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Rev. BA

# Annubar<sup>®</sup> Averaging Pitot Tube Installation and Operation Manual



**Dieterich Standard**

A SUBSIDIARY OF ROSEMOUNT INC.

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**FISHER-ROSEMOUNT™** Managing The Process Better.™



## Annubar<sup>®</sup> Averaging Pitot Tube Installation and Operation Manual

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**IMPORTANT**

Procedures and instructions in this manual may require special precautions to ensure the safety of the personnel performing the operations. **Refer to the safety messages at the beginning of each section before performing any operations.**

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# Introduction

## USING THIS MANUAL

This product manual provides installation, configuration, calibration, troubleshooting, and maintenance instructions for the Annubar Flowmeter.

This section contains an explanation of each section of the manual, a flowchart for using the manual, and an installation checklist.

**Section 2: Installation Location and Orientation** explains initial inspection, operating limitations, and in what location and orientation to install the Annubar Flowmeter.

**Section 3: Hardware Installation for Annubar Regular (Threaded, Pak-Lok) — Models 1295R, DCR-15/16, 25/26, 35/36, 45/46** explains how to install the direct mounted regular Annubar model for liquid, gas or steam service.

**Section 4: Hardware Installation for Annubar Flanged — Models 1295F, DBF-15/16, 25/26, 35/36, 45/46** explains how to install the direct mounted flanged Annubar models for liquid, gas or steam service.

**Section 5: Hardware Installation for Annubar Pak-Lok Flanged — Models DPF-15/16, 25/26, 35/36, 45/46** explains how to install the direct mounted flanged Annubar models for liquid, gas or steam service.

**Section 6: Hardware Installation for Annubar Flo-Tap — Models DHF-15, 25, 35** explains how to install the direct mounted flanged Annubar models for liquid, gas or steam service.

**Section 7: Hardware Installation for Annubar Pak-Lok Flanged — Models DHT-15, 25, 35** explains how to install the direct mounted flanged Annubar models for liquid, gas or steam service.

**Section 8: Hardware Installation for Annubar Pak-Lok Flanged — Models DMT-15, 25, 35** explains how to install the direct mounted flanged Annubar models for liquid, gas or steam service.

**Section 9: Hardware Installation for Annubar In-Line — Models DNF-10, DNW-10, DNT-10** explains how to install the direct in-line series Annubar for liquid, gas or steam service.

**Section 10: Annubar Remote Mounting** explains how to install the remote mounted Annubar series flowmeter transmitter for liquid, gas or steam service.

**Section 11: Direct Mount Annubar Commissioning** describes how to commission a direct mounted Annubar flowmeter after installation.

**Section 12: Remote Mount Annubar Commissioning** describes how to commission a remote mounted Annubar flowmeter after installation.

**Section 13: Model 3051 Transmitter Optional RTD Maintenance** provides information on how to wire your integral or remote RTD and maintenance for integral RTDs.

**Section 14: Model 3095 Transmitter RTD Maintenance** provides information on how to wire your integral or remote RTD and maintenance for integral RTDs.

**Section 15: Troubleshooting** provides troubleshooting techniques for common operating problems associated with the Annubar flowmeter.

**Section 16: Specifications and Reference Data** provides specification data for the Annubar flowmeter series.

**Appendix A: Standard ODF Dimensions** provides mounting height dimensions necessary for installing the Annubar flowmeter.

## INSTALLATION CHECKLIST

The following list is a summary of the steps required to complete a Annubar flowmeter installation. If this is an entirely new installation, begin with step 1. If the mounting is already in place, verify that the hole size and the fittings match the recommended specifications, and begin with step 5.

1. Determine where the Annubar is to be placed within the piping system.
2. Establish the proper orientation as determined by the intended Annubar service for the flowmeter.
3. Review **Appendix D: Approval Drawings** if the flowmeter is located in a hazardous location.
4. Confirm the Annubar configuration.
5. Drill the correct size hole in the pipe.
  - For Annubar models equipped with opposite-side support, drill a second, identical hole 180 degrees from the first hole.
6. Weld the mounting, and clean the burrs and welds.
7. Measure the pipe's internal diameter (ID), preferably at 1 x ID from the hole (upstream or downstream).

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### NOTE

Providing the pipe internal diameter at the time of purchase is necessary to maintain published flowmeter accuracy.

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8. Check the fit-up of the Annubar assembly to the pipe.
9. Install the flowmeter.
10. Wire the Annubar transmitter.
11. Supply power to the flowmeter.
12. Perform a zero trim for mounting effects.
13. Check for leaks.
14. Commission the Annubar.

# Installation Location and Orientation

This section describes the orientation, location, and alignment limits for installing the Annubar flowmeter. Read it thoroughly before any installation is performed.

## RECEIVING AND INSPECTION

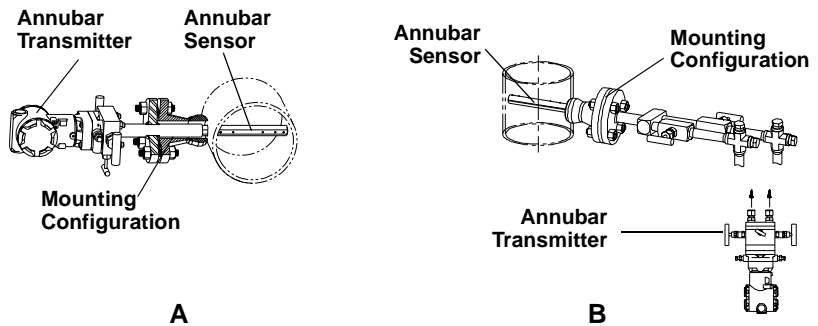
Annubar flowmeters are available in different models and with different options, so it is important to inspect and know which model you have before beginning installation.

Upon receipt of the shipment, check the packing list against the material received and the purchase order. All items are tagged with a model number, serial number, and customer tag number. Report any damage to the carrier.

## ANNUBAR CONFIGURATIONS

The Annubar is available in a variety of mounting configurations and has two methods of electronic mounting: integral mount (or, *direct mount*) and remote mount. An integrally-mounted Annubar may be shipped with the transmitter already bolted directly to the sensor.

FIGURE 2-1.  
Annubar Mounting Configuration  
Examples: A (Integral Mount)  
and B (Remote Mount).



8900-8900V30A, 8900\_28A

## BOLTING A TRANSMITTER TO THE ANNUBAR

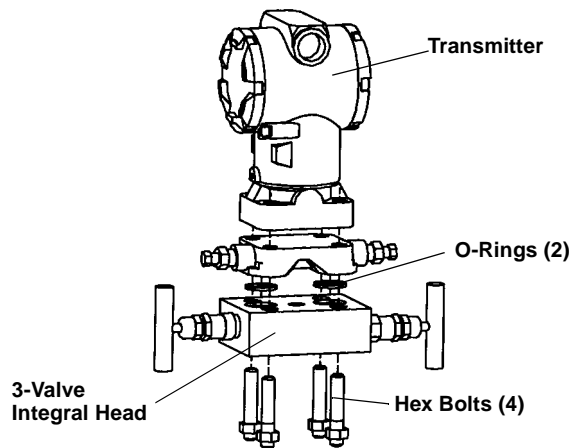
If your integral mount Annubar is shipped without a transmitter previously attached, you will have to assemble the Annubar to the transmitter. Follow the instructions below according to the type of manifold and sensor size used with the Annubar.

### 3-Valve Manifolds

#### Sensor Sizes of 15/16, 25/26, 35/36

1. Place the o-rings between the transmitter and the manifold head.
2. Insert hex bolts.
3. Tighten the bolts in a cross pattern, using the appropriate torque.
  - Torque lubricated stainless steel threaded bolts to 300 in-lbs.
  - Torque non-lubricated carbon steel threaded bolts to 650 in-lbs.

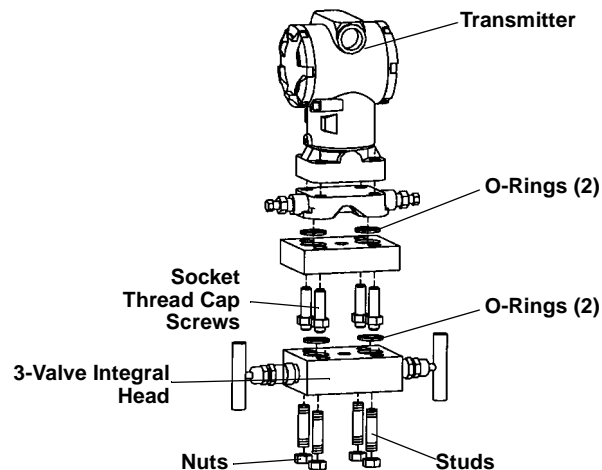
FIGURE 2-2.  
Transmitter Installation for Integral Mount 3-Valve Manifold Used With Sensor Size of 15/16, 25/26, 35/36.



#### Sensor Size of 45/46

1. Place the o-rings between the transmitter and the adapter.
2. Place o-rings between the Annubar manifold head and the adapter.
3. Install the socket head cap screws.
  - Torque lubricated stainless steel cap screws to 300 in-lbs.
4. Install the stainless steel studs.
5. Torque the nuts to 300 in-lbs.

FIGURE 2-3.  
Transmitter Installation for Integral Mount 3-Valve Manifold Used With Sensor Size of 45/46.

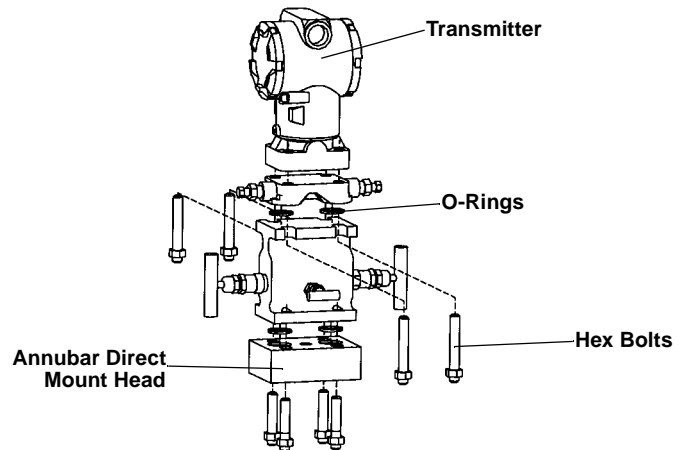


## 5-Valve Manifolds

### Sensor Sizes of 15/16, 25/26, 35/36

1. Place o-rings between the transmitter and the manifold head.
2. Insert the hex bolts.
3. Tighten the hex bolts in a cross pattern, using the appropriate torque.
  - Torque lubricated stainless steel threaded hex bolts to 300 in-lbs.
  - Torque non-lubricated carbon steel threaded hex bolts to 650 in-lbs.

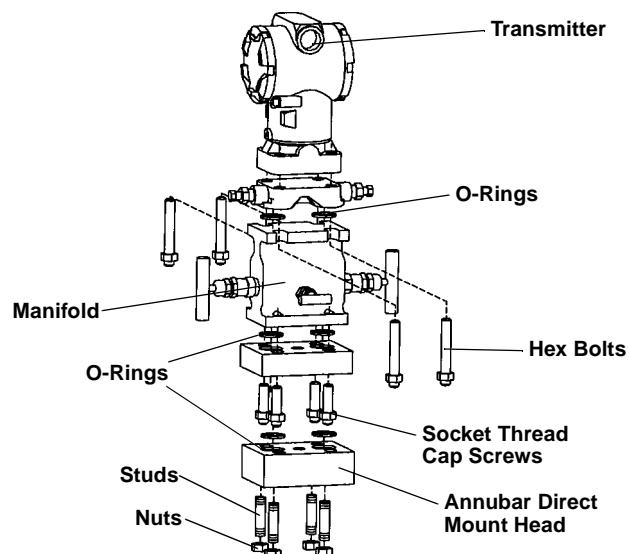
FIGURE 2-4.  
Transmitter Installation for Integral Mount 5-Valve Manifolds Used With Sensor Sizes of 15/16, 25/26, or 35/36.



### Sensor Size of 45/46

1. Place the o-rings between the transmitter and the adapter.
2. Place o-rings between the Annubar manifold head and the adapter.
3. Install the socket head cap screws.
  - Torque lubricated stainless steel threaded cap screws to 300 in-lbs.
4. Install the stainless steel studs.
5. Torque the nuts to 300 in-lbs.

FIGURE 2-5.  
Transmitter Installation for Integral Mount 5-Valve Manifold Used With Sensor Size of 45/46.



**STRUCTURAL LIMITATIONS**

**CAUTION**

Structural limitations are printed on the Annubar sensor tag. Exceeding the Annubar structural limitations may cause the sensor to fail.

**FUNCTIONAL LIMITATIONS**

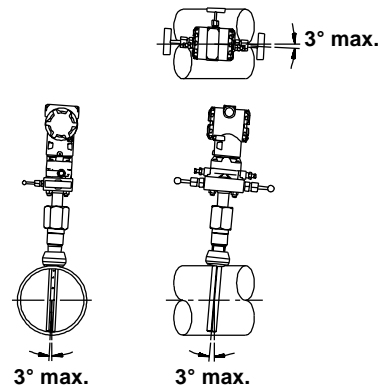
The Annubar best produces accurate and repeatable flow measurement under the following conditions:

- The maximum differential pressure, as printed on the tag attached to the Annubar, is not exceeded.
- The Annubar is not used for two-phase flow or for steam service below saturation temperature.

Install the Annubar in the correct location within the piping branch to prevent measurement inaccuracies caused by flow disturbances.

Annubar installation allows for a maximum misalignment of 3 degrees, as illustrated in Figure 2-6. Misalignment beyond 3 degrees will cause errors in flow measurement.

FIGURE 2-6. Permissible Misalignment for the Annubar.



8900-8900V14A

**Straight Run Requirements**

Use Table 2-1 to determine the proper Annubar straight run requirements.

**NOTES**

For gas service, multiply values from Table 2-1 by 1.5.

If longer lengths of straight run are available, position the Annubar where 80% of the run is *upstream* of the Annubar and 20% is downstream.

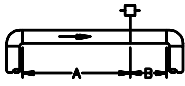
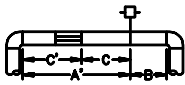
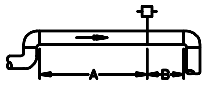
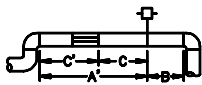
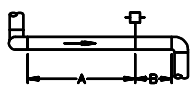
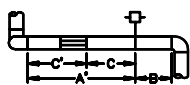
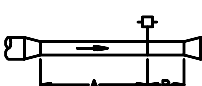

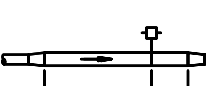

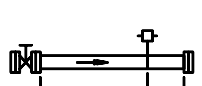

Information contained in this manual applies to circular pipes *only*. Consult the factory for instructions regarding Annubar use in square or rectangular ducts.

Straightening vanes may be used to reduce the required straight run length and will improve performance.

Row 6 in Table 2-1 applies to gate, globe, plug, and other throttling valves that are partially opened. If a “through-type” valve will remain open, use the values shown in Row 5. Refer to Row 6 for the straight run requirements of a Annubar located downstream of the control valve.



TABLE 2-1. Straight Run Requirements.

		Upstream dimension					Downstream Dimensions
		Without vanes		With vanes			
		In plane A	Out of plane A	A'	C	C'	
1.		8	10	-	-	-	4
		-	-	8	4	4	4
2.		11	16	-	-	-	4
		-	-	8	4	4	4
3.		23	28	-	-	-	4
		-	-	8	4	4	4
4.		12	12	-	-	-	4
		-	-	8	4	4	4
5.		18	18	-	-	-	4
		-	-	8	4	4	4
6.		30	30	-	-	-	4
		-	-	8	4	4	4

## ENVIRONMENTAL CONSIDERATIONS

Location of the Annubar in pulsating flow will cause a noisy signal. Vibration can also distort the output signal and comprise the structural limits of the flowmeter. Mount the Annubar in a secure run of pipe as far as possible from pulsation sources such as check valves, reciprocating compressors or pumps, and control valves.

Mount the transmitter to minimize ambient temperature changes.

**Section 12: Specifications and Reference Data** lists the temperature operating limits. Mount the transmitter to avoid vibration and mechanical shock; mounting will also avoid external contact with corrosive materials. See **Section 8: Annubar Electronics Functions** for environmental considerations.

## Annubar Orientation

Proper venting or draining must be considered when selecting a location.

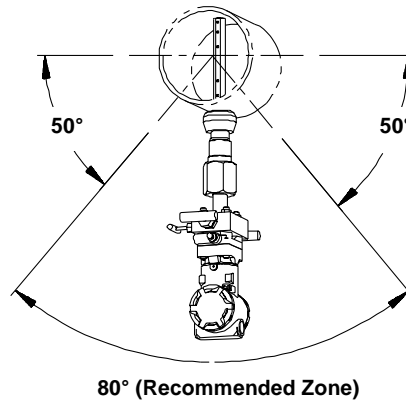
For *liquid service*, mount the side drain/vent valve upward; this allows gases to vent. For *gas service*, mount the drain/vent valve down to allow any accumulated liquid to drain. In *steam service*, fill lines with water to prevent contact of the live steam with the electronics; condensate chambers are not needed because the volumetric displacement of the electronics is negligible.

Annubar instrument head connections differ on horizontal and vertical pipes. Refer to the specification **head code number** to confirm the proper pipe orientation for your Annubar.

### Horizontal Pipe: Liquid or Steam Application

Due to the possibility of air getting trapped in the probe, the Annubar should be located per the drawing below. The area between 0° and 50° (50° angle) should not be used unless full bleeding of air from the probe is possible. Figure 2-7 illustrates the recommended location of the flowmeter.

FIGURE 2-7.  
Liquid or Steam Service  
in a Horizontal Pipe.

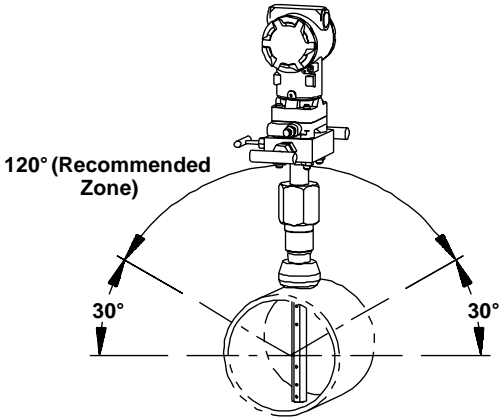


8900-8900V15A

**Horizontal Pipe:  
Air and Gas Applications**

The Annubar should be located on the upper half of the pipe, at least 30° above the horizontal line. Figure 2-8 illustrates the recommended location of the flowmeter.

