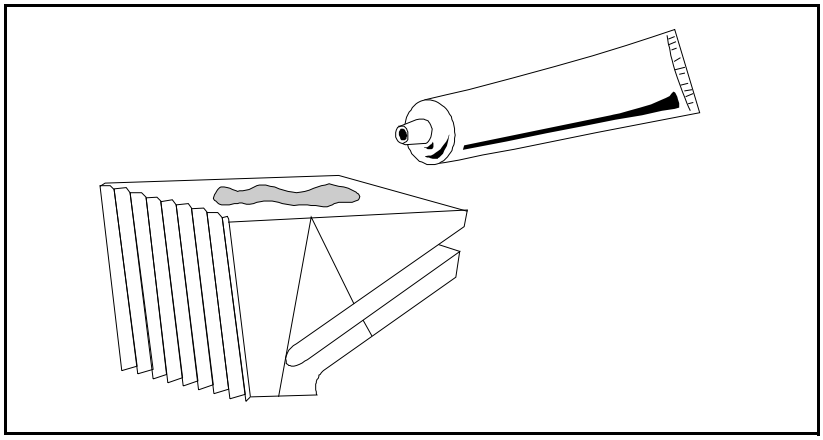
Figure 37: Transducer Dimples and Scribe Marks

To mount the transducers into the Magnetic Clamping Fixture, complete the following steps:

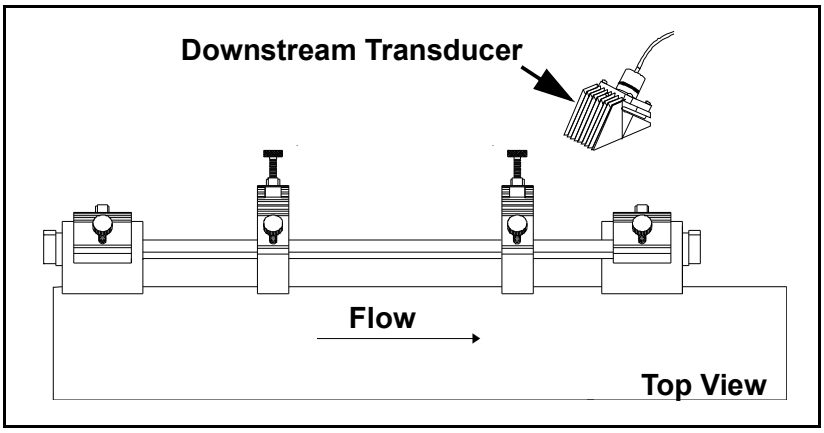
1. Connect the transducer cables to the BNC connectors on the transducers.



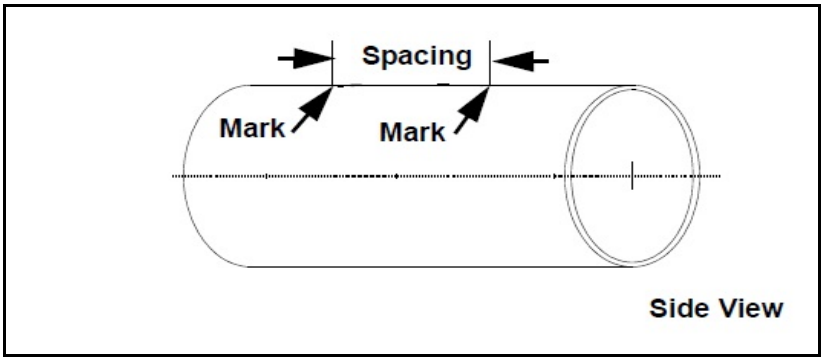
2. Apply a thin bead of couplant to one of the transducers. A bead approximately the size of a toothpaste bead should be placed down the center of the transducer face.



3. Determine the upstream and downstream ends of the pipe and place the appropriate transducer into the corresponding block on one of the sub-assemblies. Make sure the transducer cable connector faces away from the center of the installation.



4. Use the pressure bolt to secure the transducer in place. The pressure bolt should fit into the dimple on the transducer. Hand tighten the bolt just enough to hold the transducer in place, but do not overtighten it or the fixture will lift off the pipe.



5. Repeat Steps 1-4 to mount the remaining transducer in the other sub-assembly. See Figure 38 on the following page for completed typical MCF installations.
6. Connect the other end of the transducer cables to the flowmeter electrical console (see your flowmeter manual for wiring instructions).

WARNING! **If your fixture is installed at an elevated location, Panametrics recommends securing the fixture with a tether or leash to prevent injury if the MCF falls from the pipe.**

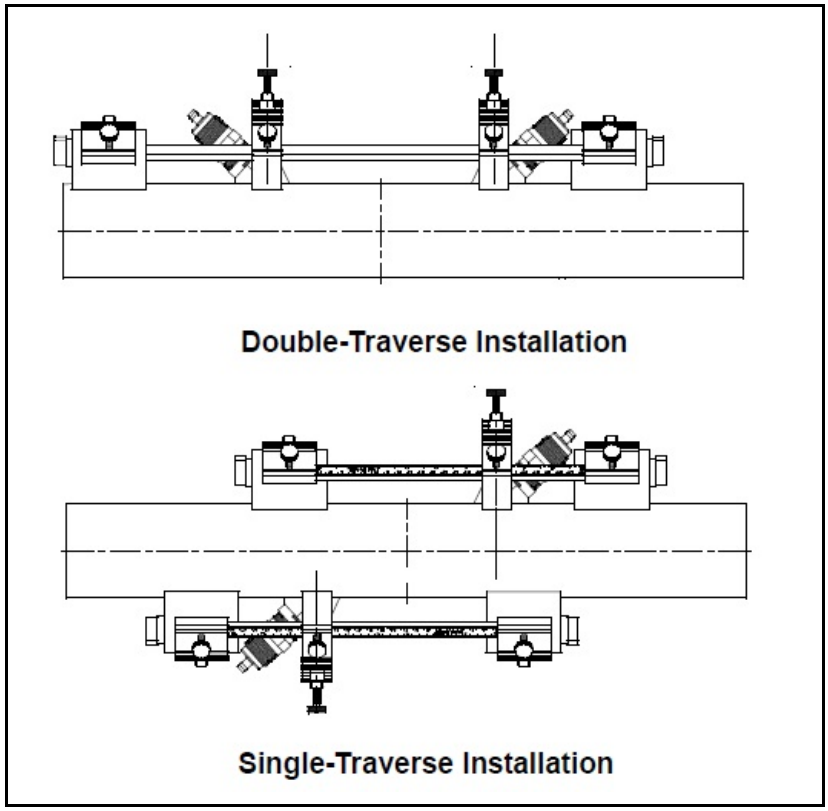


Figure 38: Completed MCF Installations with Transducers

Note: *If you have mounted the transducers into the MCF properly, the two transducer cable connectors will face away from each other as shown above.*

3.1.3.5 Using the Small Pipe Clamping Fixture - SPCF

The *Small Pipe Clamping Fixture (SPCF)* is used on pipes from 1/2" (12.5 mm) to 2" (50 mm) in diameter and is supplied with the transducers already installed. The SPCF measures flow using the double-traverse method.