FIGURE 2-8.  
Air and Gas Applications  
in a Horizontal Pipe.

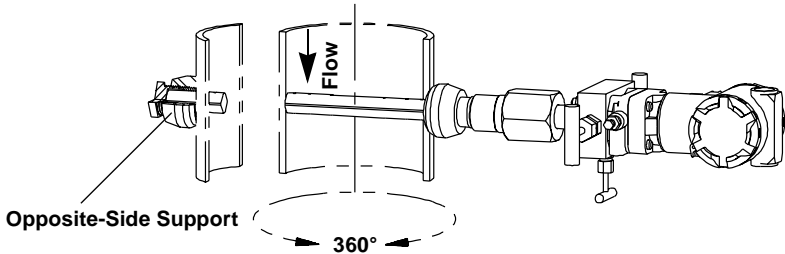


8900-8900V16A

**Vertical Pipe: Liquid, Air,  
Gas, and Steam Applications**

The Annubar can be installed in any position around the circumference of the pipe, provided the vents are positioned properly for bleeding or venting. Vertical pipe installations require more frequent bleeding or venting depending on the location. Figure 2-9 illustrates the recommended location of the flowmeter.

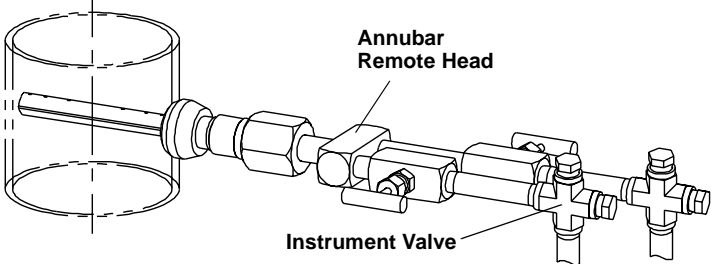
FIGURE 2-9.  
Liquid, Air, and Gas Applications  
in a Vertical Pipe.



8900-8900V19A

Remote mounting is required for steam installations; see Figure 2-10.

FIGURE 2-10.  
Steam Service in a Vertical Pipe.



8900-8900\_04A

## Process Connections (Remote Mounted Annubar only)

The Annubar process connections on the electronics flange are  $\frac{1}{4}$ -18 NPT. Flange adapter unions with  $\frac{1}{2}$ -14 NPT connections are supplied as standard with the remote mounted Annubar. The threads are Class 2; use your plant-approved lubricant or sealant when making the process connections. The process connections on the electronics flange are on  $2\frac{1}{8}$ -inch (54 mm) centers to allow direct mounting to a three-valve or five-valve manifold. Rotate one or both of the flange adapters to attain connection centers of 2 inches (51 mm),  $2\frac{1}{8}$  inches (54 mm), or  $2\frac{1}{4}$  inches (57 mm).

**⚠** Install and tighten all four flange bolts before applying pressure, or process leakage will result. When properly installed, the flange bolts will protrude through the top of the module housing. Do not attempt to loosen or remove the flange bolts while the Annubar is in service.

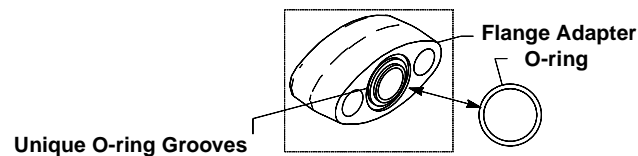
Perform the following procedure to install adapters to a coplanar flange:

1. Remove the flange bolts.
2. Leaving the flange in place, move the adapters into position with the o-ring installed.
3. Clamp the adapters and the coplanar flange to the transmitter module using the larger of the bolts supplied.
4. Tighten the bolts. Refer to **Mounting Bolts** on page 2-9 for torque specifications.

### **⚠ WARNING**

Failure to install proper flange adapter O-rings can cause process leaks, which can result in death or serious injury.

The flange adapters require a unique O-ring, as shown below.




When compressed, Teflon<sup>®</sup> O-rings tend to cold flow, which aids in their sealing capabilities. Whenever you remove flanges or adapters, visually inspect the Teflon O-rings. Replace them if there are any signs of damage, such as nicks or cuts. If they are undamaged, you may reuse them. If you replace the O-rings, retorque the flange bolts after installation to compensate for cold flow. Refer to the process sensor body reassembly procedure in **Section 15 Troubleshooting**.

**Mounting Bolts**

The following guidelines have been established to ensure a tight flange, adapter, or manifold seal. The Annubar is shipped with the Coplanar flange installed with four 1.75-inch flange bolts. The following bolts also are supplied to facilitate other mounting configurations:

**Bolt Installation**

 Only use bolts supplied with the Annubar or sold by Rosemount Inc. as spare parts for the Annubar. Use the following bolt installation procedure:

- 1. Finger-tighten the bolts.
- 2. Torque the bolts to the initial torque value using a cross-pattern (see [Table 2-2](#) for torque values).
- 3. Torque the bolts to the final torque value using the same cross-pattern.

TABLE 2-2. Bolt Installation Torque Values.

Bolt Material	Initial Torque Value	Final Torque Value
Carbon Steel (CS)	300 in-lb (34 N-m)	650 in-lb (73 N-m)
Stainless Steel (SST)	150 in-lb (17 N-m)	300 in-lb (34 N-m)



## Hardware Installation for Annubar Regular (Threaded, Pak-Lok)

### ANNUBAR MODELS:

DCR+15S/16S

DCR+25S/26S

DCR+35S/36S

DCR+45S/46S

This section provides hardware installation instructions for the Annubar Regular (Threaded, Pak-Lok) for service in either a horizontal or vertical pipe. Installation procedures are similar for all services. Service-specific instructions are provided where necessary; otherwise, all instructions in this section apply to all services.

If remote mounting of the transmitter is required, use this section for hardware installation. Then, see **Section 10: Annubar Remote Mounting** for transmitter installation.

- The direct mount maximum service temperature is 500 °F (260 °C).
- The transmitter must be remote mounted when service temperatures exceed 500 °F (260 °C).
- Annubar models with a sensor size of 15 or 16 require remote mounted transmitter. After installing the sensor, see **Section 6: Annubar Remote Mounting** for electronics installation instructions.
- Annubar models with a sensor size of 45 or 46 are shipped with a packing guide cover instead of a compression nut.

### SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

#### WARNING

##### Explosions could result in death or serious injury:

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

#### WARNING

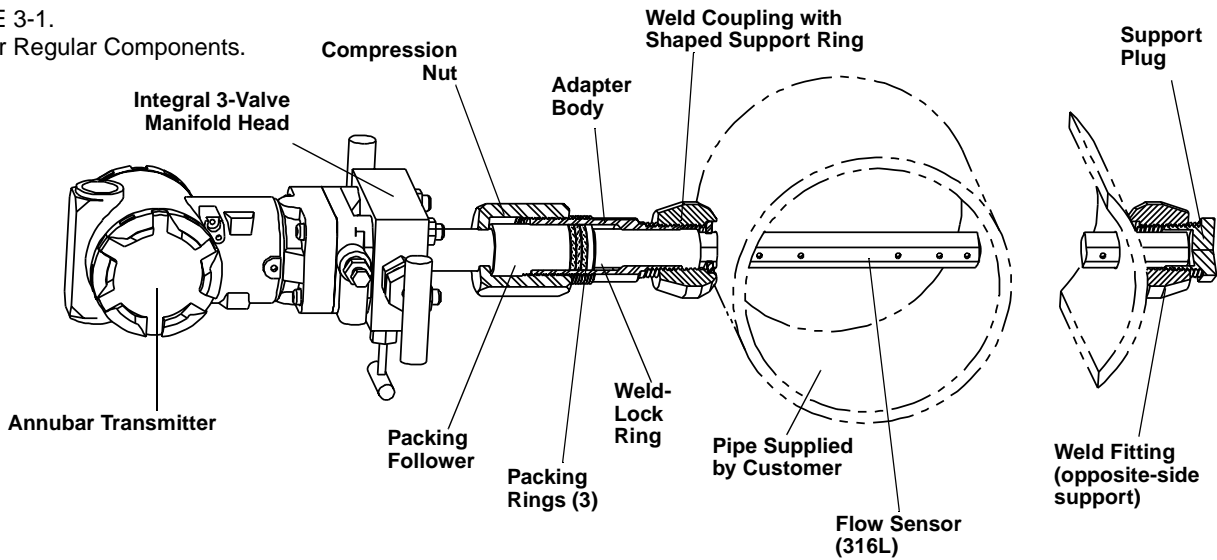
##### Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.

## ANNUBAR REGULAR COMPONENTS

Figure 3-1 identifies the components of the Annubar Regular. The flowmeter is shown in this position for hardware clarity; see the actual installation instructions for proper positioning of the flowmeter.

FIGURE 3-1.  
Annubar Regular Components.



8900-8900V18A

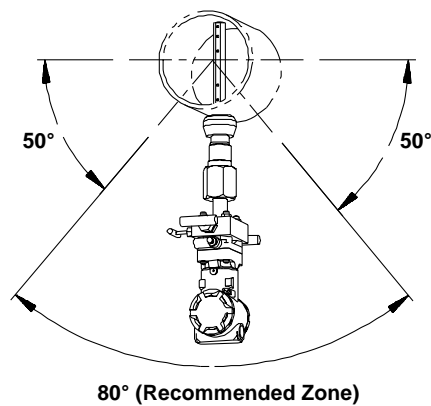
### STEP 1: DETERMINE THE PROPER ANNUBAR ORIENTATION

Orientation of the Annubar depends upon two factors: the orientation of the pipe that will receive the flowmeter, and the service that uses the pipe. The following sections provide illustrations of the possible pipe orientations and services. After determining the flowmeter's orientation, proceed with step 2 on page 3-5.

#### Liquid Service in a Horizontal Pipe

Install the flowmeter within 40 degrees of the vertical axis to prevent air from becoming entrapped within the probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 3-2 illustrates the recommended location for the Annubar when used with liquid service.

FIGURE 3-2.  
Liquid Service in a Horizontal Pipe.



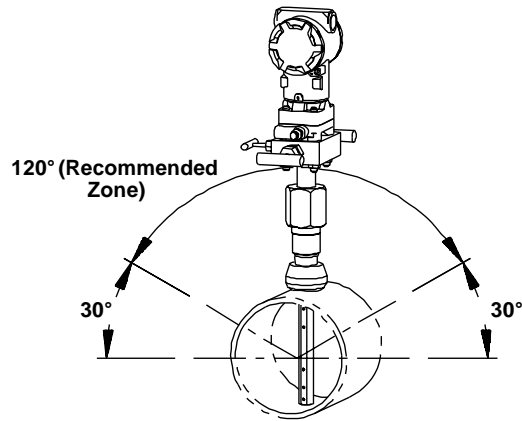
8900-8900V15A



### Gas Service in a Horizontal Pipe

Install the flowmeter in the upper half of the pipe, *but not within 30 degrees of the horizontal axis*, as shown in Figure 3-3 below. This orientation prevents condensate from becoming entrapped in the sensor probe.

FIGURE 3-3.  
Gas Service in a Horizontal Pipe.

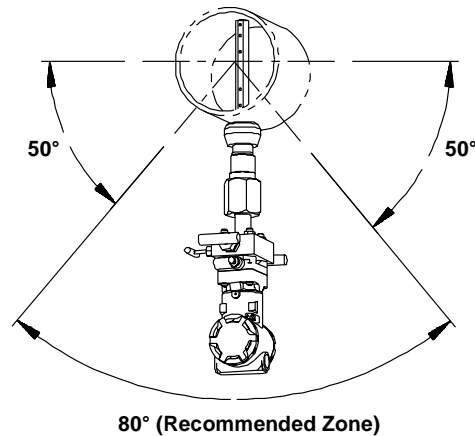


8900-8900V16A

### Steam Service in a Horizontal Pipe

Install the flowmeter within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 3-4 illustrates the recommended location for the Annubar when used with steam service.

FIGURE 3-4.  
Steam Service in a Horizontal Pipe.

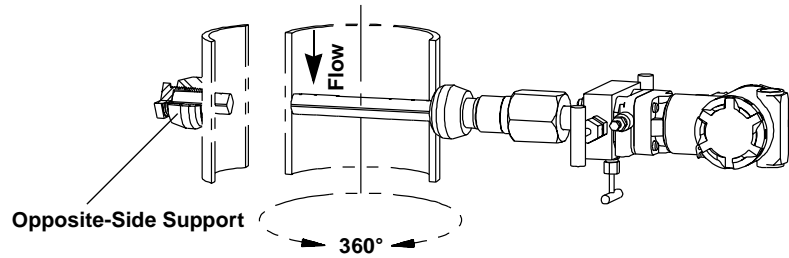


8900-8900V15A

### Liquid or Gas Service in a Vertical Pipe

Install the flowmeter anywhere around the circumference of the pipe, as shown in Figure 3-5. The Annubar transmitter runs in the opposite direction of the process flow.

FIGURE 3-5.  
Liquid or Gas Service  
in a Vertical Pipe.

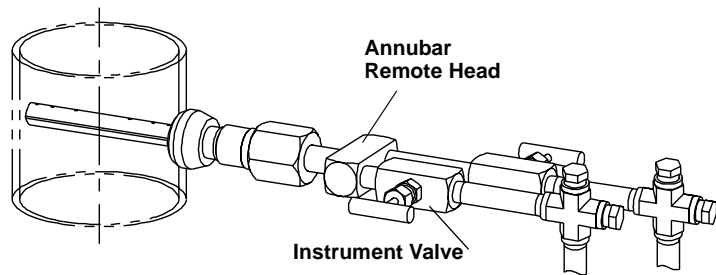


8900-8900V19A

### Steam Service in a Vertical Pipe

Install the flowmeter anywhere around the circumference of the pipe, as shown in Figure 3-6. The Annubar transmitter must be remote mounted. See **Section 6: Annubar Remote Mounting** for instructions.

FIGURE 3-6.  
Steam Service in a Vertical Pipe.



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### SHIPPING NOTE

All Annubar Regular models are shipped with the Annubar sensor pre-assembled and the Pak-Lok nut, follower, and lock ring in place. The factory-supplied weld fitting with support ring is required to install the Annubar. To prevent injury, remove pressure and drain pipe before installing or removing the sensor.

**STEP 2:  
DRILL THE HOLE  
IN THE PIPE**

Follow the steps below to drill the hole in the pipe.

1. Depressurize and drain the pipe.
2. Select the location for the hole you are about to drill.  
Select a location anywhere around the circumference of the pipe for vertical pipes.  
For horizontal pipes, the hole location depends upon the service for which the Annubar is to be used:
  - *Liquid service*: drill the hole along the *bottom* of the pipe
  - *Gas service*: drill the hole along the *top* of the pipe
  - *Steam service*: drill the hole along the *bottom* of the pipe
3. Determine the diameter of the hole to be drilled. Use the chart in Figure 3-7.
4. After the hole is drilled, deburr the hole on the inside of the pipe.

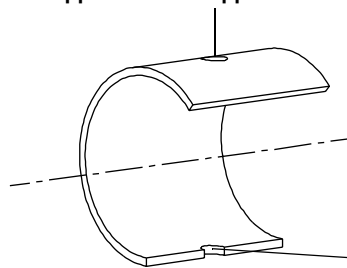
**Drill a Hole for  
Opposite-Side Support**

A second hole must be drilled for the opposite-side support weld coupling if opposite-side support is supplied. This hole must be the same diameter as the first hole; place it directly opposite the first hole so that the sensor can pass completely through the pipe. Use the following steps to find the location for the second hole:

1. Wrap a piece of soft wire or string around the pipe to measure the pipe's circumference.
2. Remove the wire or string and measure half of the circumference length.
3. Re-wrap the half-length around the pipe from the center of the first hole.
4. Mark the center of what will become the second hole, as shown in Figure 3-7.

FIGURE 3-7.  
Sensor Size/Hole Diameter Chart.

**Note: Drill the hole 180 degrees from the first hole for opposite-side support models.**



Drill	
Sensor	Diameter (in.)
15/16	7/16
25/26	7/8
35/36	1-5/16
45/46	2-1/8

8900-8900\_15A

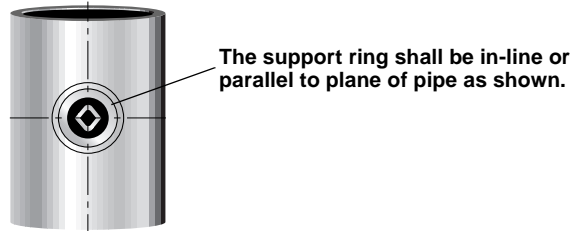
5. Deburr the drilled hole on the inside of the pipe.

### STEP 3: TACK WELD THE FITTINGS TO THE PIPE

Follow these steps to tack weld the fittings to the pipe:

1. Insert the Annubar assembly into the factory-supplied weld fitting (with integral support ring), then into the hole.
2. Align the head and transmitter so they are parallel with the ground.
3. Tack weld the fitting(s) to the pipe and remove the Annubar. See Figure 3-8 below.

FIGURE 3-8.  
Tack Weld the Fittings to the Pipe.



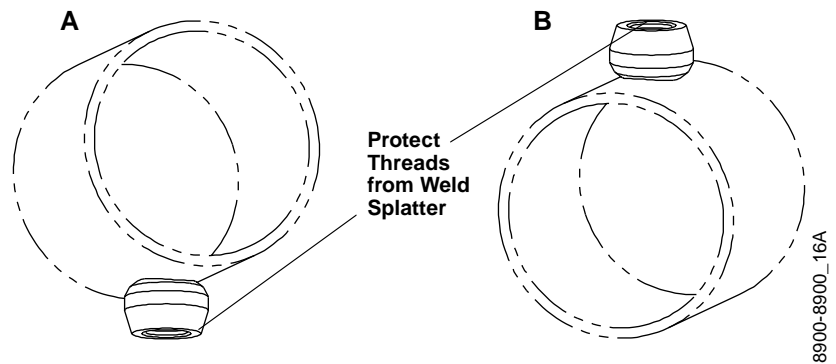
8900-8900V20A

#### NOTE

The larger radius in Figure 3-8 must be parallel to the centerline of the pipe.

To protect the weld fitting threads from weld splatter, wrap the factory-supplied heavy aluminum foil around the threads before welding, or use a thread protector cap, as shown in Figure 3-9. Be sure to allow the mounting to cool or serious burns may occur.

FIGURE 3-9.  
Protect Threads from Weld Splatter:  
A (Liquid or Steam Service) and  
B (Gas Service).



8900-8900\_16A

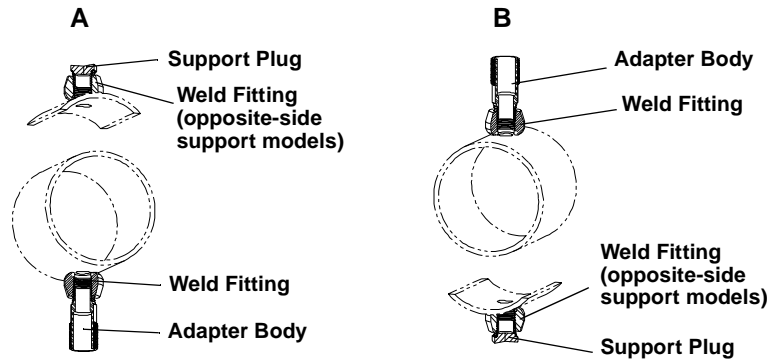
**STEP 4:  
INSERT THE ANNUBAR  
INTO THE PIPE**

After the mounting hardware has cooled, install the adapter body and support plug (if required), as shown in Figure 3-10. Use a sealant compound rated for use at the process temperature on the threads.

**NOTE**

The adapter body must be threaded into the weld fitting *before* the Pak-Lok nut is threaded onto the adapter body.

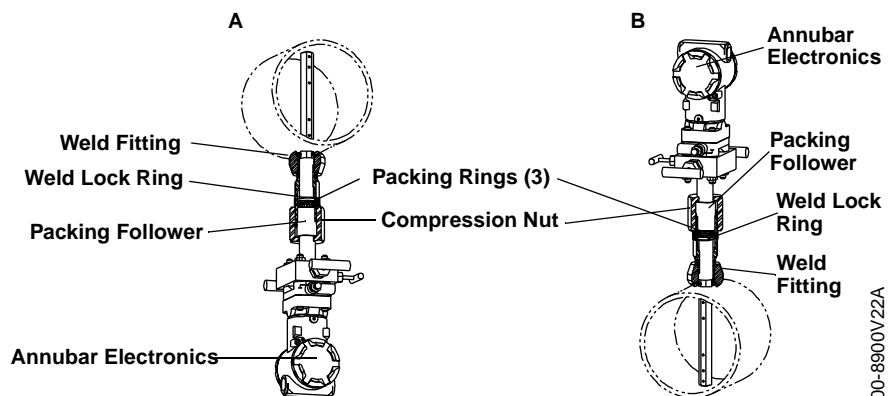
FIGURE 3-10.  
Adapter Body and Support Plug  
Installation: A (Liquid or Steam  
Service) and B (Gas Service).



8900-8900\_01A

1. Mark the tip of the Annubar sensor with a marker.
2. Insert the flowmeter into the adapter body until the sensor tip contacts the pipe wall (or support plug).
3. Remove the flowmeter.
4. Verify that the sensor tip touched the pipe wall. *If the tip did not touch the wall, adjust the adapter body until sensor tip touches the wall, and re-install the Annubar.*
5. Install the first packing ring on the Annubar between the lock ring and the packing follower; take care not to damage the split packing rings.
6. Push the packing ring into the adapter body and against the weld-lock ring. Repeat this process for the two remaining rings, alternating the location of the packing ring split by 180 degrees. Figure 3-11 illustrates the Annubar insertion process described here.

FIGURE 3-11.  
Packing Ring Installation: A (Liquid or  
Steam Service) and B (Gas Service).



8900-8900V22A

**NOTE**

If the Annubar appears to be too long, go back to step 3. Verify that the adapter body was installed into the weld fitting before the Annubar was installed.

---

7. With the flow arrow on the Annubar head pointed in the direction of the pipe flow, thread the Pak-Lok nut onto the adapter fitting until it is *hand tight only*.
  8. Use a wrench to tighten the Pak-Lok nut in  $\frac{1}{4}$  turn increments until it has been tightened one full turn. The Pak-Lok nut should be tightened only enough to prevent leakage. Do not overtighten the Pak-Lok nut; damage to the sensor will result.
- 

**NOTE**

Use a maximum of  $1\frac{1}{4}$  turns when installing the sensor. *This is critical when installing Annubar models with a sensor size of 15 or 16.*

---

## Hardware Installation for Annubar Flanged

### ANNUBAR MODELS:

DFF+15S/16S

DFF+25S/26S

DFF+25H/26H

DFF+25M/26M

DFF+35S/36S

DFF+45S/46S

DFF+45H/46H

DFF+45M/46M

This section provides hardware installation instructions for the Annubar Flanged for service in either a horizontal or vertical pipe. Installation procedures are similar for all services. Service-specific instructions are provided where necessary; otherwise, all instructions in this section apply to all services.

If remote mounting of the transmitter is required, use this section for hardware installation. Then, see **Section 10: Annubar Remote Mounting** for transmitter installation.

- The direct mount maximum service temperature is 500 °F (260 °C).
- The transmitter must be remote mounted when service temperatures exceed 500 °F (260 °C).

### SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

#### **WARNING**

##### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

#### **WARNING**

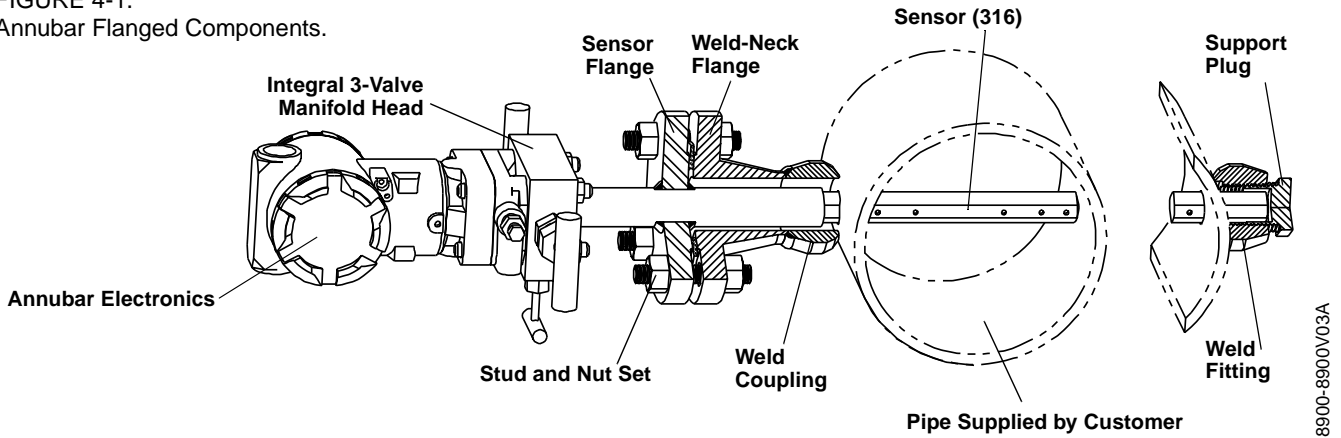
##### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

**ANNUBAR FLANGED COMPONENTS**

Figure 4-1 identifies the components of the Annubar Flanged.

FIGURE 4-1. Annubar Flanged Components.



8900-8900V03A

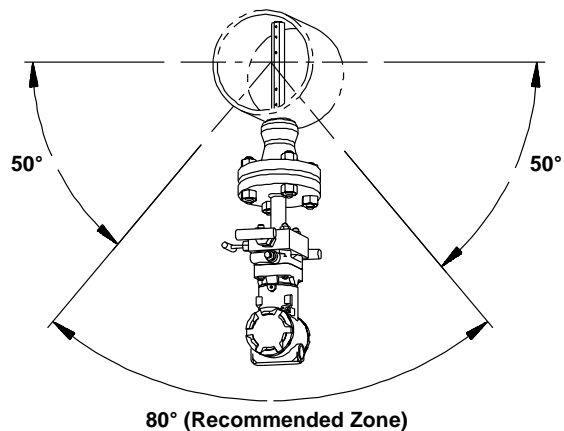
**STEP 1:  
DETERMINE THE PROPER  
ORIENTATION OF  
THE ANNUBAR**

The orientation of the flowmeter depends upon two factors: the orientation of the pipe that will receive the flowmeter, and the service that uses the pipe. The following sections provide illustrations of the possible pipe orientations and services. After determining the flowmeter's orientation, proceed with step 2 on page 4-4.

**Liquid Service in a  
Horizontal Pipe**

Install the flowmeter within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 4-2 illustrates the recommended location for the Annubar when used with liquid service.

FIGURE 4-2. Liquid Service in a Horizontal Pipe.



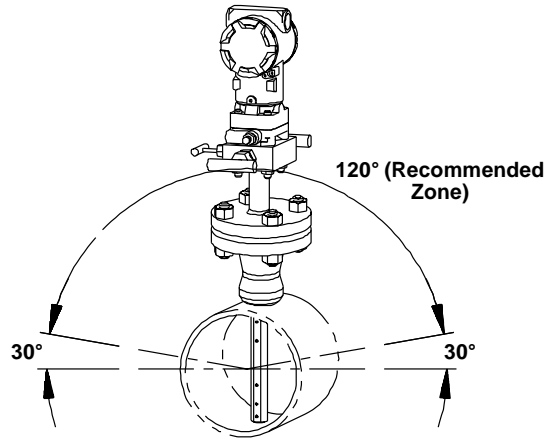
8900-8900V04A



### Gas Service in a Horizontal Pipe

Install the flowmeter in the upper half of the pipe, *but not within 30 degrees of the horizontal axis*, as shown in Figure 4-3. This will prevent condensate from becoming entrapped in the sensor probe.

FIGURE 4-3.  
Gas Service in a Horizontal Pipe.

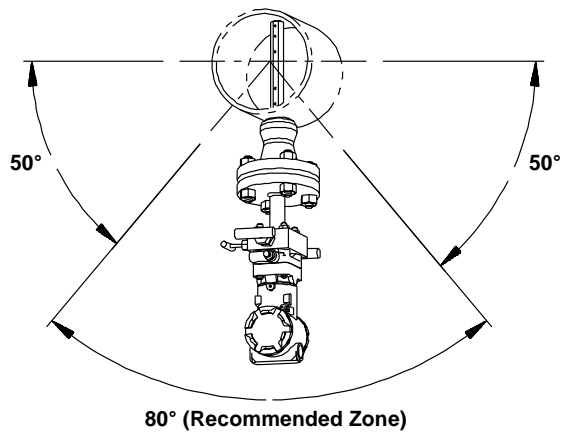


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### Steam Service in a Horizontal Pipe

Install the flowmeter within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 4-4 illustrates the recommended location for the Annubar when used with steam service.

FIGURE 4-4.  
Steam Service in a Horizontal Pipe.

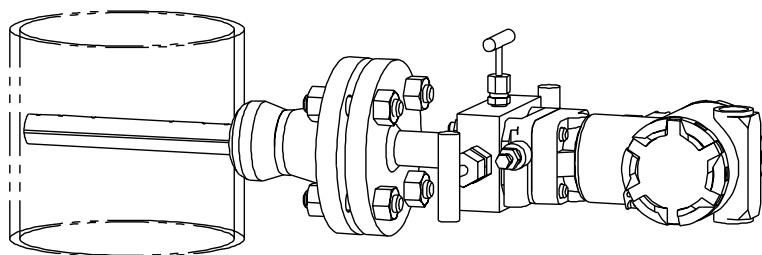


8900-8900V04A

### Liquid or Gas Service in a Vertical Pipe

Install the flowmeter anywhere around the circumference of the pipe, as shown in Figure 4-5 below. The Annubar transmitter runs in the opposite direction of the process piping.

FIGURE 4-5.  
Liquid or Gas Service in a Vertical Pipe.

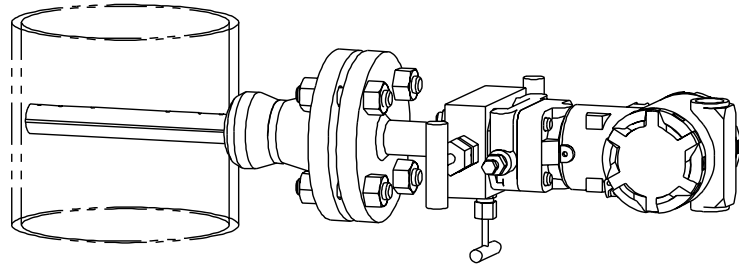


8900-8900V10A

## Gas Service in a Vertical Pipe

Install the flowmeter anywhere around the circumference of the pipe, as shown in Figure 4-6 below. The Annubar electronics run in the opposite direction of the process piping.

FIGURE 4-6.  
Gas Service in a Vertical Pipe.

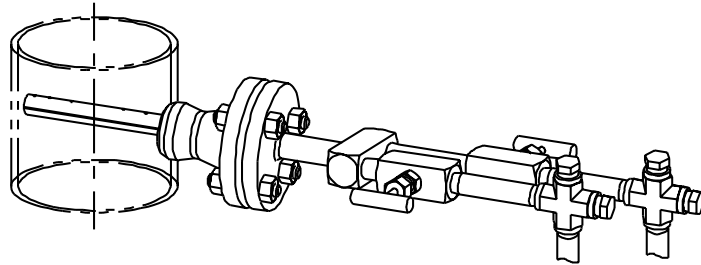


8900-8900V11A

## Steam Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 4-7. The Annubar transmitter must be remote mounted. See **Section 6: Annubar Remote Mounting** for instructions.

FIGURE 4-7.  
Steam Service in a Vertical Pipe.



8900-8900\_05A

## SHIPPING NOTE

All Annubar Flanged models are shipped with the weld fitting and weld-neck flange pre-welded for ease of installation. To prevent injury, remove pressure and drain the pipe before installing or removing the sensor.

## STEP 2: DRILL THE HOLE IN THE PIPE

Follow the steps below to drill the hole in the pipe.

1. Depressurize and drain the pipe.
2. Select the location for the hole you are about to drill.  
Select a location anywhere around the circumference of the pipe for vertical pipes.  
For horizontal pipes, the hole location depends upon the service for which the Annubar is to be used:
  - *Liquid service:* drill the hole along the *bottom* of the pipe
  - *Gas service:* drill the hole along the *top* of the pipe
  - *Steam service:* drill the hole along the *bottom* of the pipe
3. Use the chart in Figure 4-8 to determine the diameter of the hole to be drilled.
4. After the hole is drilled, deburr the hole on the inside of the pipe.

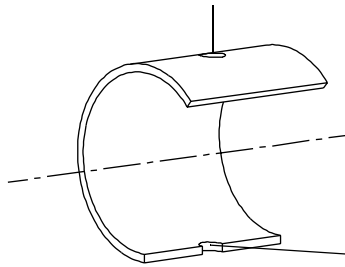
## Drill a Hole for Opposite-Side Support

A second hole must be drilled for the opposite-side support weld coupling if opposite-side support is supplied. This hole must be the same diameter as the first hole; place it directly opposite the first hole so that the sensor can pass completely through the pipe. Use the following steps to find the location for the second hole:

1. Wrap a piece of soft wire or string around the pipe to measure the pipe's circumference.
2. Remove the wire or string and measure half of the circumference length.
3. Re-wrap the half-length around the pipe from the center of the first hole.
4. Mark the center of what will become the second hole, as shown in Figure 4-8.

FIGURE 4-8.  
Sensor Size/Hole Diameter Chart.

**Note:** Drill the hole 180 degrees from the first hole for opposite-side support models.



Drill	
Sensor	Diameter (in.)
15/16	$\frac{7}{16}$
25/26	$\frac{7}{8}$
35/36	$1\frac{5}{16}$
45/46	$2\frac{1}{8}$

Drill the appropriate diameter hole through the pipe wall.

8900-8900\_15A

5. Deburr the drilled hole on the inside of the pipe.

## STEP 3: WELD THE WELD-NECK FLANGE

Weld the weld-neck flange and weldolet assembly to the pipe. See **Appendix A: Standard ODF Dimensions** for the proper ODF.

## STEP 4: ASSEMBLE THE ANNUBAR AND MOUNTING HARDWARE

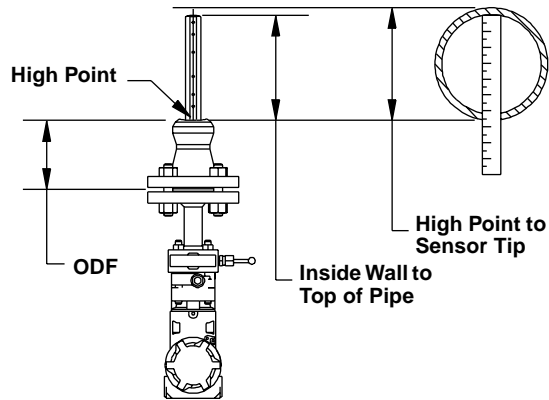
1. Assemble the Annubar to the mounting hardware with the gasket and bolts.
2. Hand-tighten the bolts just enough to hold the position of the Annubar sensor centered in the mounting hardware.
3. Install the studs and nuts.
4. Tighten the studs and nuts in a cross pattern.
5. Attach the Annubar to the mounting hardware as described below. (The high point of the contoured weld fitting will define the alignment of the Annubar to the pipe. For horizontal pipes, the Annubar head axis will be parallel to the pipe axis. For vertical pipes, the Annubar head will be perpendicular to the pipe axis.)

**STEP 5:  
CHECK THE FIT-UP  
OF THE ANNUBAR  
TO THE PIPE**

1. Check the fit of the Annubar to the pipe by inserting a rule, stick, or stiff wire through the hole.
2. Note the distance from the opposite inside wall to the outside wall at the hole.
3. Measure the distance on the Annubar assembly from the weld fitting high point to the Annubar sensor tip.