Note: *Four-traverse applications are possible, but the SPCF cannot be used for a single-traverse method (or an odd number of traverses).*

A variety of small pipe clamping fixtures available for standard, weatherproof and explosion-proof installations. Although there are differences between these fixtures, the basic installation procedures are the same for all of them. Each SPCF consists of the following components (see Figure 39 below):

- two Velcro straps
- two stainless steel straps or clamps
- one fixed transducer assembly
- one sliding transducer assembly with a pointer
- a ruler

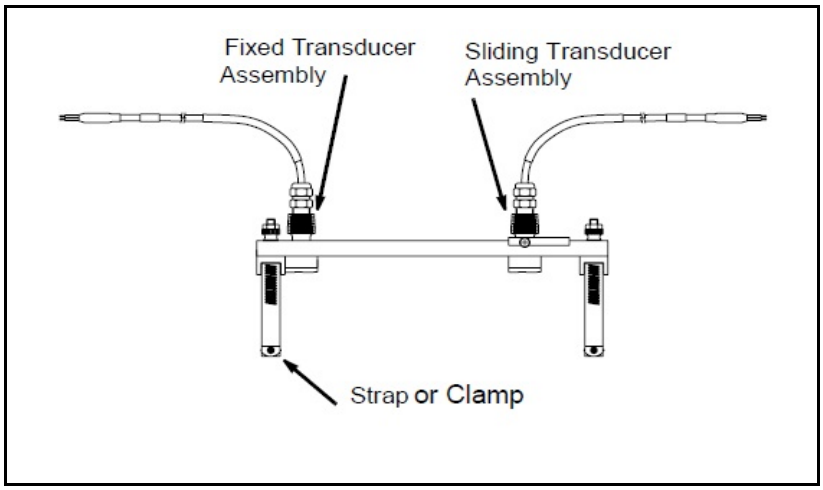
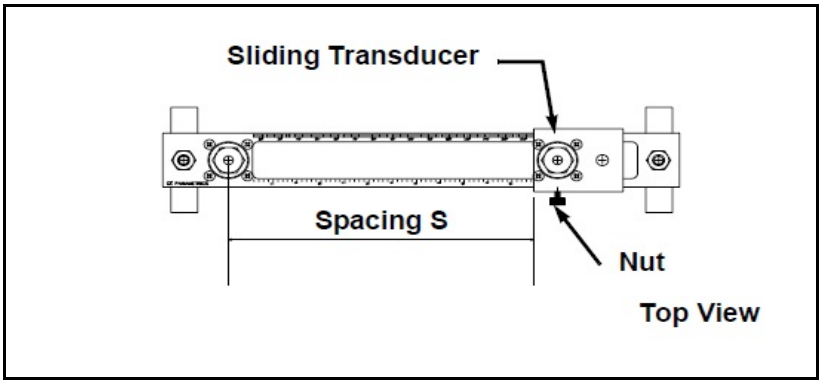


Figure 39: Components of the SPCF

Installing the SPCF

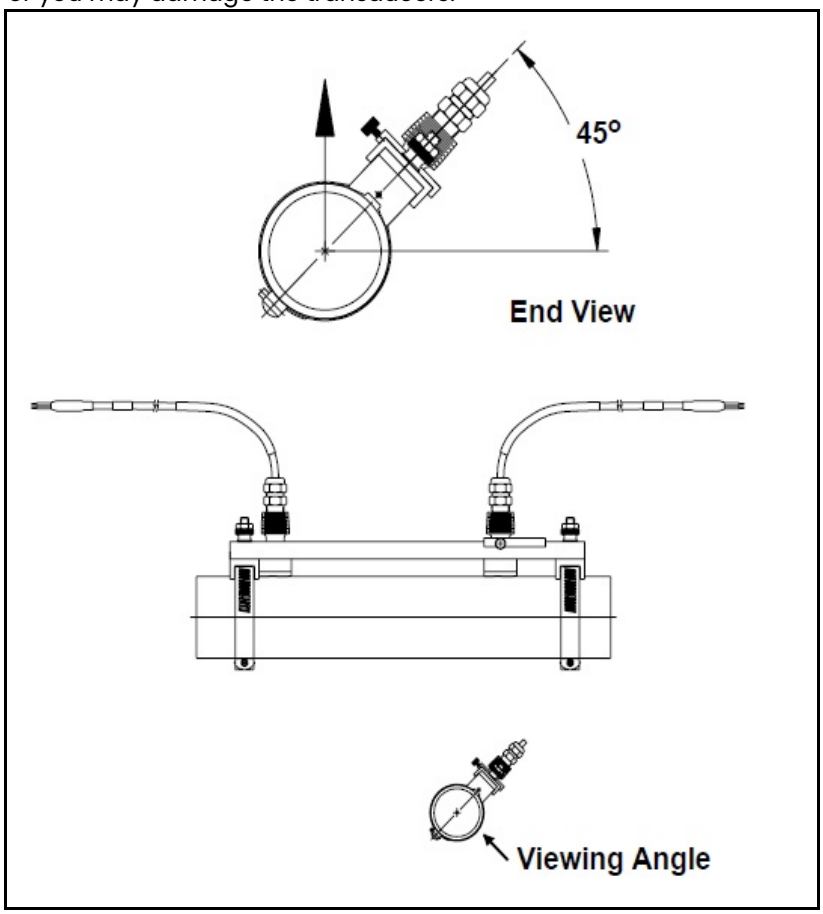
To install the SPCF, complete the following steps:

1. Be sure the location you have chosen for the installation has at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Obtain the transducer spacing dimension (**S**) as described in your flowmeter user's manual. Using the attached ruler on the SPCF as a guide, loosen the nut 1/2 turn and move the sliding transducer so that the distance between the transducers equals the **S** dimension. Use the edge of the sliding transducer as reference point, as shown below. Secure the transducer by tightening the nut.



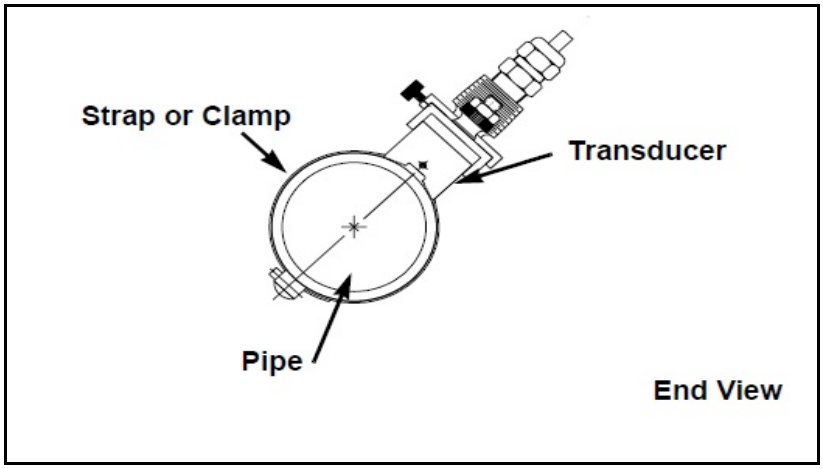
4. Apply a thin bead of couplant to each transducer face. The couplant should not extrude from beneath the transducer face when the SPCF is fastened to the pipe.
5. Position the SPCF along the side of the pipe, as shown below. Panametrics recommends placing the fixture at a 45° angle for optimum performance.