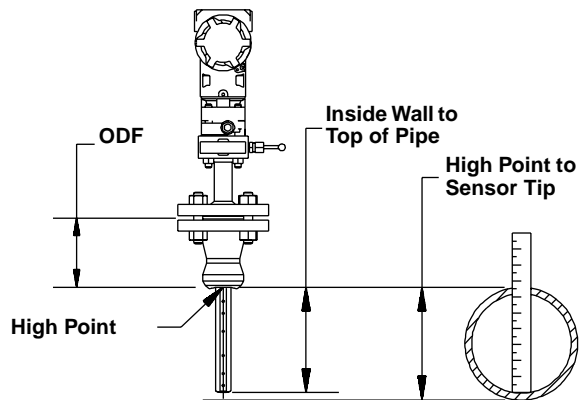
The length should be slightly less than the measured length of the pipe. Large discrepancies may cause installation problems or errors in measurement. See Figures 4-9 and 4-10.

FIGURE 4-9.  
Annubar Fit-Up Check for Liquid or Steam Service.



8900-8900V13A

FIGURE 4-10.  
Annubar Fit-Up Check for Gas Service.



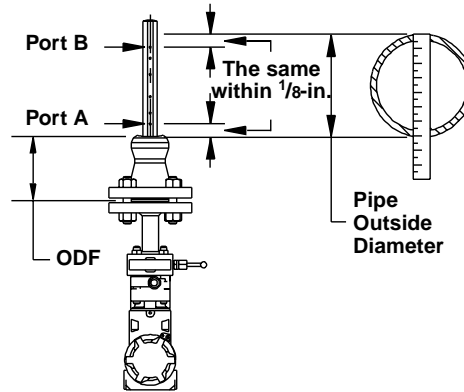
8900-8900V07A

**Check the Fit-Up of the Annubar with Opposite-Side Support to the Pipe**

1. Check the fit of the Annubar assembly to the pipe by inserting a rule, stick, or stiff wire through both mounting holes.
2. Note the distance across the outside wall (pipe outside diameter).
3. Transfer this length to the Annubar assembly from the high point of weld fitting to the Annubar sensor.

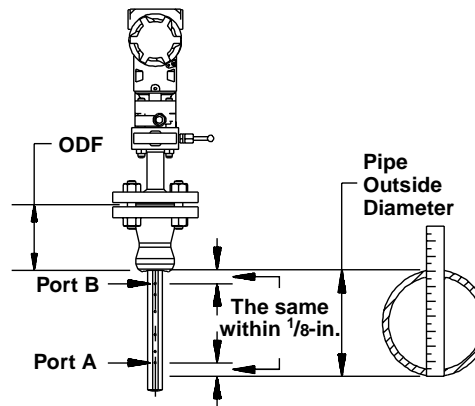
The marked distance to the first Annubar sensing port A (near the tip) should be the same as the distance from the high point of the weld fitting to the closest sensing port B. Small discrepancies can be compensated for with the fit-up of the mounting hardware. Large discrepancies may cause installation problems or errors in measurement. See Figures 4-11 and 4-12.

FIGURE 4-11.  
Annubar with Opposite-Side Support  
Fit-Up Check for Liquid or  
Steam Service.



8900-8900V12A

FIGURE 4-12.  
Annubar with Opposite-Side Support  
Fit-Up Check for Gas Service.



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**STEP 6: TACK WELD THE MOUNTING HARDWARE**

Follow these steps to tack weld the mounting hardware.

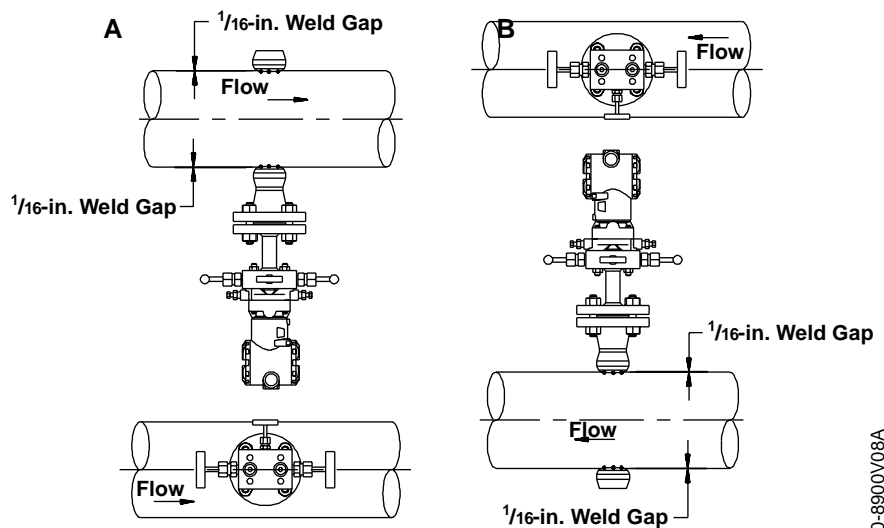
1. Insert the Annubar assembly through the pipe hole.
2. Align the flow arrow on the transmitter head to point in the direction of the flow.
3. Check that the contoured weld fitting is aligned properly on the pipe wall. The Annubar tip should just touch or be just above the inside opposite pipe wall.
4. Confirm that the Annubar is perpendicular to the pipe.
5. Tack weld the fitting to the pipe with the proper weld gap.

**Tack Weld the Opposite-Side Support Fitting**

If opposite-side support is supplied, follow the instructions below.

1. Insert the Annubar assembly through the pipe wall, making sure that the tip of the sensor passes through the opposite wall.
2. Align the flow arrow on the transmitter head to point in the direction of the flow.
3. Check that the contoured weld fitting is aligned properly on the pipe wall.
4. Check the alignment of the assembly to the pipe.
5. Tack weld the fitting to the pipe with the proper weld gap, as shown in Figure 4-13.
6. Assemble the support coupling to the support plug until it is hand tight.
7. Slide the assembly over the sensor tip protruding from the pipe wall. The sensor tip should engage the plug bore.
8. Align the contour of the fitting to the pipe and tack weld the fitting to the pipe with the proper weld gap.

FIGURE 4-13.  
Tack Weld the Opposite-Side Support Fitting: A (Liquid or Steam Service) and B (Gas Service).



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**STEP 7: FINISH WELDING**

Disassemble the Annubar and mounting hardware. Remove the gasket. Complete welding the weld fitting and support coupling (if required).

**STEP 8:  
ASSEMBLE THE  
ANNUBAR AND  
MOUNTING FLANGE**

1. Allow the mounting hardware to cool to avoid serious burns.
1. Reassemble the Annubar and mounting flange using gasket, bolts, and nuts.
2. Tighten the nuts in a cross pattern to allow even compression of the gasket.

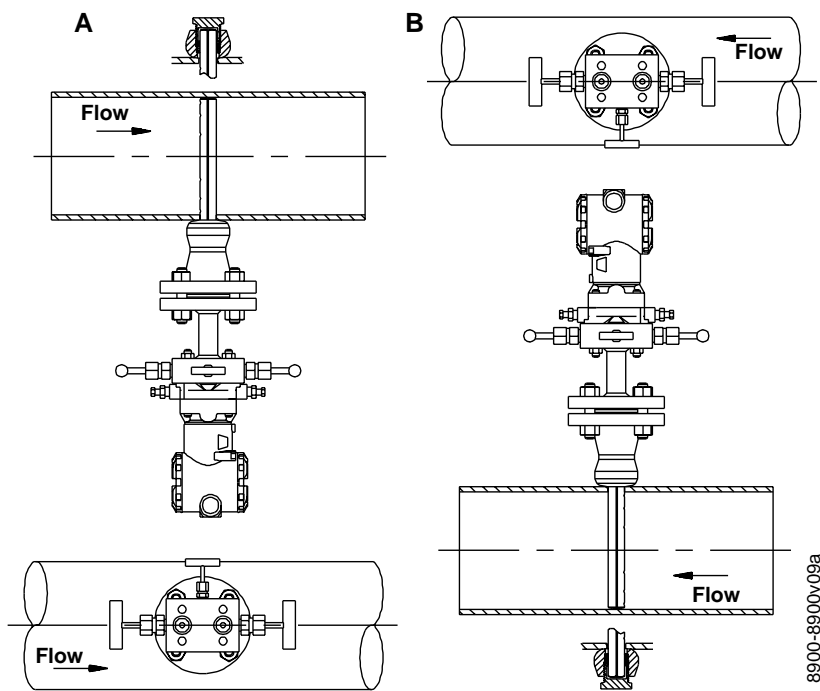
**Opposite-Side Support**

If opposite-side support is supplied, apply an appropriate thread-sealant compound to the support plug threads. Assemble the plug and support coupling. Be sure to tighten the plug until it bottoms on the Annubar tip.

**NOTE**

Threaded connections may have to be retightened after the system comes up to operating temperature.

FIGURE 4-14.  
Opposite-Side Support Plug and  
Coupling Assembly: A (Liquid or Steam  
Service) and B (Gas Service).







## Hardware Installation for Annubar Pak-Lok Flanged

### ANNUBAR MODELS:

DPF+15S/16S

DPF+25S/26S

DPF+35S/36S

DPF+45S/46S

This section provides hardware installation instructions for the Annubar Pak-Lok Flanged used in liquid service in either a horizontal or vertical pipe. Installation procedures are similar for all services. Service-specific instructions are provided where necessary; otherwise, all instructions in this section apply to all services.

If remote mounting of the electronics is required, use this section for hardware installation. Then, see **Section 10: Annubar Remote Mounting** for electronics installation.

- The direct mount maximum service temperature is 500 °F (260 °C).
- The electronics must be remote mounted when service temperatures exceed 500 °F (260 °C).
- Annubar models with a sensor size of 45 or 46 are shipped with a packing guide cover instead of a compression nut.

### SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

#### **WARNING**

##### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

#### **WARNING**

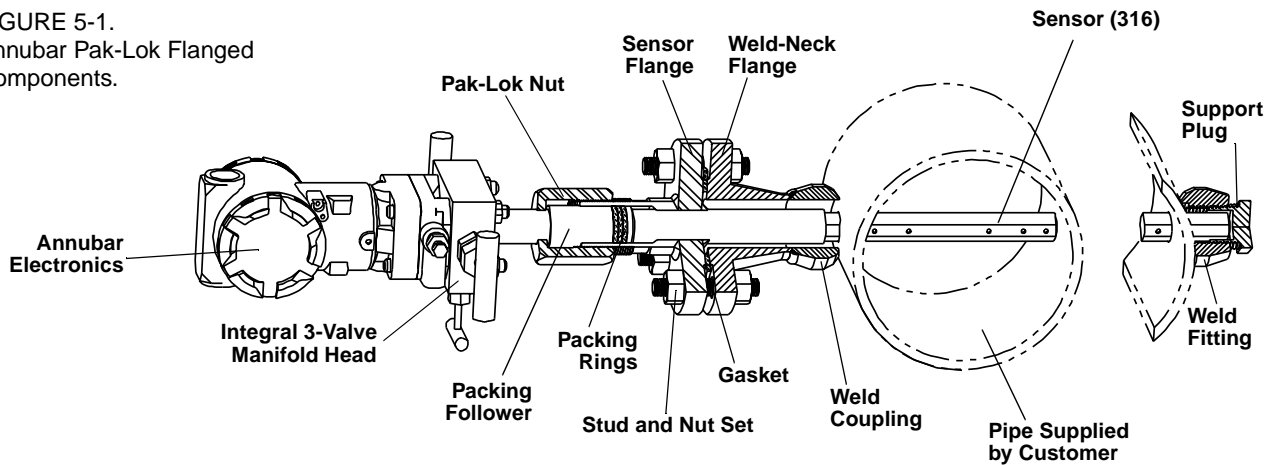
##### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

**ANNUBAR PAK-LOK  
FLANGED COMPONENTS**

Figure 5-1 identifies the components of the Annubar Pak-Lok Flanged.

FIGURE 5-1.  
Annubar Pak-Lok Flanged  
Components.



8900-8900V44A

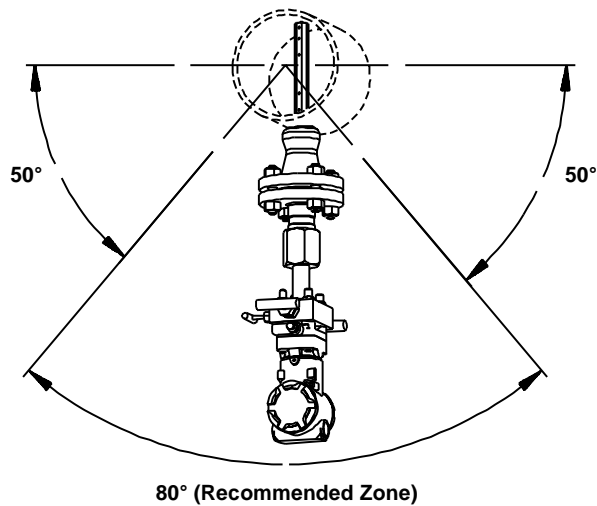
**STEP 1:  
DETERMINE THE PROPER  
ORIENTATION  
OF THE ANNUBAR**

The orientation of the Annubar depends upon two factors: the orientation of the pipe that will receive the flowmeter, and the service that uses the pipe. The following sections provide illustrations of the possible pipe orientations and services. After determining the Annubar's orientation, proceed with step 2 on page 4-8.

**Liquid or Steam Service  
in a Horizontal Pipe**

Install the Annubar within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 5-2 illustrates the recommended location for the Annubar when used with liquid or steam service.

FIGURE 5-2.  
Liquid or Steam Service  
in a Horizontal Pipe.

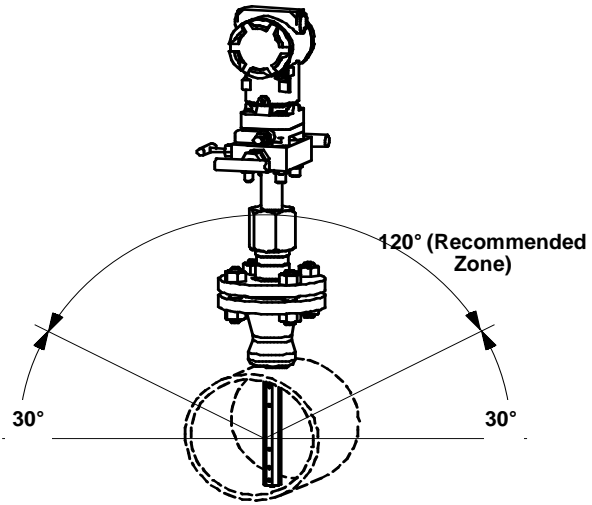


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### Gas Service in a Horizontal Pipe

Install the flowmeter in the upper half of the pipe, *but not within 30 degrees of the horizontal axis*, as shown in Figure 5-3. This orientation will prevent condensate from becoming entrapped in the instrument tubing.

FIGURE 5-3.  
Gas Service in a Horizontal Pipe.

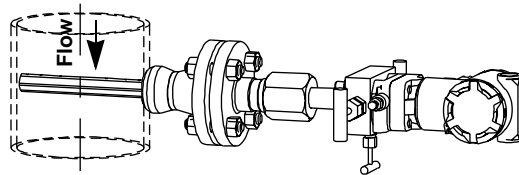


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### Liquid or Gas Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 5-4. The Annubar electronics run in the opposite direction of the process piping.

FIGURE 5-4.  
Liquid or Gas Service in a Vertical Pipe.



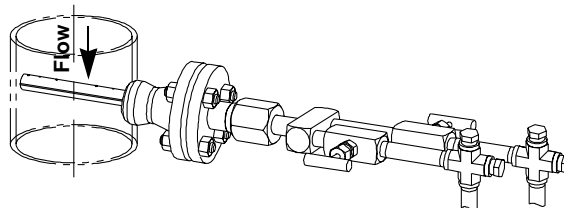
8900-8900V45A

### Steam Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 5-5.

- Annubar electronics require remote mounting when used with steam service in a vertical pipe. See **Section 8: ProBar Remote Mounting** for instructions.

FIGURE 5-5.  
Steam Service in a Vertical Pipe.



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### SHIPPING NOTE

All Annubar Pak-Lok Flanged models are shipped with the weld fitting and weld-neck flange pre-welded for ease of installation. To prevent injury, remove pressure and drain the pipe before installing or removing sensor.

**STEP 2:  
DRILL THE HOLE  
IN THE PIPE**

Follow the steps below to drill the hole in the pipe.

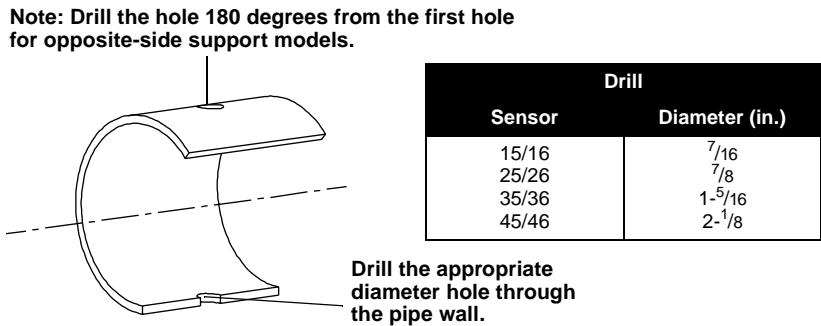
1. Depressurize and drain the pipe.
2. Select the location for the hole you are about to drill.  
Select a location anywhere around the circumference of the pipe for vertical pipes.  
For horizontal pipes, the hole location depends upon the service for which the Annubar is to be used:
  - *Liquid service*: drill the hole along the *bottom* of the pipe
  - *Gas service*: drill the hole along the *top* of the pipe
  - *Steam service*: drill the hole along the *bottom* of the pipe
3. Determine the diameter of the hole to be drilled. Use the chart in Figure 5-6.
4. After the hole is drilled, deburr the hole on the inside of the pipe.

**Drill a Hole for  
Opposite-Side Support**

A second hole must be drilled for the opposite-side support weld coupling if opposite-side support is supplied. This hole must be the same diameter as the first hole; place it directly opposite the first hole so that the sensor can pass completely through the pipe. Use the following steps to find the location for the second hole:

1. Wrap a piece of soft wire or string around the pipe to measure the pipe's circumference.
2. Remove the wire or string and measure half of the circumference length.
3. Re-wrap the half-length around the pipe from the center of the first hole.
4. Mark the center of what will become the second hole, as shown in Figure 5-6.

FIGURE 5-6.  
Sensor Size/Hole Diameter Chart.



8900-8900\_15A

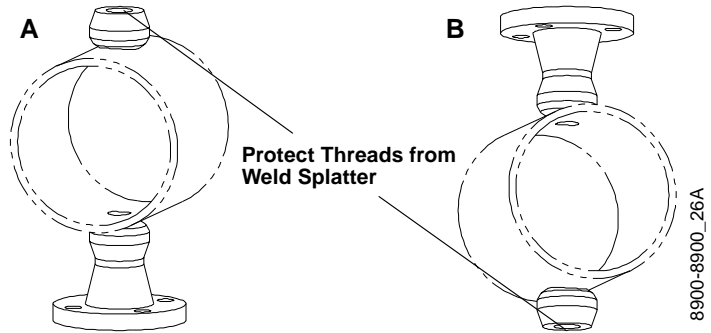
5. Deburr the drilled hole on the inside of the pipe.

**STEP 3:  
WELD THE WELD-  
NECK FLANGE**

Weld the weld-neck flange and weldolet assembly to the pipe. See **Appendix A: Standard ODF Dimensions** for the proper ODF.

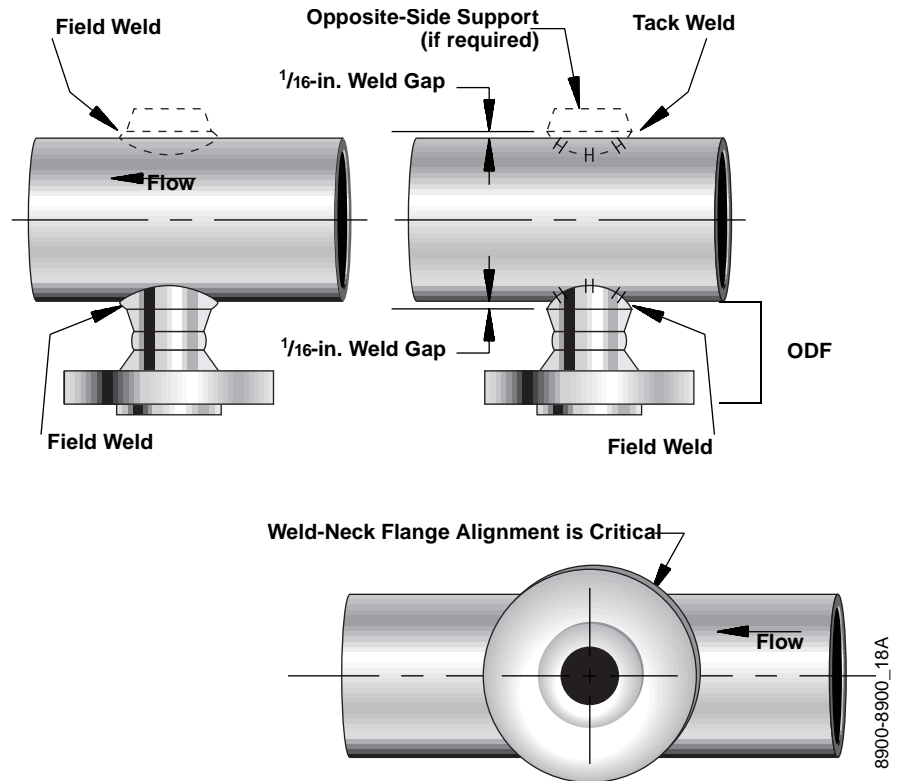
Wrap the factory-supplied heavy aluminum foil around the threads before welding, or use the thread protector cap, as shown in Figure 5-7. This will protect the weld-fitting threads from weld splatter.

FIGURE 5-7.  
Protect the Threads from Weld Splatter: A(Liquid or Steam Service) and B (Gas Service).



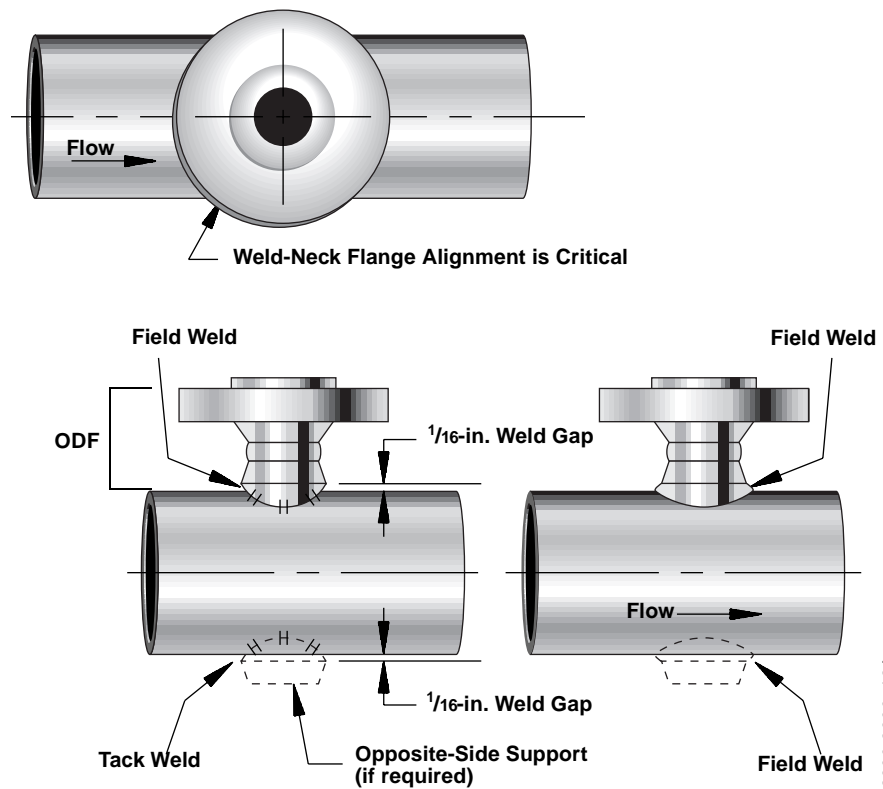
Use the Annubar for alignment and tack weld the weld-neck flange and weld fitting. Be sure to remove the Annubar before completing the welding. Straddle the flange bolt holes with the centerline of the pipe, as shown in Figures 5-8 and 5-9.

FIGURE 5-8.  
Weld Fitting/Weld-Neck Flange  
Assembly for Liquid or Steam Service.



## Annubar Averaging Pitot Tube

FIGURE 5-9.  
Weld Fitting/Weld-Neck Flange  
Assembly for Gas Service.

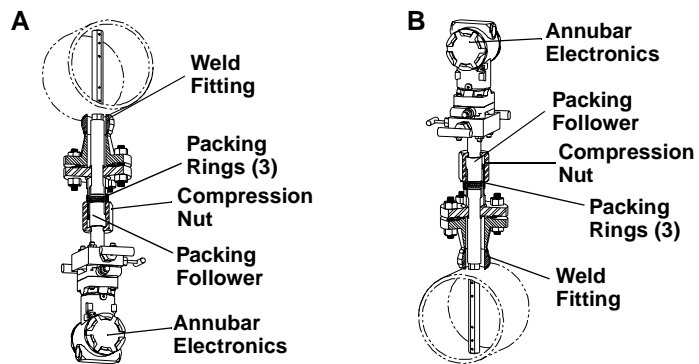


### STEP 4: INSTALL THE SENSOR ASSEMBLY

1. Install the weld fitting sensor flange using the gasket, studs and nuts after the mounting hardware has cooled.
2. Tighten the nuts in a cross pattern.
3. Apply a thread sealant to the support plug.
4. Tighten the plug into the weld fitting.
5. Insert the Annubar into the weld fitting until the sensor tip contacts the pipe wall (or support plug), as shown in Figure 5-10.
6. Install the first split packing ring on the Annubar between the lock ring and packing follower; take care not to damage the rings.

7. Push the packing ring firmly into the weld fitting and against the lock ring. Repeat this process for the two remaining rings, alternating the location of the split in the packing ring by 180 degrees, as shown in Figure 5-10.

FIGURE 5-10.  
Installation of the Packing Rings:  
A (Liquid or Steam Service) and  
B (Gas Service).



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**NOTE**

If the Annubar appears to be too long, go back to step 3. Verify that the weld fitting sensor flange was installed into the weld fitting before the Annubar was installed.

8. With the flow arrow on the Annubar head pointed in the direction of the pipe flow, thread the Pak-Lok nut to the weld fitting until it is *hand tight only*.
9. Use a wrench to tighten the Pak-Lok nut in  $\frac{1}{4}$  turn increments until it has been tightened one full turn. *The Pak-Lok nut should be tightened only enough to prevent leakage. Do not overtighten the Pak-Lok nut; damage to the sensor will result.*





## Hardware Installation for Annubar Flanged Flo-Tap

### ANNUBAR MODELS:

DHF+15S

DHF+25S

DHF+25H

DHF+25M

DHF+35S

DHF+45S

DHF+45H

DHF+45M

This section provides hardware installation instructions for the Annubar Flanged Flo-Tap used in either a horizontal or vertical pipe. Installation procedures are similar for all services. Service-specific instructions are provided where necessary; otherwise, all instructions in this section apply to all services.

If remote mounting of the electronics is required, use this section for the hardware installation. Then, see **Section 10: Annubar Remote Mounting** for electronics installation.

- The direct mount maximum service temperature is 500 °F (260 °C).
- The electronics must be remote mounted when service temperatures exceed 500 °F (260 °C).

### SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

#### **WARNING**

##### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

#### **WARNING**

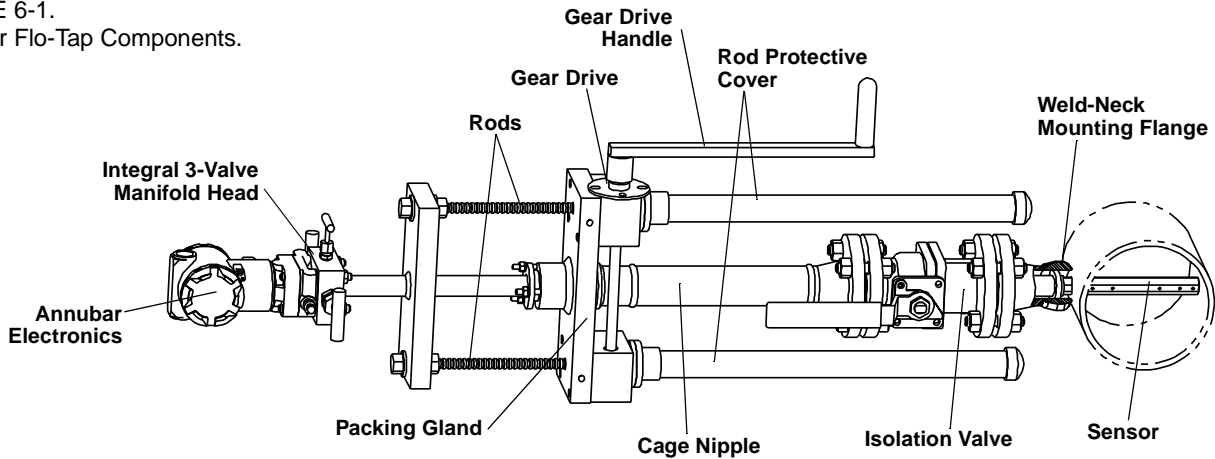
##### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

## ANNUBAR FLO-TAP COMPONENTS

Figure 6-1 identifies the components of the Annubar Flo-Tap.

FIGURE 6-1.  
Annubar Flo-Tap Components.



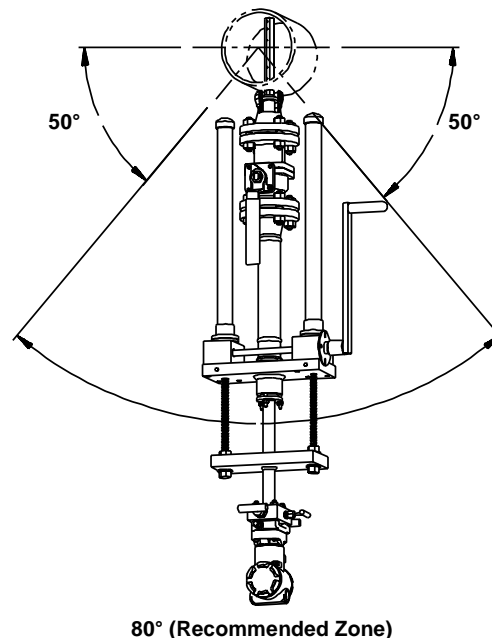
### STEP 1: DETERMINE THE PROPER ORIENTATION OF THE ANNUBAR

#### Liquid or Steam Service in a Horizontal Pipe

The orientation of the Annubar depends upon two factors: the orientation of the pipe that will receive the flowmeter, and the service that uses the pipe. The following sections provide illustrations of the possible pipe orientations and services. After determining the Annubar orientation, proceed with step 2 on page 6-4.

Install the Annubar within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 6-2 illustrates the recommended location for the Annubar when used with liquid or steam service.

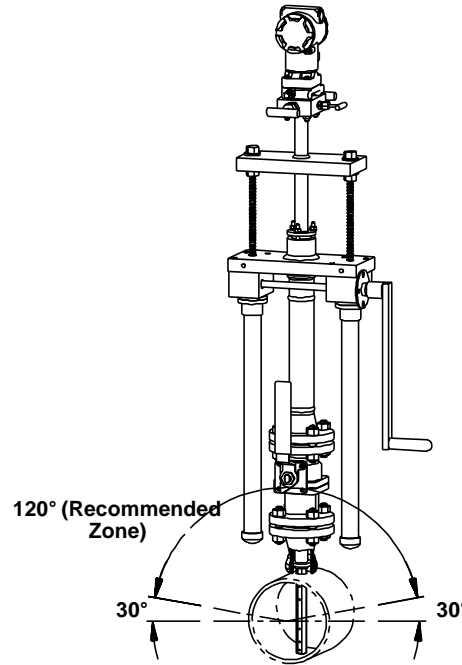
FIGURE 6-2.  
Liquid or Steam Service  
in a Horizontal Pipe.



### Gas Service in a Horizontal Pipe

Install the Annubar Flo-Tap in the upper half of the pipe, *but not within 30 degrees of the horizontal axis*. This orientation will prevent condensate from becoming entrapped in the sensor probe. Figure 6-3 illustrates the recommended location of the Annubar when used with gas service.

FIGURE 6-3.  
Gas Service in a Horizontal Pipe.



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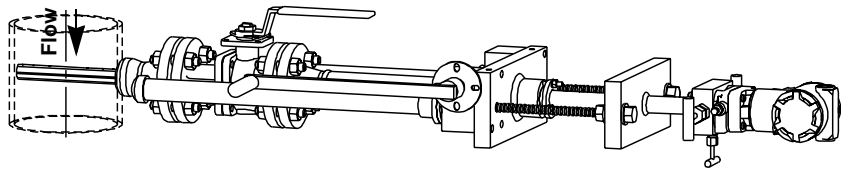
### Liquid or Gas Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 6-4.

**NOTE**

Verify that the pipe pressure and temperature are within the rated limits of the Flo-Tap Annubar as shown on the Annubar tag or by the flow calculation provided by the factory.

FIGURE 6-4.  
Liquid or Gas Service in a Vertical Pipe.



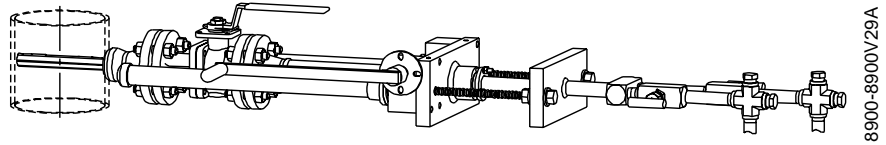
8900-8900V28A

## Steam Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 6-5.

- Annubar electronics must be remote mounted when used with steam service in a vertical pipe installations. See **Section 8: ProBar Remote Mounting** for instructions.

FIGURE 6-5.  
Steam Service in a Vertical Pipe.



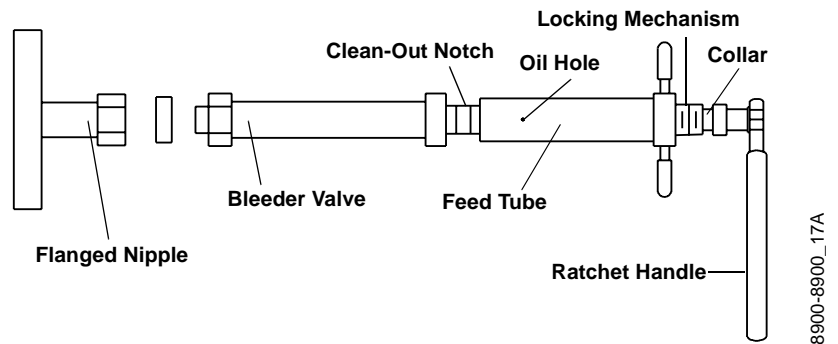
## STEP 2: OBTAIN THE REQUIRED WELDING EQUIPMENT AND HARDWARE

All hardware required for installation under pressure is furnished with the Flo-Tap. The required hardware is shown in Figure 6-6.

### NOTE

During insertion and retraction, the flow rate must be reduced below the limits shown on the Annubar tag.

FIGURE 6-6.  
Pressure Installation Hardware.



The additional welding equipment, pressure drilling machine and the special tooling required is as follows.

1. Welding equipment.
2. Pressure (hot-tap) drilling machine: Mueller D-5, T.D. Williamson T-101, 360 or equivalent.  
Maximum working pressure = 1440 psig @ 100 °F, or  
700 psig @ 700 °F.
3. A flanged machine adapter nipple that fits the isolation valve, such as those available from Mueller or T.D. Williamson.

### NOTE

A blind flange, bored and tapped with the proper thread, can be used instead of the flanged nipple.

4. Drill bit:  $\frac{7}{16}$ -in,  $\frac{7}{8}$ -in,  $1\frac{5}{16}$ -in.
5. Drill holder:  $\frac{7}{16}$ -in,  $\frac{7}{8}$ -in,  $1\frac{5}{16}$ -in.

Items 2 through 5 are available from a drilling machine manufacturer, such as Mueller Co., in Decatur, IL. or T.D. Williamson, in Tulsa, OK. This equipment can usually be purchased locally, or the local utility company may be able to provide pressure drilling, or "hot-tapping" services.