IMPORTANT: Do not place the SPCF on the top or bottom of the pipe.
If your pipe has a rough surface, do not slide the transducer face over the surface of the pipe during installation or you may damage the transducers.



6. Using your hand, push the SPCF against the pipe and fasten it with the straps provided. If the transducer cables have already been connected, make sure the they are fed through the ends of the clamping fixture. If the cables are caught under the clamping fixture, the transducers will not make contact with the pipe.

IMPORTANT: The fabric Velcro straps can be used to a maximum temperature of 170°F (77°C). For higher temperatures, use the stainless steel straps.



7. Mount both electrical junction boxes and connect the transducer cables to the transducers.

See the next page for examples of typical completed SPCF installations.

Typical SPCF Installations

The figures in this section show typical completed SPCF installations.

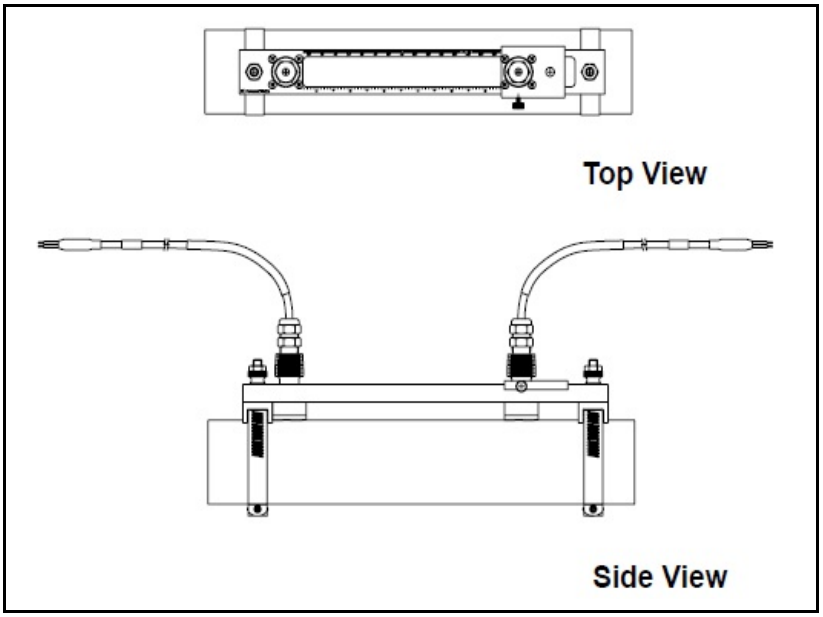


Figure 40: Standard SPCF

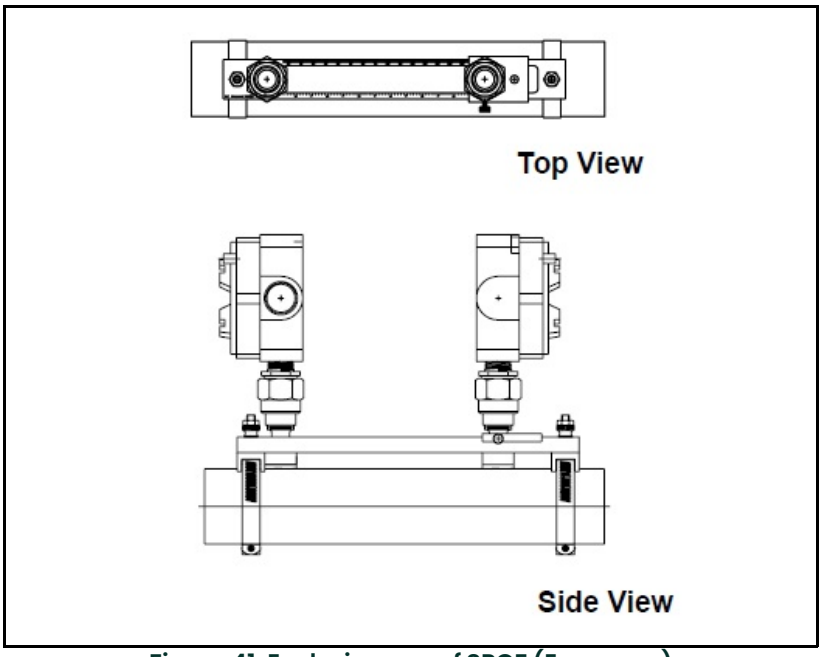


Figure 41: Explosion-proof SPCF (European)

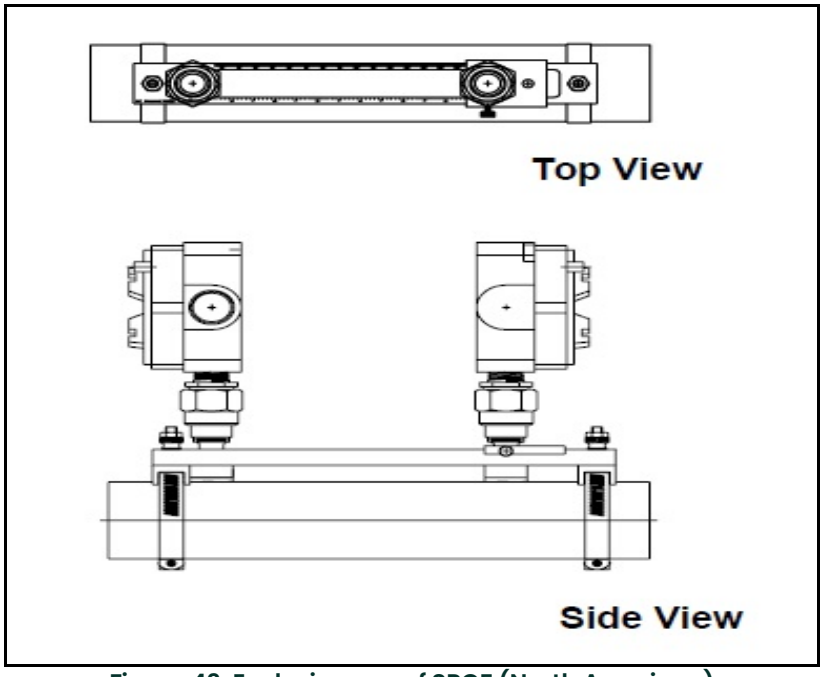


Figure 42: Explosion-proof SPCF (North American)

3.1.3.6 Using the Yoke and Strap Clamping Fixture

Another method for mounting transducers to the pipe is the *Yoke and Strap* clamping fixture (see Figure 43 below). With this fixture, the yokes are typically secured to the pipe with stainless steel straps.