**STEP 3:  
PREPARE THE WELD-  
NECK FLANGE ASSEMBLY**

1. Grind off any paint or other coatings from the pipe in the area where the weld fitting is to be positioned.
1. Orient the flange to the pipe so that the pipe centerline is between the holes of the flange, and in line with the pipe axis, as shown in Figures 6-7 and 6-8.
2. Position the weld-neck assembly on the pipe.
3. Tack weld the weld-neck in place with the proper weld gap.

FIGURE 6-7.  
Weld Fitting/Weld-Neck Flange  
Assembly for Liquid or Steam Service.

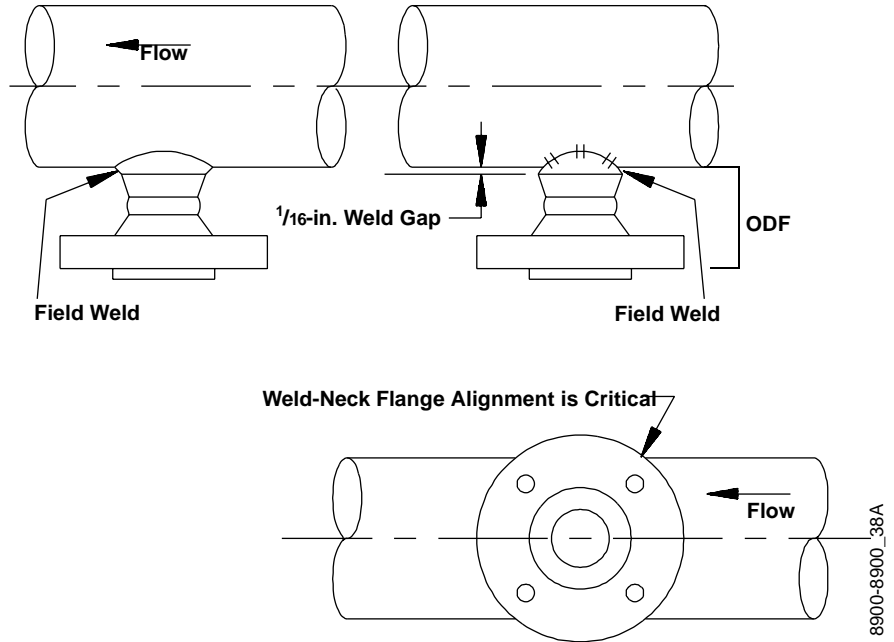
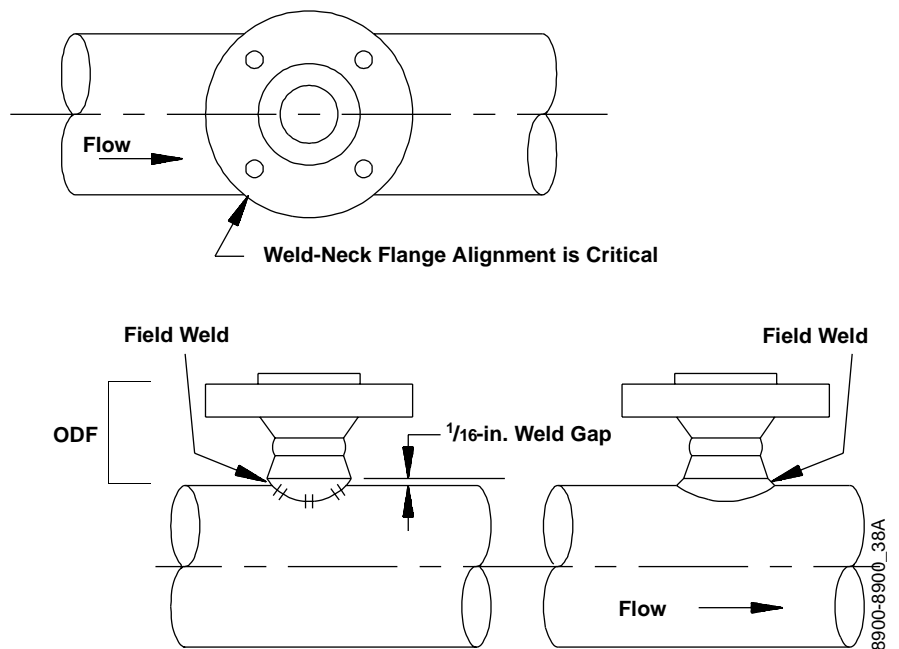


FIGURE 6-8.  
Weld Fitting/Weld-Neck Flange  
Assembly for Gas Service.



**STEP 4:  
WELD THE WELD-  
NECK FLANGE**

Weld the weld fitting/weld-neck flange assembly to the pipe.  
See **Appendix B: Standard ODF Dimensions** for the proper  
ODF dimensions.

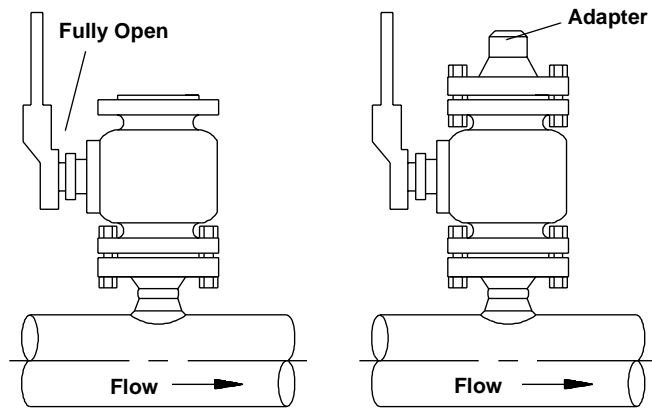
**STEP 5:  
ATTACH THE UNIT  
ISOLATION VALVE**

Fasten the unit isolation valve to the weld-neck flange with the gasket,  
bolts and nuts. The valve stem must be positioned to provide clearance  
for the Flo-Tap insert/retract mechanism, as shown in Figure 6-9.  
Tighten the bolts in a cross pattern to compress the gasket evenly.

**STEP 6:  
ATTACH THE ADAPTER**

Fasten the special adapter flanged nipple to the unit isolation valve, as  
shown in Figure 6-9.

FIGURE 6-9.  
Valve Stem and Adapter Positioning.

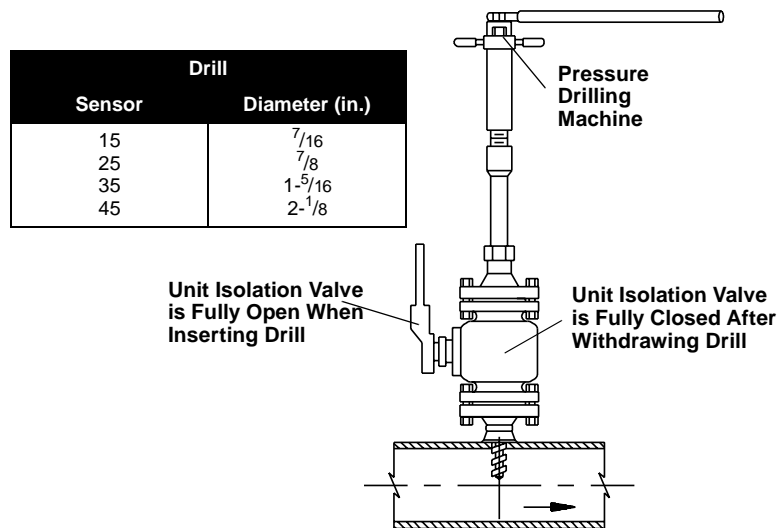


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**STEP 7:  
ATTACH THE PRESSURE  
DRILLING MACHINE**

Install the drill bit and adapter nipple into the pressure drilling  
machine. Use the chart in Figure 6-10 to determine the drill bit size  
according to the size of the sensor. Attach the machine to the special  
flanged nipple, as shown in Figure 6-10.

FIGURE 6-10.  
Pressure Drilling Diagram.



8900-8900\_08A

**STEP 8:  
DRILL THE HOLE**

Drill the hole through the pipe wall in accordance with the instructions supplied with the drilling machine.

The hole is completely drilled when resistance to the hand cranking reduces, or when the air or hydraulic drilling motor speeds up. After the hole is drilled, retract the drill fully beyond the unit isolation valve.

**STEP 9:  
REMOVE THE  
DRILLING MACHINE**

1. Withdraw the drill past the valve.
2. Close the unit isolation valve.
3. Bleed and remove the drilling machine and special flanged nipple.
4. Check the unit isolation valve and welds for leakage.

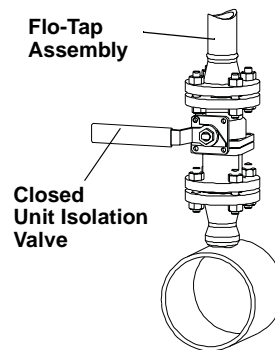
**STEP 10:  
INSTALL THE FLO-  
TAP ASSEMBLY**

Install the complete Flo-Tap assembly onto the unit isolation valve as shown in Figure 6-11 below.

**NOTE**

When installing the Flo-Tap assembly, take care not to scratch or dent any portion of the sealing surfaces.

FIGURE 6-11.  
Flo-Tap Assembly on the Closed  
Unit Isolation Valve.



8900-8900\_09A

1. Align the flow arrow on the Annubar head with the pipe axis.
2. Point the arrow in the direction of the flow.
3. Use the gasket and flange bolts supplied to fasten the Flo-Tap assembly to the isolation valve.
4. Tighten the nuts in a cross pattern to compress the gasket evenly.
5. Ensure that the vent valves on the Annubar are *closed* before proceeding with the next step.

**STEP 11:  
OPEN THE  
ISOLATION VALVE**

1. Slowly open the isolation valve.
2. Check the entire installation for leakage.
3. Tighten connections as required or reapply thread sealant to repair any leakage.

**STEP 12:  
TIGHTEN THE BOLTS**

Alternately tighten the packing gland bolts as required to eliminate leakage. *Do not overtighten.*

**STEP 13:  
INSERT THE SENSOR**

Insert the sensor with one of the two drive options available on the Annubar Flo-Tap; standard drive (IHR) or gear drive (IHD). Follow the instructions for the drive option used by your Annubar, then proceed with step 12 on page 6-9.

**Standard Drive (IHR)**

1. Position the retract drive nuts near the orange stripe on the threaded rods before initiating insertion.
2. Insert the sensor by rotating the insert drive nuts counterclockwise as viewed from the top. The nuts must be tightened alternately, about two turns at a time, to prevent binding caused by unequal loading.
3. Continue this procedure until the sensor firmly contacts the opposite pipe wall.

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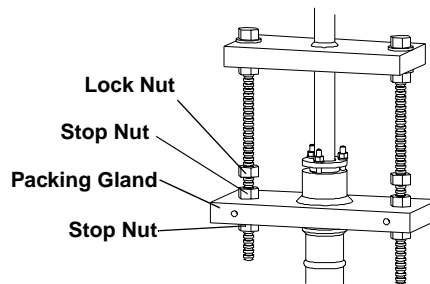
**NOTE**

Do not over-insert the sensor as damage to the sensor or pipe may occur.

---

4. After the sensor is fully inserted, with the tip solidly against the pipe wall, set the insertion stop nuts in place.
5. Tighten the nuts on either side of the packing gland against the gland.
6. Tighten the second nut against the first as a lock nut, as shown in Figure 6-12.

FIGURE 6-12.  
Setting the Stop Nut and Lock Nut.



8900-8900\_10A

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**NOTE**

Refer to the tag attached to the Annubar for insertion stop nut location instructions. The orange paint stripe on the rods alert the installer that the sensor is approaching full insertion.

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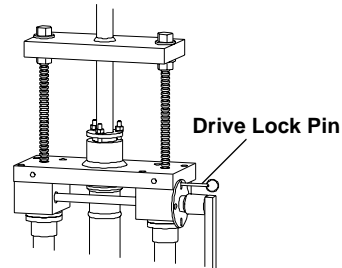
**Gear Drive (IHD)**

1. Insert the Annubar sensor by rotating the crank clockwise. If a power drill with an adapter is used, do not exceed 200 rpm.
2. Continue rotating the crank until the sensor firmly contacts the opposite side of the pipe.
3. Secure the drive by inserting the drive lock pin, as shown in Figure 6-13.

**NOTE**

For operating and maintenance procedures for the gear drive option, see DS-1635.

FIGURE 6-13.  
Insert the Drive Lock Pin.



8900-8900\_11A

**NOTE**

Refer to the tag attached to the Annubar for insertion stop nut location instructions. The orange paint stripe on the rods alert the installer that the sensor is approaching full insertion. Remove the drill and complete the insertion manually until the sensor firmly contacts the pipe wall.

**STEP 14:  
CHECK FOR LEAKAGE**

Inspect the packing gland for leakage. Tighten any bolts as required to stop leakage.

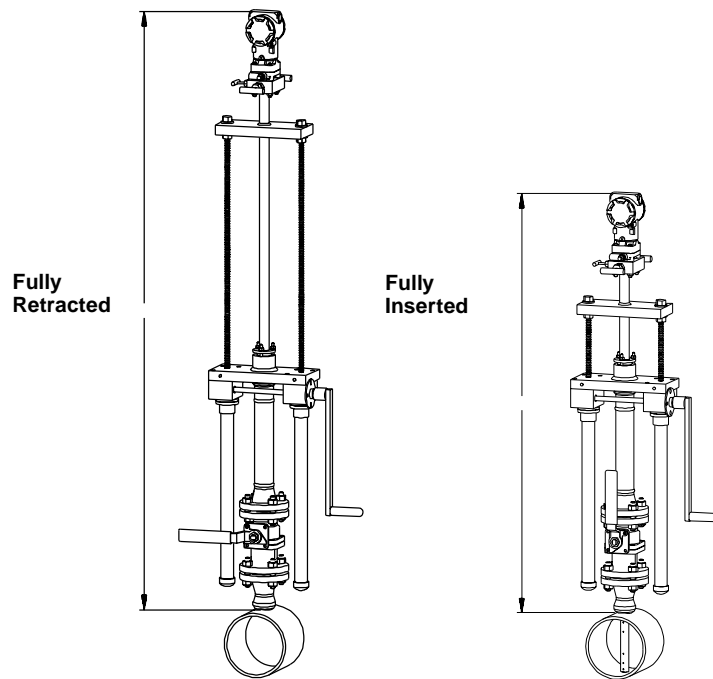
## STEP 15: RETRACT THE SENSOR

### Standard Drive (IHR)

Retract the sensor with one of two drive options available on the Annubar Flo-Tap; standard drive (IHR) or gear drive (IHD). Follow the instructions for the drive option used by your Annubar; then proceed with step 16 on page 6-10.

1. Retract the Flo-Tap by rotating the retract drive nuts clockwise as viewed from the top. The nuts must be turned alternately, about two turns at a time, to prevent binding caused by unequal loading.
2. Continue this procedure until the rod end nuts are against the packing body mechanism.

FIGURE 6-14.  
Annubar Flo-Tap at Full  
Retraction and Insertion.



8900-8900V25A, 8900V26A

### **⚠ WARNING**

Personal hazard! To prevent injury, remove pressure and drain pipe or cage nipple assembly before installing or removing sensor.

### Gear Drive (IHD)

1. Remove the drive lock pin.
2. Retract the sensor by rotating the crank counterclockwise. If a power drill with adapter is used, do not exceed 200 rpm.
3. Retract until the rod end nuts are against the packing body mechanism.

## STEP 16: CLOSE THE ISOLATION VALVE

After the sensor is fully retracted, the Flo-Tap unit isolation valve may be closed to isolate the probe from the pipe.

## STEP 17: REMOVE THE FLO-TAP ASSEMBLY

The Flo-Tap may be removed entirely if desired by unbolting the cage nipple from the unit isolation valve. If the Annubar is to be removed entirely from the isolation valve, the cage nipple must be depressurized. Open the equalizer valve on the Annubar head, then open the vent valve on either the high or low side of the Annubar.

## Hardware Installation for Annubar In-Line

### ANNUBAR MODELS:

DNF+10S

DNF+10H

DNF+10M

DNW+10S

DNT+10S

This section provides hardware installation instructions for the In-Line Threaded, Welded, and Flanged Annubar models used in either a horizontal or vertical pipe.

If remote mounting of the transmitter is required, use this section for hardware installation. Then, see **Section 10: Annubar Remote Mounting** for transmitter installation.

- The direct mount maximum service temperature is 500 °F (260 °C).
- The transmitter must be remote mounted when service temperatures exceed 500 °F (260 °C).

### SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

#### **WARNING**

##### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

#### **WARNING**

##### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

## **ANNUBAR IN-LINE CONFIGURATIONS**

The Annubar In-Line series comes pre-assembled and requires only installation into a service pipe. General installation instructions are as follows.

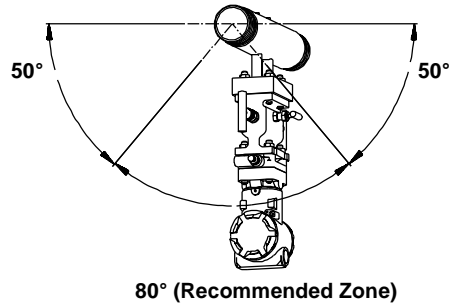
1. Determine the appropriate Annubar orientation according to two factors: the type of service used and the pipe orientation. Orientation guidelines are provided in the following pages.
2. Make sure the line is depressurized.
3. Remove the section of pipe that will be replaced by the Annubar In-Line.
4. Prep the pipe ends as required.
  - For flanged models, ensure that the pipe mounting flange is the same size or rating.
  - For threaded models, ensure that the pipe union or coupling is the same size pipe thread as the Annubar flowmeter.
5. Orient the transmitter flow arrow so that it points in the same direction as the flow in the pipe.
6. Ensure that the ID of the Annubar and the ID of the pipe are concentric.
7. Complete assembly to the appropriate connections.

**LIQUID SERVICE IN A HORIZONTAL PIPE**

Install the Annubar within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 7-1 illustrates the recommended location for the Annubar when used with liquid service.

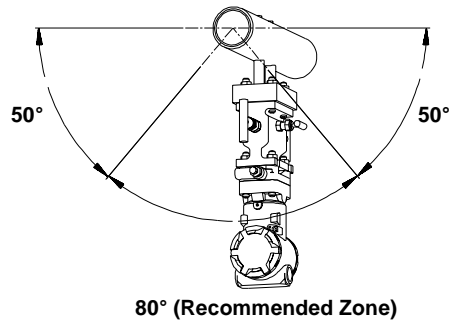
FIGURE 7-1.  
Liquid Service in a Horizontal Pipe.

In-Line Threaded



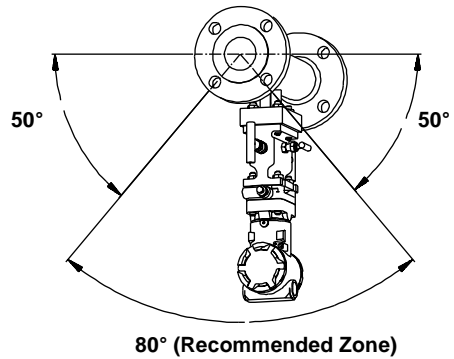
8900-8900V34A

In-Line Welded



8900-8900V38A

In-Line Flanged



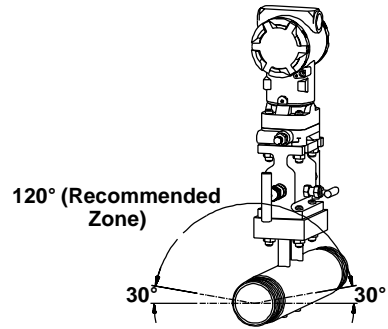
8900-8900V30A

### GAS SERVICE IN A HORIZONTAL PIPE

Install the Annubar in the upper half of the pipe, *but not within 30 degrees of the horizontal axis*, as shown in Figure 7-2. This orientation will prevent condensate from becoming entrapped in the sensor probe.

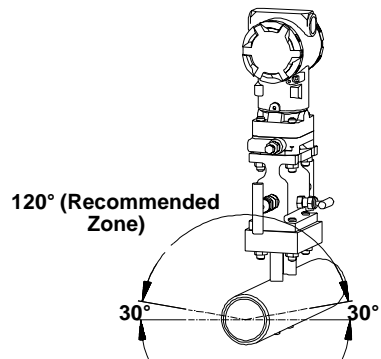
FIGURE 7-2.  
Gas Service in a Horizontal Pipe.

In-Line Threaded



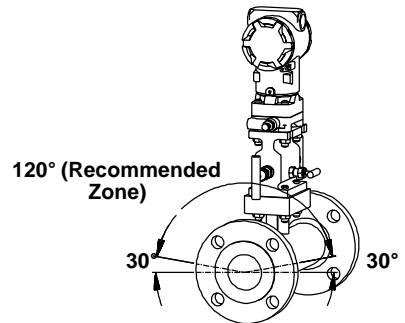
8900-8900V36A

In-Line Welded



8900-8900V40A

In-Line Flanged



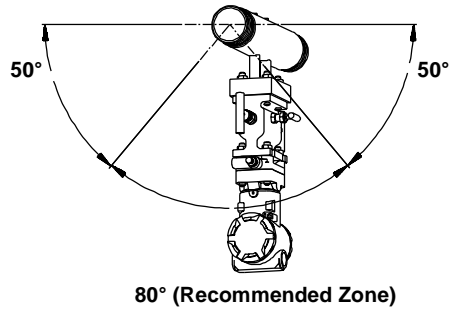
8900-8900V32A

**STEAM SERVICE IN A HORIZONTAL PIPE**

Install the Annubar within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 7-3 illustrates the recommended location for the Annubar when used with steam service.

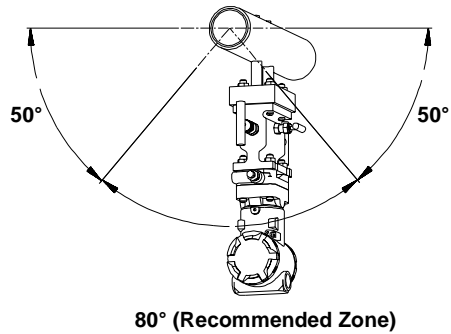
FIGURE 7-3.  
Steam Service in a Horizontal Pipe.

In-Line Threaded



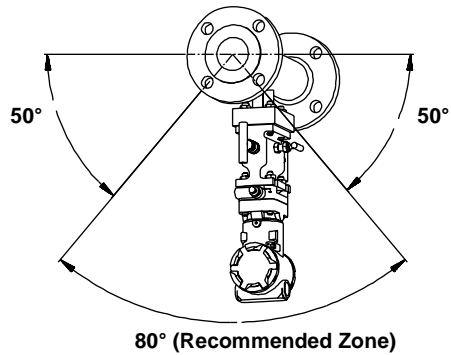
8900-8900V34A

In-Line Welded



8900-8900V38A

In-Line Flanged



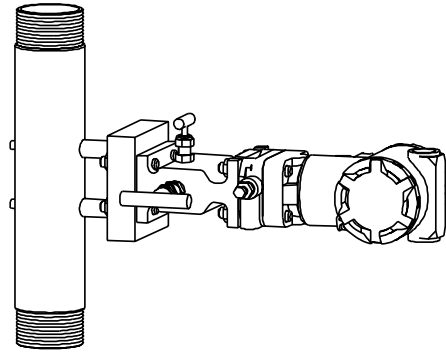
8900-8900V30A

### LIQUID SERVICE IN A VERTICAL PIPE

The Annubar can be installed anywhere around the circumference of the pipe, as shown in Figure 7-4. For liquid service, ensure that the side vent valves are on the *upper or top* of the Annubar transmitter flange.

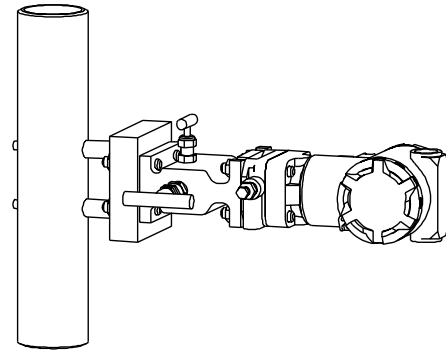
FIGURE 7-4.  
Liquid Service in a Vertical Pipe.

In-Line Threaded



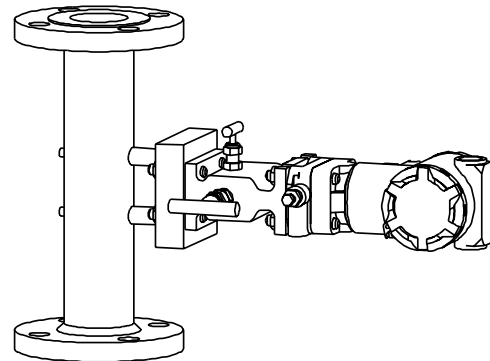
8900-8900V35A

In-Line Welded



8900-8900V39A

In-Line Flanged



8900-8900V31A

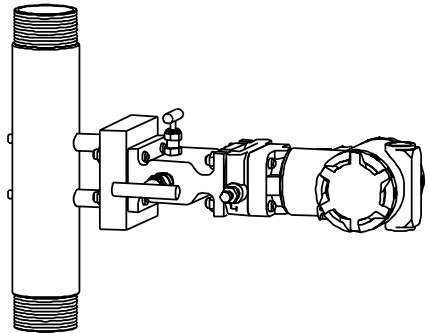


**GAS SERVICE IN A VERTICAL PIPE**

The Annubar can be installed anywhere around the circumference of the pipe, as shown in Figure 7-5. For gas service, ensure that the side vent valves are on the *lower or bottom* of the Annubar transmitter flange.

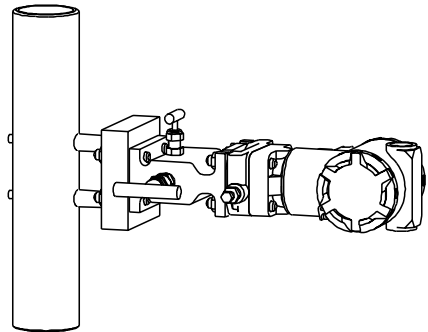
FIGURE 7-5.  
Gas Service in a Vertical Pipe.

In-Line Threaded



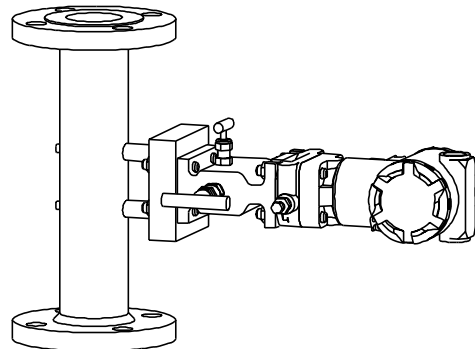
8900-8900V37A

In-Line Welded



8900-8900V41A

In-Line Flanged



8900-8900V33A

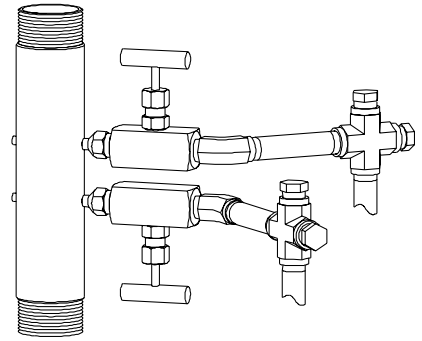
### STEAM SERVICE IN A VERTICAL PIPE

The Annubar can be installed anywhere around the circumference of the pipe, as shown in Figure 7-6. For steam service, ensure that the side vent valves are on the *upper or top* of the Annubar transmitter flange.

- Annubar transmitter must be remote mounted when used with steam service in a vertical pipe. See **Section 6: Annubar Remote Mounting** for instructions.

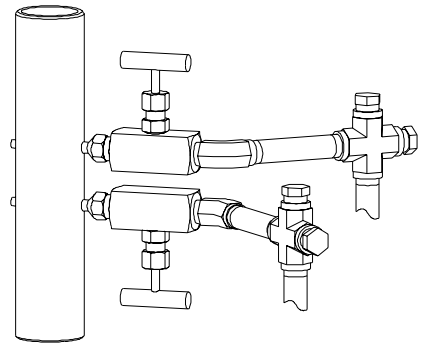
FIGURE 7-6.  
Steam Service in a Vertical Pipe.

In-Line Threaded



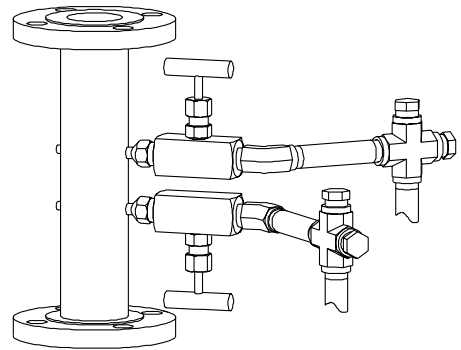
8900-8900\_13A

In-Line Welded



8900-8900\_19A

In-Line Flanged



8900-8900\_12A

## Hardware Installation for Annubar Threaded Flo-Tap

### ANNUBAR MODELS:

DHT+15S

DHT+25S

DHT+35S

This section provides hardware installation instructions for the Annubar Threaded Flo-Tap used in either a horizontal or vertical pipe. Installation procedures are similar for all services. Service-specific instructions are provided where necessary; otherwise, all instructions in this section apply to all services.

If remote mounting of the electronics is required, use this section for the hardware installation. Then, see **Section 10: Annubar Remote Mounting** for electronics installation.

- The direct mount maximum service temperature is 500 °F (260 °C).
- The electronics must be remote mounted when service temperatures exceed 500 °F (260 °C).

### SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

#### **WARNING**

##### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

#### **WARNING**

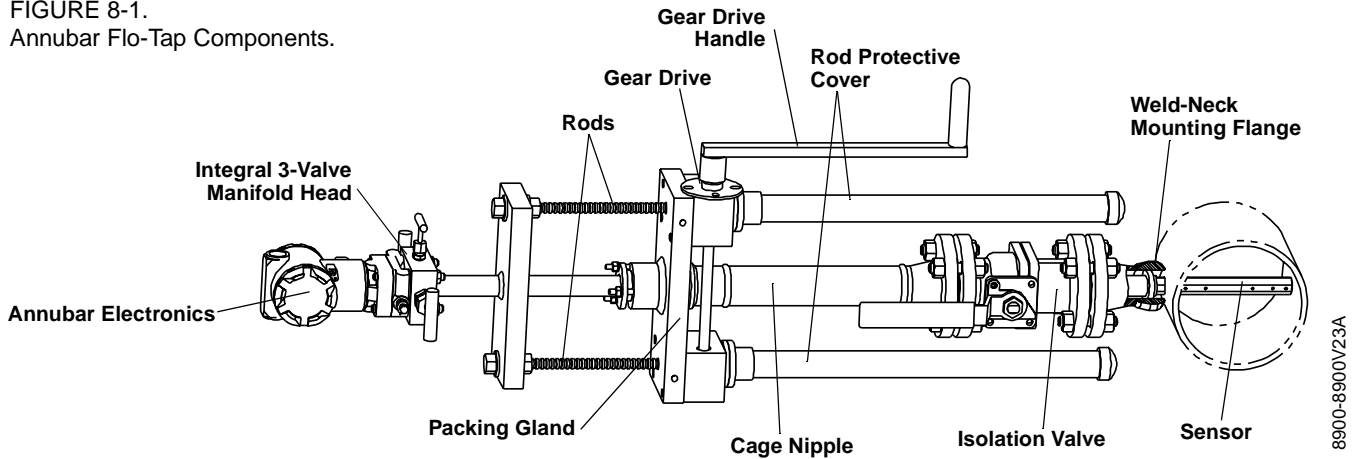
##### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

## ANNUBAR FLO-TAP COMPONENTS

Figure 8-1 identifies the components of the Annubar Flo-Tap.

FIGURE 8-1.  
Annubar Flo-Tap Components.



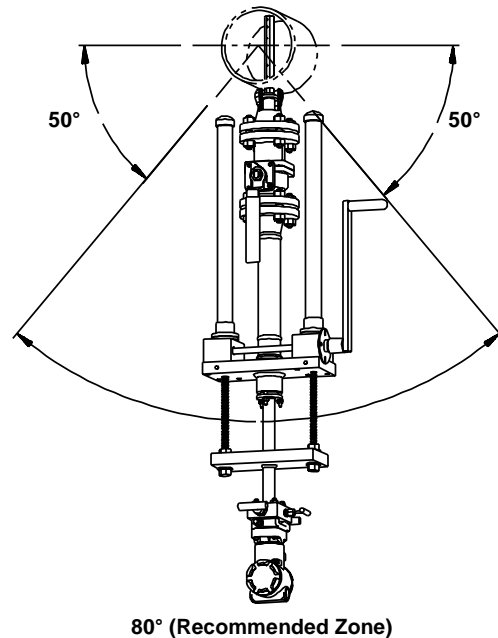
### STEP 1: DETERMINE THE PROPER ORIENTATION OF THE ANNUBAR

The orientation of the Annubar depends upon two factors: the orientation of the pipe that will receive the flowmeter, and the service that uses the pipe. The following sections provide illustrations of the possible pipe orientations and services. After determining the Annubar's orientation, proceed with step 2 on page 8-4.

#### Liquid or Steam Service in a Horizontal Pipe

Install the Annubar within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 8-2 illustrates the recommended location for the Annubar when used with liquid or steam service.

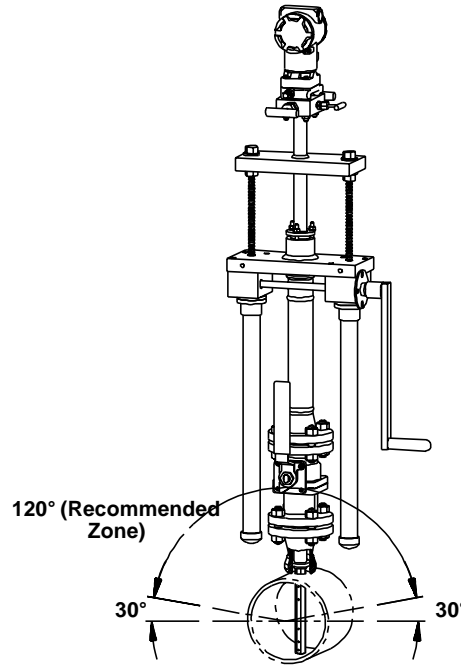
FIGURE 8-2.  
Liquid or Steam Service  
in a Horizontal Pipe.



### Gas Service in a Horizontal Pipe

Install the Annubar Flo-Tap in the upper half of the pipe, *but not within 30 degrees of the horizontal axis*. This orientation will prevent condensate from becoming entrapped in the sensor probe. Figure 8-3 illustrates the recommended location of the Annubar when used with gas service.

FIGURE 8-3.  
Gas Service in a Horizontal Pipe.



8900-8900V27A

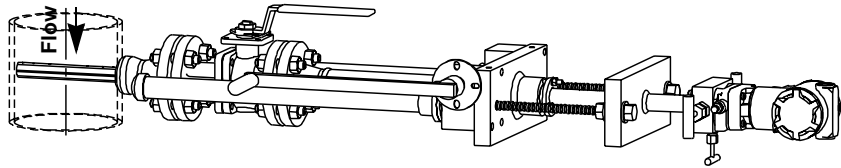
### Liquid or Gas Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 8-4.

**NOTE**

Verify that the pipe pressure and temperature are within the rated limits of the Flo-Tap Annubar as shown on the Annubar tag or by the flow calculation provided by the factory.

FIGURE 8-4.  
Liquid or Gas Service in a Vertical Pipe.



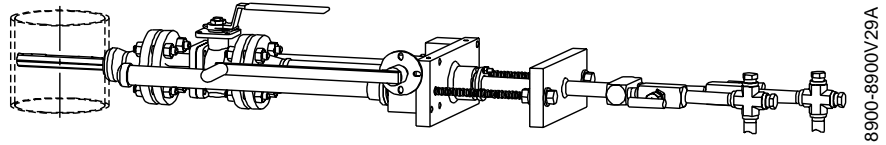
8900-8900V28A

## Steam Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 8-5.

- Annubar electronics must be remote mounted when used with steam service in a vertical pipe installations. See **Section 8: ProBar Remote Mounting** for instructions.

FIGURE 8-5.  
Steam Service in a Vertical Pipe.