Note: *The yokes may also be welded to the pipe, but you must be sure to follow all local codes, especially in pressurized vessel applications.*

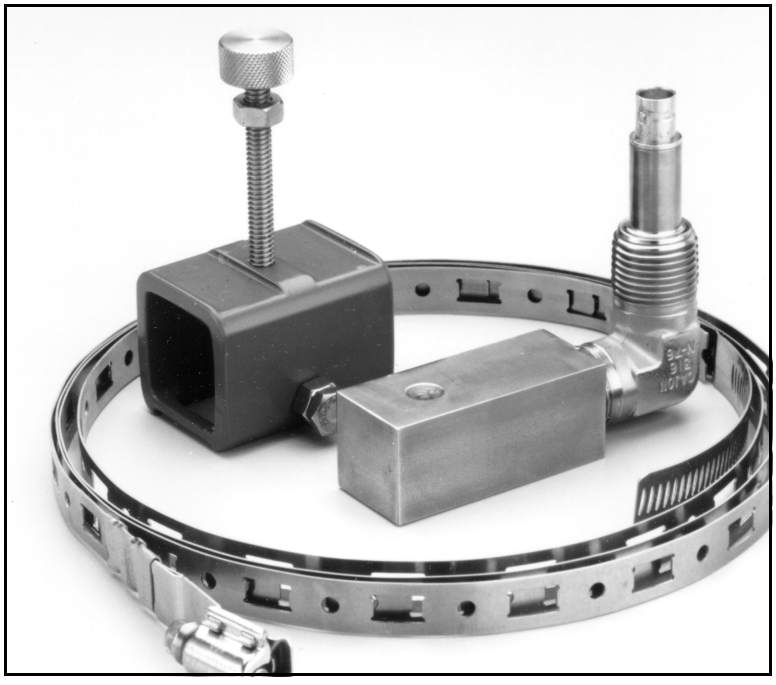


Figure 43: Strap, Yoke and Transducer

Install the yoke and strap clamping fixture as follows:

1. Be sure the location you have chosen for the installation has at least 10 pipe diameters of straight, undisturbed flow upstream and 5 pipe diameters of straight, undisturbed flow downstream from the measurement point.
2. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Obtain the transducer spacing dimension (**S**) as described in your flowmeter user's manual.

IMPORTANT: The transducers must be installed along the horizontal plane of the pipe. They must not be located on the top or bottom of the pipe.

4. For a single-traverse installation, the transducers must be on opposite sides of the pipe. For a double-traverse installation, the transducers must be on the same side of the pipe. Determine which type of installation you require and then mark the pipe at the two transducer locations.

Note: *See the previous detailed GCF instructions for the techniques required to mark the transducer locations.*

5. Fasten the yokes to the pipe at the marked locations using the stainless steel straps. Loosen the top pressure bolt and the side support bolts on both yokes.
6. Install the transducers into the yokes and secure the transducers into the fixture by tightening the side support bolts and the top pressure bolt.

3.1.4 TransFlection Installations

TransFlection measurements also require two transducers. These transducers must be mounted on the pipe using a *TransFlection Mode Clamping Fixture (TMCF)* that is clamped to the pipe with a chain or strap. Depending on the relative locations of the two transducers on the pipe, different versions of the TMCF are required.

The following instructions are included in this section:

- mounting the TMCF in <180° configurations
- mounting the TMCF in 180° configurations
- mounting the transducers into the TMCF

3.1.4.1 Using the TransFlection Mode Clamping Fixture - TMCF

The transducers can be mounted up to 180° apart around the circumference of the pipe. The angle between the transducers is dependent on the size of the pipe:

- The transducers are located opposite each other (180° apart) on pipes with 2" (50 mm) to 4" (100 mm) diameters.
- For pipes larger than 4" (100 mm) in diameter, the transducers are located less than 180° apart.

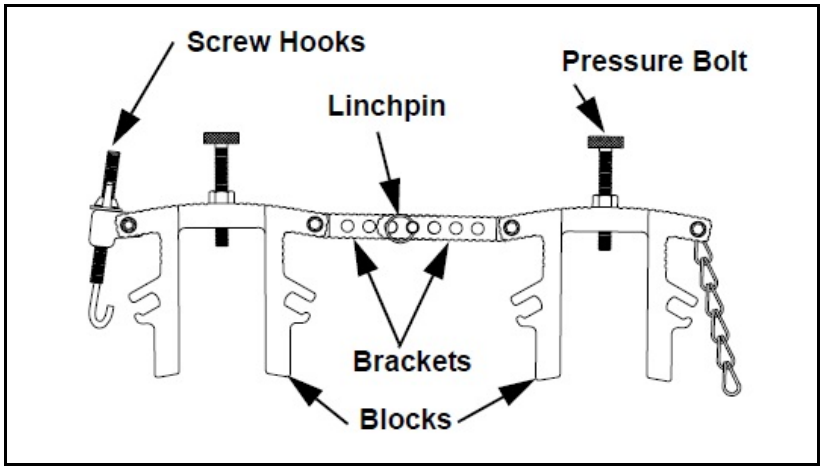
Note: *If your process contains high concentrations of a two-phase liquid, the transducers should be located less than 180° apart for all pipe diameters.*

Proceed to one of the following sections to properly mount the TMCF on the pipe and install the transducers in the fixture.

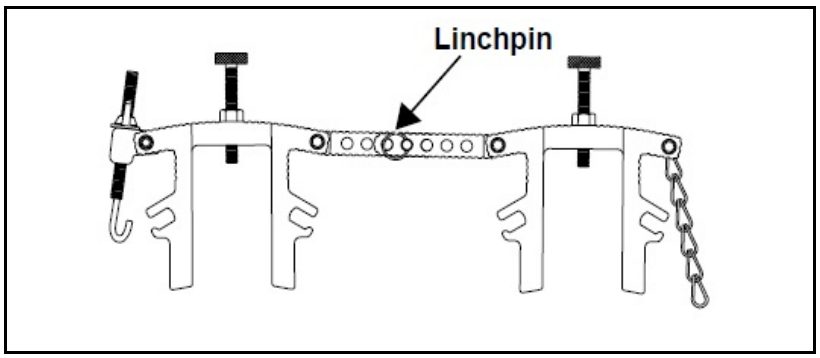
<180° Configuration

To properly mount the TMCF and install the transducers in a <180° configuration, complete the following steps:

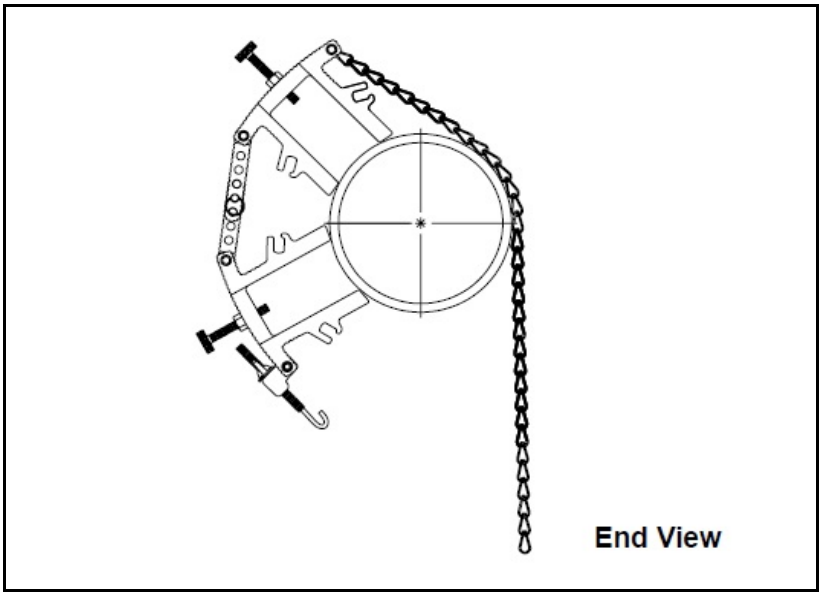
1. Familiarize yourself with the components of the TMCF as shown in the figure below.



2. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Estimate the distance required between the two blocks for your installation, and connect the two brackets with the linchpin. If necessary, the distance can be adjusted later.

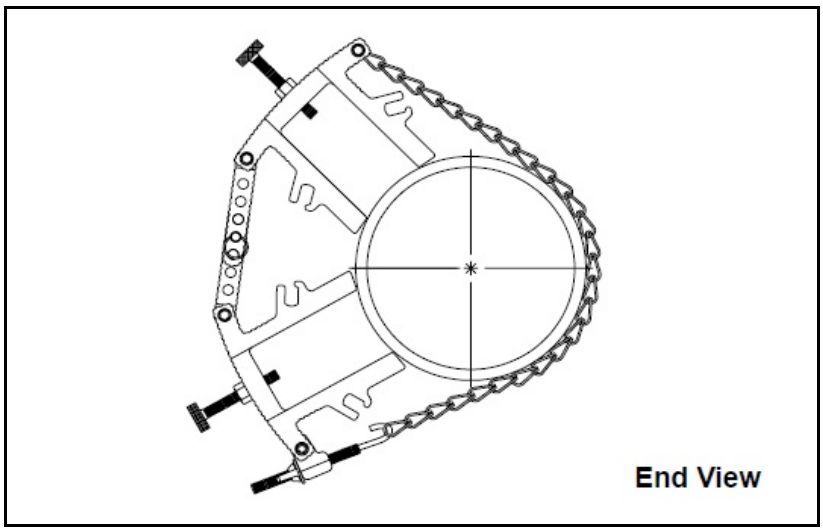


4. Position the fixture along a **horizontal plane** of the pipe. **It must not be on the top or bottom of the pipe.**



5. Wrap the chains around the pipe and fasten them to the screw hooks on the other block. If necessary, adjust the distance between the blocks with the brackets and linchpin.

IMPORTANT: Make sure the chains are perpendicular to the blocks and are not twisted.



6. Fine tune the angle between the blocks by adjusting the chain screw hooks and the block brackets as required. The blocks must fit snugly against the pipe after the adjustments are completed.

IMPORTANT: Make sure the blocks are on a common axial plane so the chains are not slanted. If the chains are slanted, the slack may cause the fixture to move.

Figure 44 below shows a typical completed <180° TMCF installation without transducers. Proceed to the section on mounting the transducers later in this chapter.

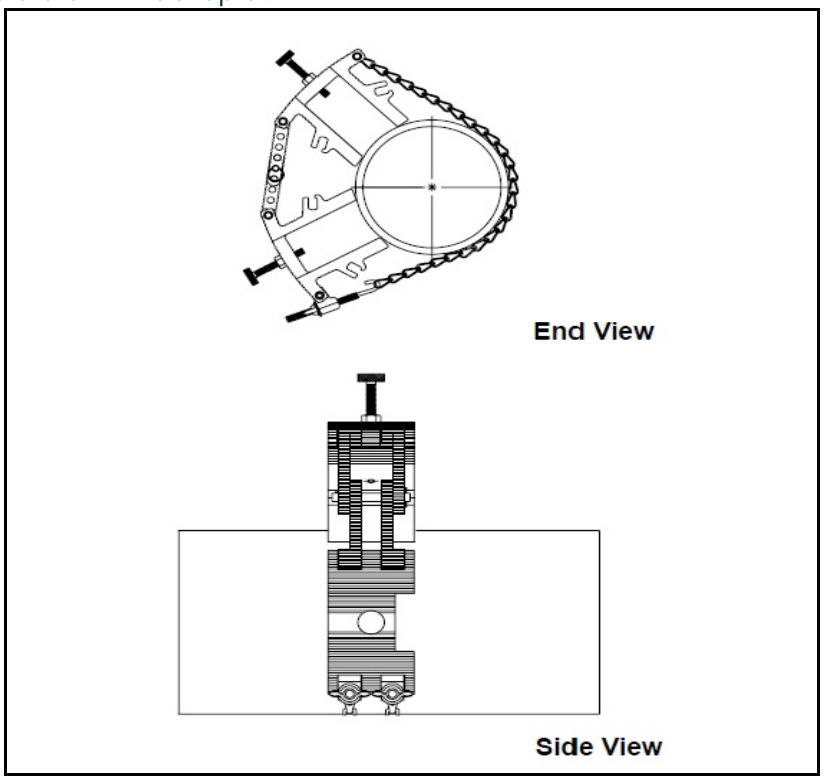
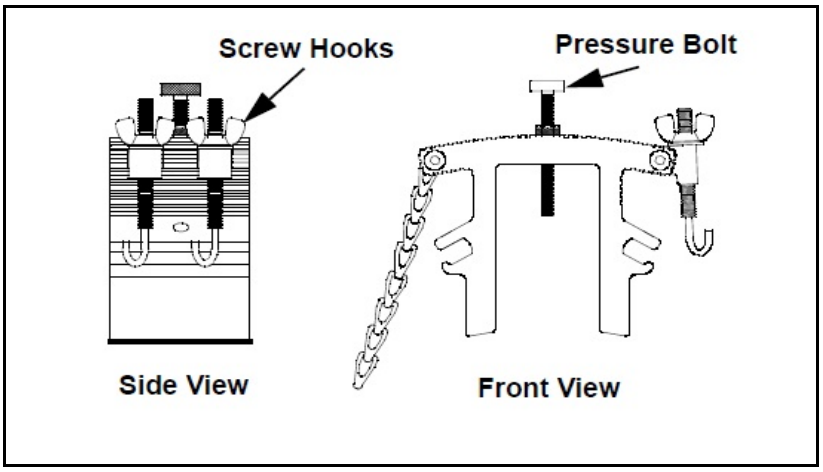


Figure 44: Completed <180° Installation without Transducers

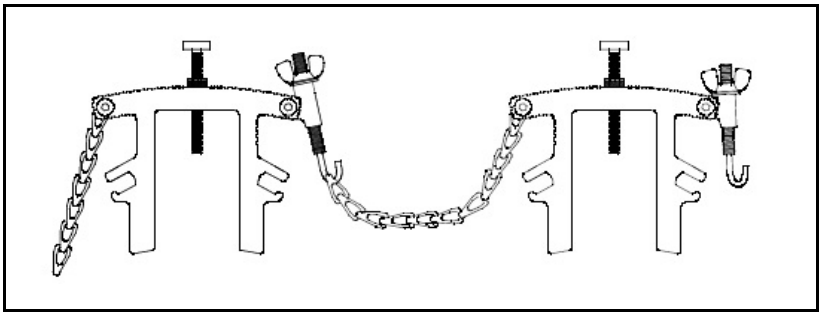
180o Configuration

To properly mount the TMCF and install the transducers in a 180° configuration, complete the following steps:

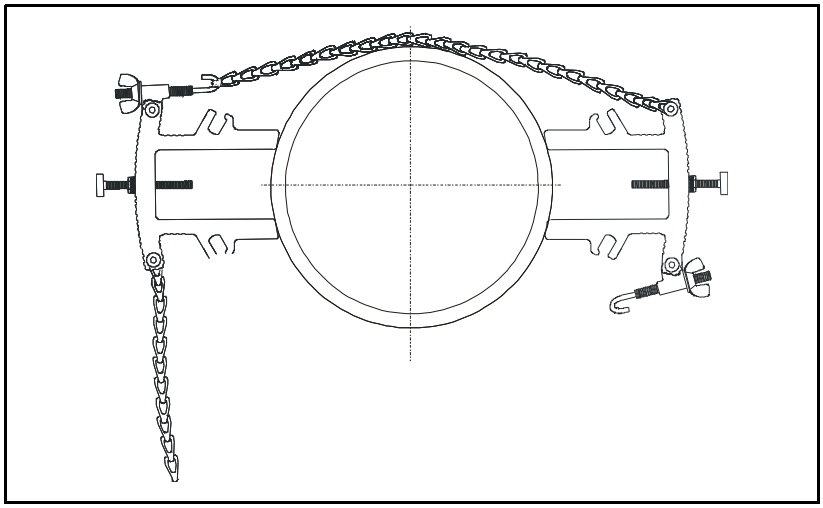
1. Familiarize yourself with the components of the TMCF as shown in the figure below.



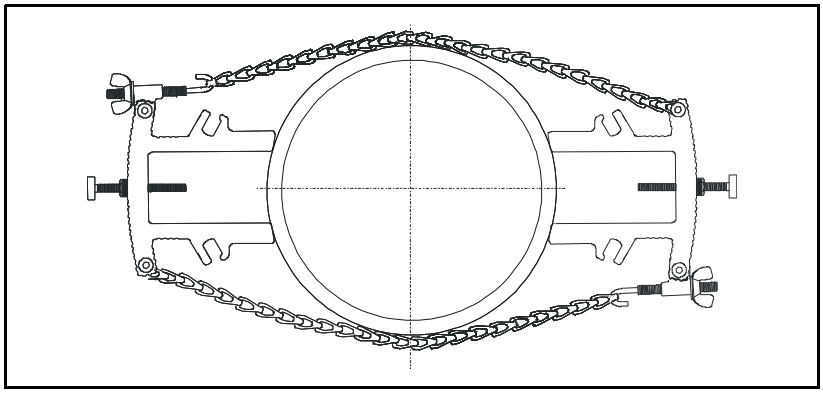
2. Prepare the pipe where you intend to place the clamping fixture by making sure it is clean and free of loose material. Sanding, though usually not required, may be necessary to remove any high spots. However, be careful to preserve the original curvature of the pipe.
3. Estimate the distance required between the two blocks for your installation, and connect the chains from one block to the screw hooks on the other block. If necessary, the distance can be adjusted later.



4. Position the fixture along a **horizontal plane** of the pipe. **It must not be on the top or bottom of the pipe** The blocks should be exactly opposite each other (180° apart).



5. Wrap the remaining chains around the pipe and fasten them to the screw hooks on the other block. Make sure the chains on both sides of the pipe are approximately the same length.



6. Adjust the chains using the screw hooks on both blocks to fine tune the angle between the blocks. Make sure the chains are not twisted or slanted.

Figure 45 below shows a typical completed 180° TMCF installation without transducers. Proceed to the section on mounting the transducers later in this chapter.

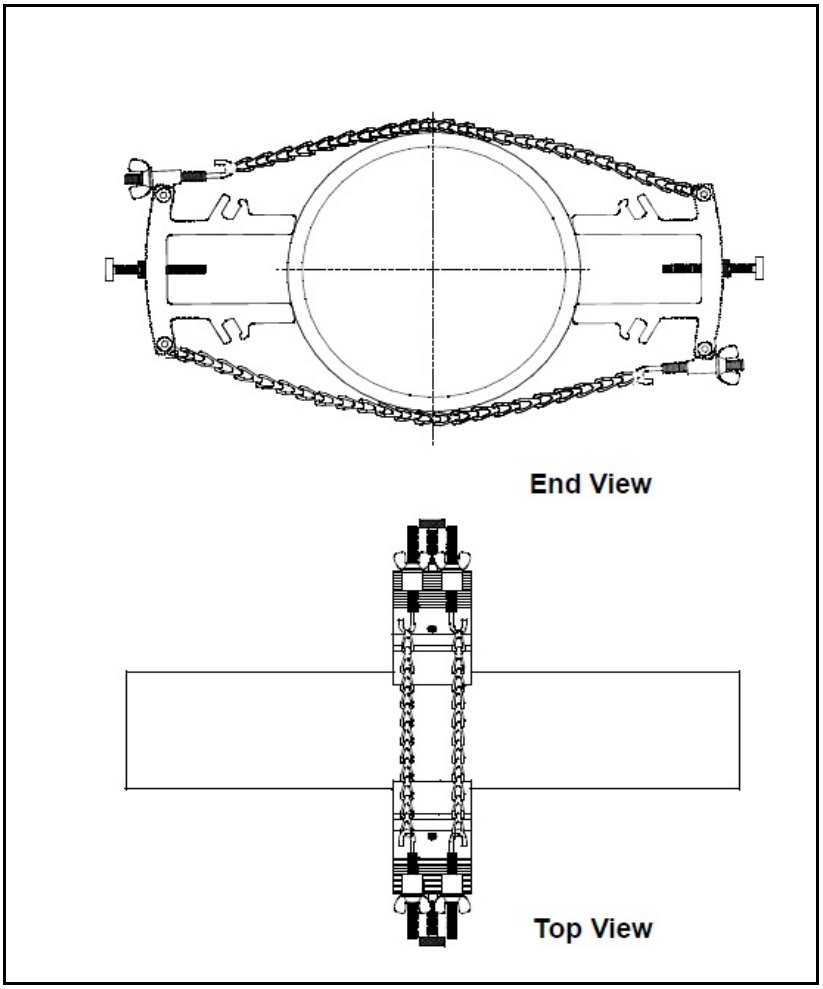


Figure 45: Completed 180° Installation without Transducers

Mounting Transducers into the TMCF

The last step in the installation is mounting the transducers into the clamping fixture. Although not all transducer models are installed exactly the same way, the following information provides some general guidelines to help you.

The face of the transducer must be in contact with the pipe because this is where the ultrasonic signal is emitted. All Panametrics transducers include a dimple, depression, or drill point on the side opposite the face, for use as a guide in aligning and securing the transducer. In addition, some transducers have scribe marks on the side to assist in setting the transducer spacing. Figure 46 below shows the two most commonly used transducers.

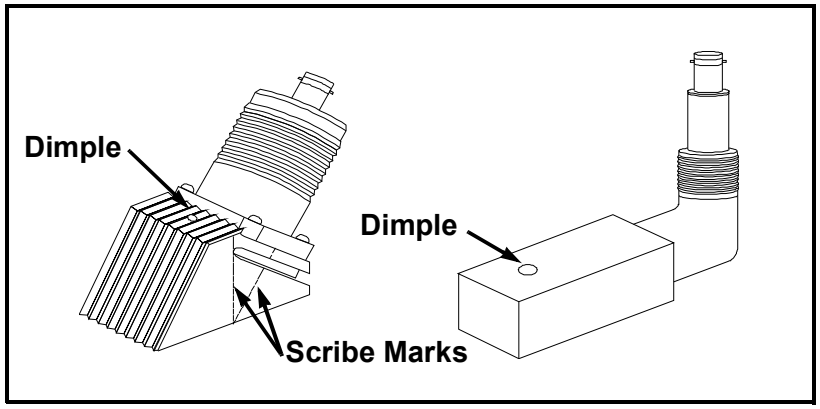
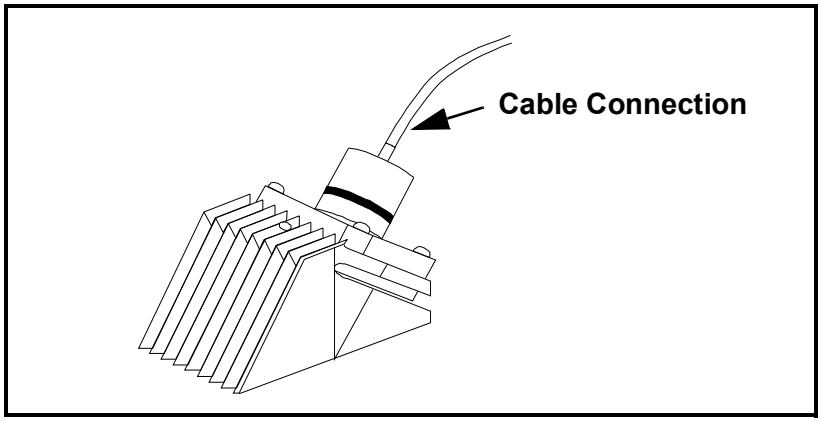


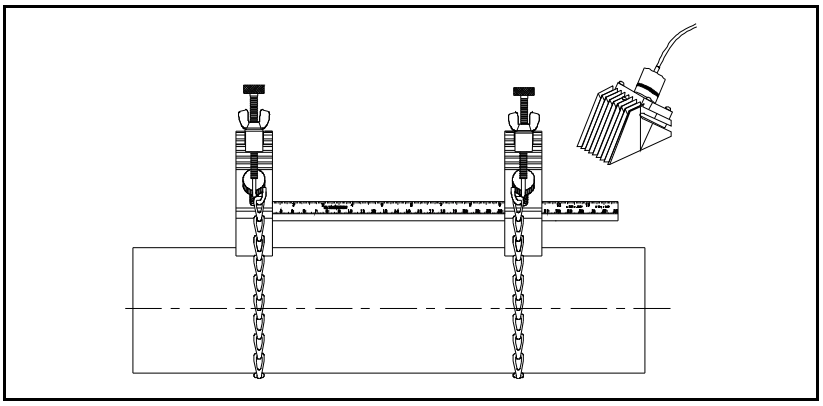
Figure 46: Transducer Dimples and Scribe Marks

To mount the transducers into the TransFlection Mode Clamping Fixture, complete the following steps:

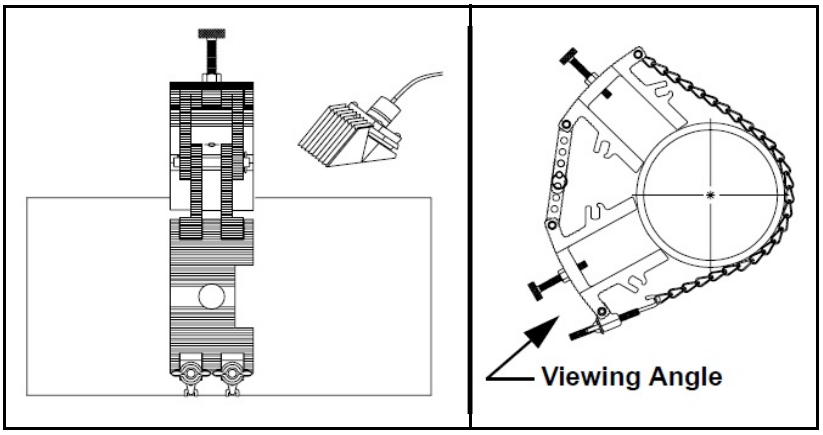
1. Connect the transducer cables to the BNC connectors on the transducers.



2. Apply a thin bead of couplant to the center of each transducer face. The couplant should not extrude from beneath the transducer when it is fastened to the pipe.



3. Slide the transducer into one of the blocks.



4. Use the pressure bolt to secure the transducer in place. The pressure bolt should fit into the dimple on the transducer. Hand tighten the bolt just enough to hold the transducer in place, but do not overtighten it or the block will lift off the pipe.
5. Repeat Steps 1-4 to mount the other transducer in the remaining block. See Figure 47 on the following page for completed typical TMCF installations.
6. Connect the other end of the transducer cables to the flowmeter electrical console (see your flowmeter manual for wiring instructions).

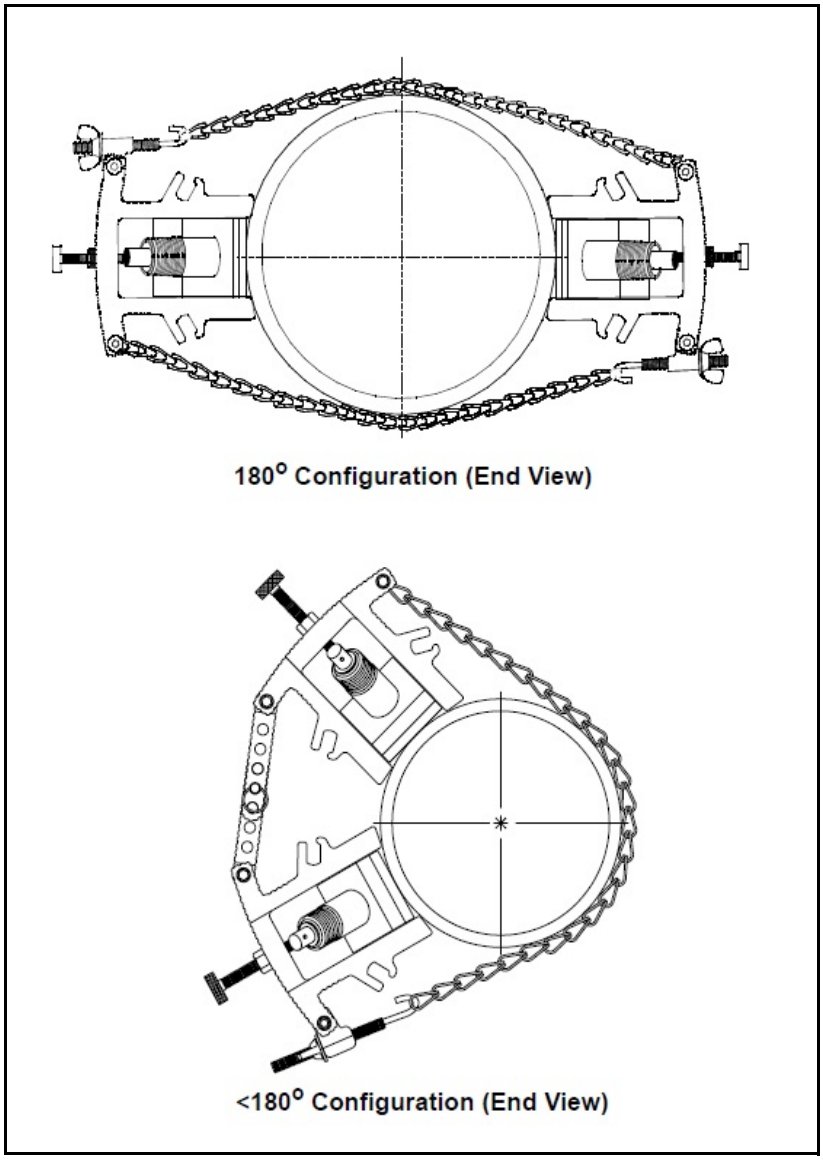


Figure 47: Completed TMCF Installations with Transducers

Note: *If you have mounted the transducers into the TMCF properly, the two transducer cable connectors will face away from each other as shown above.*

3.1.4.2 Tips for TransFlection Mode Installations

Follow these tips to set up your TransFlection mode installation and determine if the meter is operating properly:

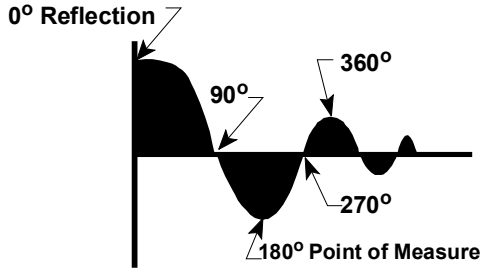
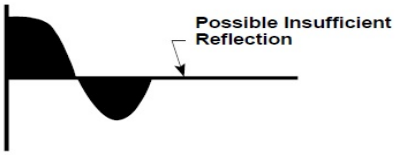
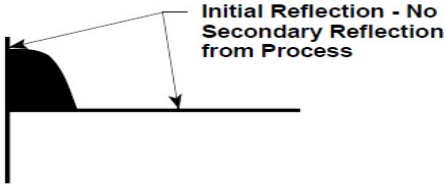
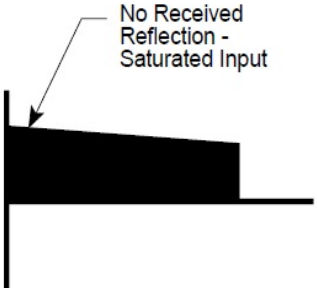
1. Make sure the process flow rate is not less than 1 ft/sec (0.3 m/sec)
2. Determine if the composition of your process fluid is:
   - Gas/Liquid
   - Liquid/Solid
   - Liquid/Soft Solid

If you know the composition of your process fluid, you can better determine the *"reflectivity"* of the ultrasonic transducer signal. The greater the ratio of the sound speeds (or densities) of the product phases, the more perfect the reflection becomes. Use Table 4 below to determine how well you can expect the signal to reflect

Table 4: TransFlection Mode Installation

Category	Ratio	Diagnostic Quality	Application Example
Gas to Liquid	300:1500 (1:5)	Good	Pump Cavitation/LNG
Liquid to Solid	500:1000 (1:2)	Intermediate	Coal Water Slurry
Liquid to Soft Solid	500:500 (1:1)	Challenging	Pulp Paper/ Waste Water

3. Measure the process using the transit time method first. If you have prior experience with the application, select the most suitable transit time method and transducers. If you have little or no experience with the application, try the following methods in the order listed until you get good results, then proceed to step 4:
   a. two-traverse with 1.0 MHz transducers
   b. single-traverse with 1.0 MHz transducers
   c. single-traverse with 0.5 MHz transducers.
4. If the transit time measurement:
   - ***Almost works*** –
     - install the *transducers* in the **180° configuration**
     - set the flowmeter *Depth of Reflection* to **50%**
     - set the flowmeter *Reynolds Correction* to **ON**
   - ***Does not work at all*** -
     - install the transducers in a **90° configuration**
     - set the flowmeter *Depth of Reflection* to **35-45%**
     - set the flowmeter *Reynolds Correction* to **OFF**
5. Check the transducer signal and refer to Table 5 below to determine the quality of your signal. If the signal quality is good, check the diagnostics against the values shown in Table 6 on page 75. If the signal quality is not good: install the transducers right next to each other, set the Depth of Reflection to 10-35%, and set the Reynolds Correction to OFF. Then, check the diagnostics again.

Evaluation	Graphic Image of TransFlection Signal
Ideal Great Application	
Possible Insufficient Reflection OK Application	
No Secondary Reflection Bad Application	
No Reflection Bad Application	

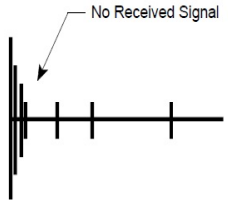
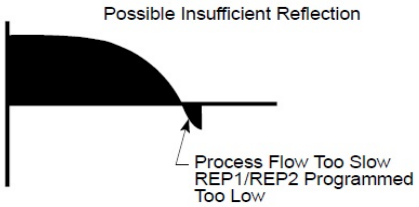
Evaluation	Graphic Image of TransFlection Signal
No Received Signal Bad Application	
Insufficient Reflection REP1/REP2 Programmi	

Table 5: Signal Quality determination

Diagnostic	Gas/ Liquid	Liquid/Solid	Liquid/ Soft Solid
RPWR	60 to 70	60 to 65	55 to 65
RQUAL	60 to 70	60 to 65	55 to 65
INCO1	±10%, maximum 15%		
INCO2	±10%, maximum 15%		
REP P	Within programmed limits of REP1 and REP2		

Note: *Use the dual display to view* RPWR *and* RQUAL *simultaneously. These diagnostics should be within ± 10% of each other. Do the same for* INCO1 *and* INCO2. *These diagnostics should also be within ± 10% of each other.*

6. Evaluate the results:

Table 6: Results Evaluation

If the Diagnostics are:	And the Signal Shape is:	Then the Flow Measurement is:
Within Range	Ideal to Good	Accurate*
Within Range	Irregular	Incorrect
Out of Range	Good	Incorrect
Out of Range	Irregular	Incorrect
*If the diagnostics and signal shape are good but the flow reading is lower than expected, this could be caused by too low a value entered as the *Depth of Reflection* (e.g. 10 to 35%). In these situations, the flow measurement is incorrect.		

[no content intended for this page]

Customer Support Centers

U.S.A.
The Boston Center
1100 Technology Park Drive
Billerica, MA 01821
U.S.A.

Tel: 800 833 9438 (toll-free)
978 437 1000

E-mail: panametricstechsupport@bakerhughes.com

Ireland
Sensing House
Shannon Free Zone East
Shannon, County Clare
Ireland

Tel: +353 61 61470200
E-mail: panametricstechsupport@bakerhughes.com

BH050C21 EN C