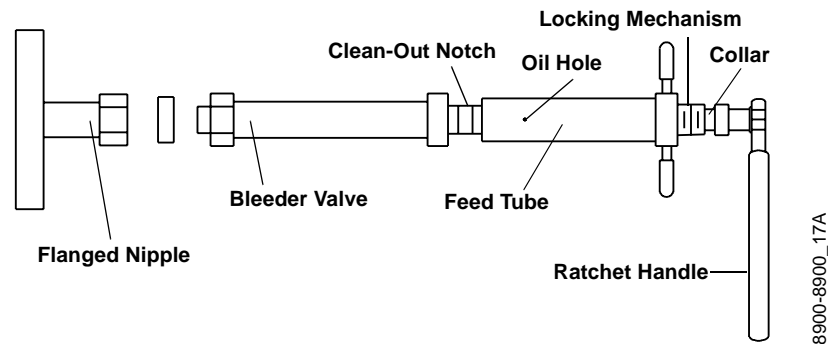
## STEP 2: OBTAIN THE REQUIRED WELDING EQUIPMENT AND HARDWARE

All hardware required for installation under pressure is furnished with the Flo-Tap. The required hardware is shown in Figure 8-6.

### NOTE

During insertion and retraction, the flow rate must be reduced below the limits shown on the Annubar tag.

FIGURE 8-6.  
Pressure Installation Hardware.



The additional welding equipment, pressure drilling machine and the special tooling required is as follows.

1. Welding equipment.
2. Pressure (hot-tap) drilling machine: Mueller D-5, T.D. Williamson T-101, 360 or equivalent.  
Maximum working pressure = 1440 psig @ 100 °F, or  
700 psig @ 700 °F.
3. A threaded machine adapter nipple that fits the isolation valve, such as those available from Mueller or T.D. Williamson.
4. Drill bit:  $\frac{7}{16}$ -in,  $\frac{7}{8}$ -in,  $1\frac{5}{16}$ -in.
5. Drill holder:  $\frac{7}{16}$ -in,  $\frac{7}{8}$ -in,  $1\frac{5}{16}$ -in.

Items 2 through 5 are available from a drilling machine manufacturer, such as Mueller Co., in Decatur, IL. or T.D. Williamson, in Tulsa, OK. This equipment can usually be purchased locally, or the local utility company may be able to provide pressure drilling, or “hot-tapping” services.

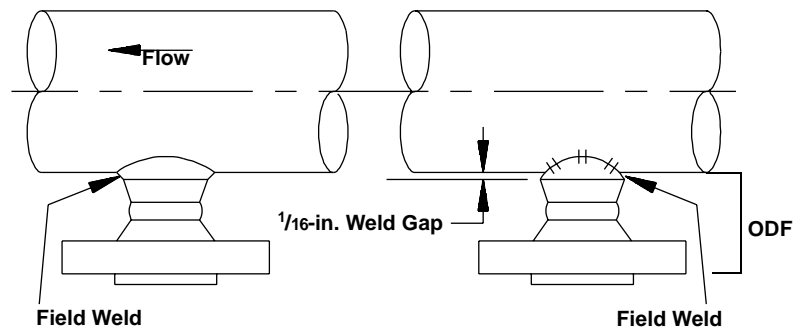
**STEP 3:  
PREPARE THE WELD-  
NECK FLANGE ASSEMBLY**

1. Grind off any paint or other coatings from the pipe in the area where the weld fitting is to be positioned.
2. Position the weld fitting and the tack weld in place using the proper weld gap.
3. Complete the welding of the weld fitting. Install the close nipple using the proper thread sealant compound.
4. Tack weld the weld-neck in place with the proper weld gap.

**CAUTION**

The close nipple threaded connection must be leak-tight; it can not be serviced after hot-tapping.

FIGURE 8-7.  
Weld Fitting Assembly for  
Liquid or Steam Service.



Weld-Neck Flange Alignment is Critical

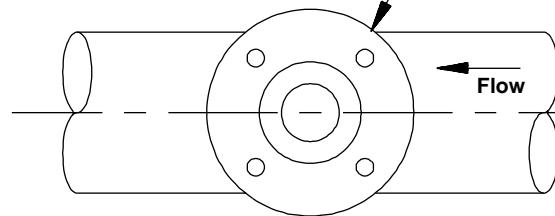
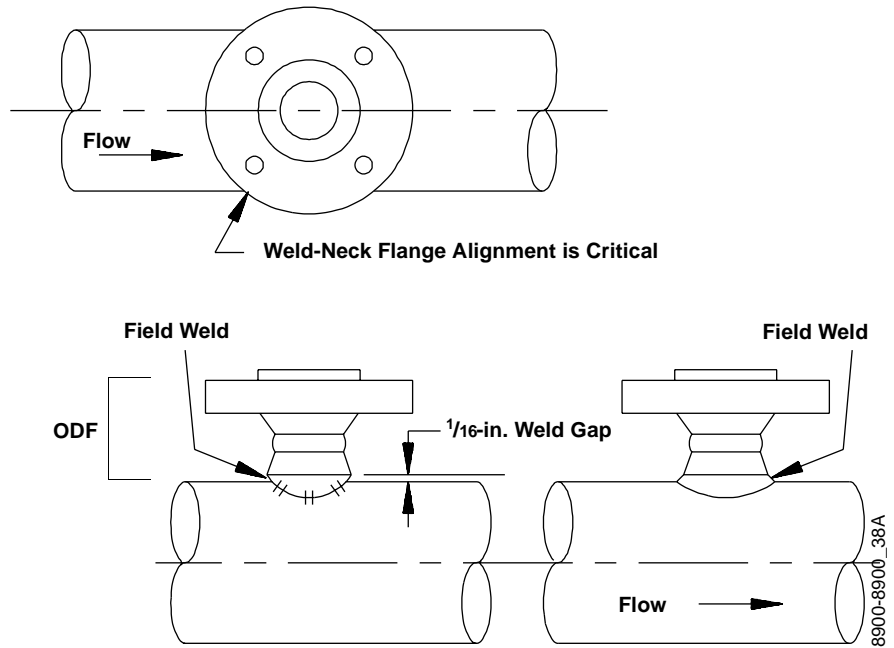


FIGURE 8-8.  
Weld Fitting/Weld-Neck Flange  
Assembly for Gas Service.



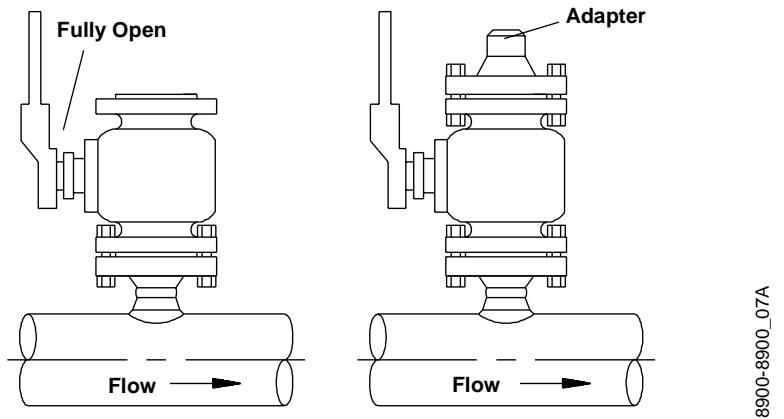
**STEP 4:  
ATTACH THE UNIT  
ISOLATION VALVE**

Install the unit isolation valve to the close nipple using proper thread sealant. The valve stem must be positioned to provide clearance for the Flo-Tap insert/retract mechanism, as shown in Figure 8-9. Verify the isolating valve is in the fully open position.

**STEP 5:  
ATTACH THE ADAPTER**

Fasten the special adapter flanged nipple to the unit isolation valve, as shown in Figure 8-9.

FIGURE 8-9.  
Valve Stem and Adapter Positioning.

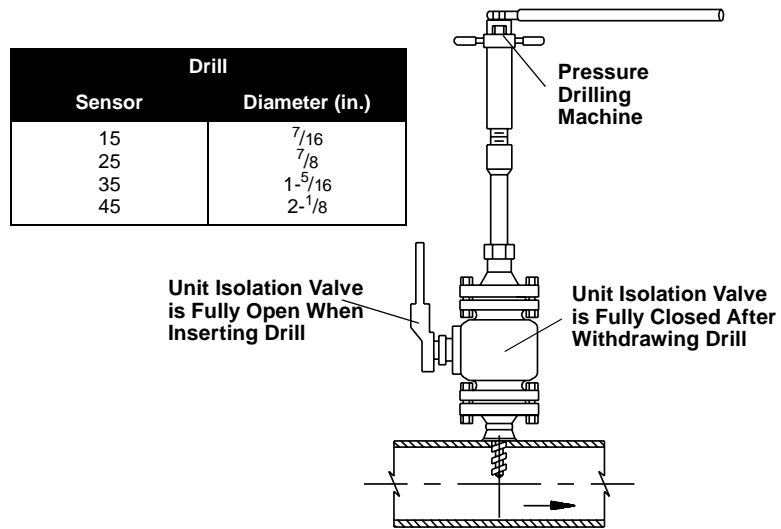


**STEP 6:  
ATTACH THE PRESSURE  
DRILLING MACHINE**

Install the drill bit and adapter nipple into the pressure drilling machine. Use the chart in Figure 8-10 to determine the drill bit size according to the size of the sensor. Attach the machine to the special flanged nipple, as shown in Figure 8-10.



FIGURE 8-10.  
Pressure Drilling Diagram.



8900-8900\_08A

**STEP 7:  
DRILL THE HOLE**

Drill the hole through the pipe wall in accordance with the instructions supplied with the drilling machine.

The hole is completely drilled when resistance to the hand cranking reduces, or when the air or hydraulic drilling motor speeds up. After the hole is drilled, retract the drill fully beyond the unit isolation valve.

**STEP 8:  
REMOVE THE  
DRILLING MACHINE**

1. Withdraw the drill past the valve.
2. Close the unit isolation valve.
3. Bleed and remove the drilling machine and special flanged nipple.
4. Check the unit isolation valve and welds for leakage.

**STEP 9:  
INSTALL THE  
FLO-TAP ASSEMBLY**

Install the complete Flo-Tap assembly onto the unit isolation valve as shown in Figure 8-11 below.

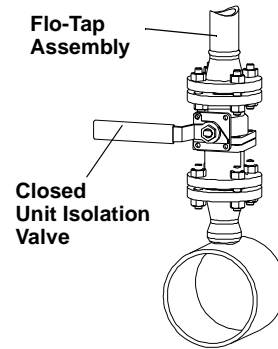
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**NOTE**

When installing the Flo-Tap assembly, take care not to scratch or dent any portion of the sealing surfaces.

---

FIGURE 8-11.  
Flo-Tap Assembly on the Closed  
Unit Isolation Valve.



8900-8900\_09A

1. Install the complete Flo-Tap assembly (fully retracted) on the unit isolation valve by threading the close nipple into the valve using the proper thread sealant compound. The flow arrow on the head must point in the direction of the flow
2. Point the arrow in the direction of the flow.
3. Use the gasket and flange bolts supplied to fasten the Flo-Tap assembly to the isolation valve.
4. Tighten the nuts in a cross pattern to compress the gasket evenly.
5. Ensure that the vent valves on the Annubar are *closed* before proceeding with the next step.

**STEP 10:  
OPEN THE  
ISOLATION VALVE**

1. Slowly open the isolation valve.
2. Check the entire installation for leakage.
3. Tighten connections as required or reapply thread sealant to repair any leakage.

**STEP 11:  
TIGHTEN THE BOLTS**

Alternately tighten the packing gland bolts as required to eliminate leakage. *Do not overtighten.*

**STEP 12:  
INSERT THE SENSOR**

Insert the sensor with one of the two drive options available on the Annubar Flo-Tap; standard drive (IHR) or gear drive (IHD). Follow the instructions for the drive option used by your Annubar, then proceed with step 12 on page 8-10.

**Standard Drive (IHR)**

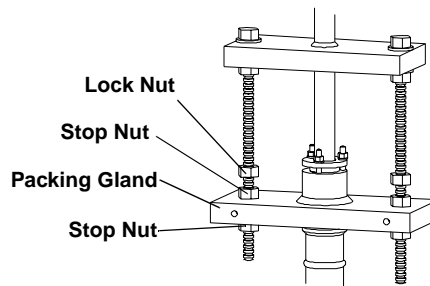
1. Position the retract drive nuts near the orange stripe on the threaded rods before initiating insertion.
2. Insert the sensor by rotating the insert drive nuts clockwise as viewed from the top. The nuts must be tightened alternately, about two turns at a time, to prevent binding caused by unequal loading.
3. Continue this procedure until the sensor firmly contacts the opposite pipe wall.

**NOTE**

Do not over-insert the sensor as damage to the sensor or pipe may occur.

4. After the sensor is fully inserted, with the tip solidly against the pipe wall, set the insertion stop nuts in place.
5. Tighten the nuts on either side of the packing gland against the gland.
6. Tighten the second nut against the first as a lock nut, as shown in Figure 8-12.

FIGURE 8-12.  
Setting the Stop Nut and Lock Nut.



8900-8900\_10A

**NOTE**

Refer to the tag attached to the Annubar for insertion stop nut location instructions. The orange paint stripe on the rods alert the installer that the sensor is approaching full insertion.

### Gear Drive (IHD)

1. Insert the Annubar sensor by rotating the crank clockwise. If a power drill with an adapter is used, do not exceed 200 rpm.
2. Continue rotating the crank until the sensor firmly contacts the opposite side of the pipe.
3. Secure the drive by inserting the drive lock pin, as shown in Figure 8-13.

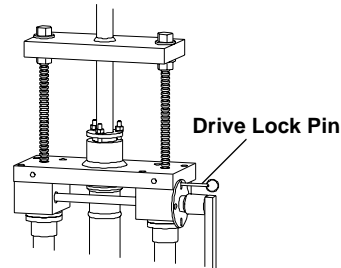
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**NOTE**

For operating and maintenance procedures for the gear drive option, see DS-1635.

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FIGURE 8-13.  
Insert the Drive Lock Pin.



8900-8900\_11A

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**NOTE**

Refer to the tag attached to the Annubar for insertion stop nut location instructions. The orange paint stripe on the rods alert the installer that the sensor is approaching full insertion. Remove the drill and complete the insertion manually until the sensor firmly contacts the pipe wall.

---

### STEP 13: CHECK FOR LEAKAGE

Inspect the packing gland for leakage. Tighten any bolts as required to stop leakage.

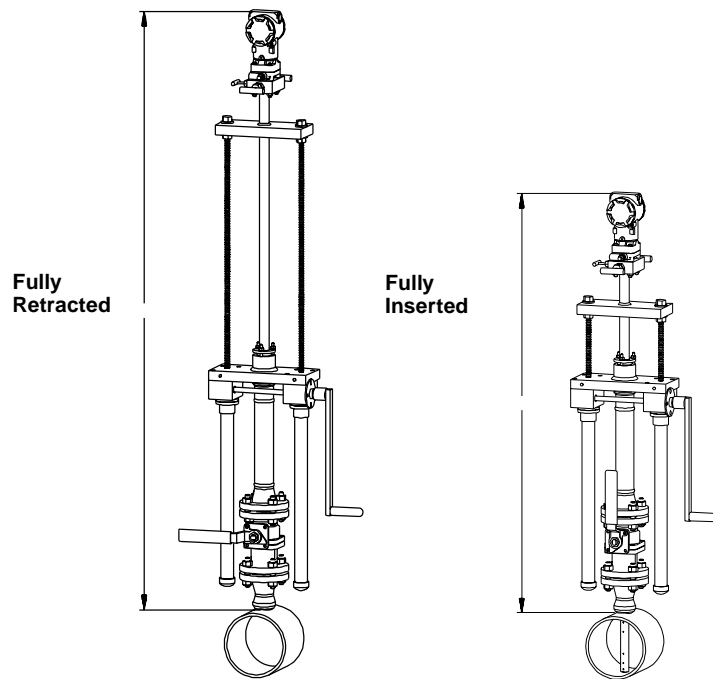
**STEP 14:  
RETRACT THE SENSOR**

Retract the sensor with one of two drive options available on the Annubar Flo-Tap; standard drive (IHR) or gear drive (IHD). Follow the instructions for the drive option used by your Annubar, then proceed with step 16 on page 8-11.

**Standard Drive (IHR)**

1. Retract the Flo-Tap by rotating the retract drive nuts clockwise as viewed from the top. The nuts must be turned alternately, about two turns at a time, to prevent binding caused by unequal loading.
2. Continue this procedure until the rod end nuts are against the packing body mechanism.

FIGURE 8-14.  
Annubar Flo-Tap at Full  
Retraction and Insertion.



8900-8900V25A, 8900V26A

**⚠ WARNING**

Personal hazard! To prevent injury, remove pressure and drain pipe or cage nipple assembly before installing or removing sensor.

**Gear Drive (IHD)**

1. Remove the drive lock pin.
2. Retract the sensor by rotating the crank counterclockwise. If a power drill with adapter is used, do not exceed 200 rpm.
3. Retract until the rod end nuts are against the packing body mechanism.

**STEP 16: CLOSE THE  
ISOLATION VALVE**

After the sensor is fully retracted, the Flo-Tap unit isolation valve may be closed to isolate the probe from the pipe.

**STEP 17: REMOVE THE  
FLO-TAP ASSEMBLY**

The Flo-Tap may be removed entirely if desired by unbolting the cage nipple from the unit isolation valve. If the Annubar is to be removed entirely from the isolation valve, the cage nipple must be depressurized. Open the equalizer valve on the Annubar head, then open the vent valve on either the high or low side of the Annubar.



## Hardware Installation for Annubar Threaded Flo-Tap (Medium Pressure)

### ANNUBAR MODELS:

DMT+15S

DMT+25S

DMT+35S

This section provides hardware installation instructions for the Annubar Threaded Flo-Tap used in either a horizontal or vertical pipe. Installation procedures are similar for all services. Service-specific instructions are provided where necessary; otherwise, all instructions in this section apply to all services.

If remote mounting of the electronics is required, use this section for the hardware installation. Then, see **Section 10: Annubar Remote Mounting** for electronics installation.

- The direct mount maximum service temperature is 500 °F (260 °C).
- The electronics must be remote mounted when service temperatures exceed 500 °F (260 °C).

### SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

#### **WARNING**

##### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

#### **WARNING**

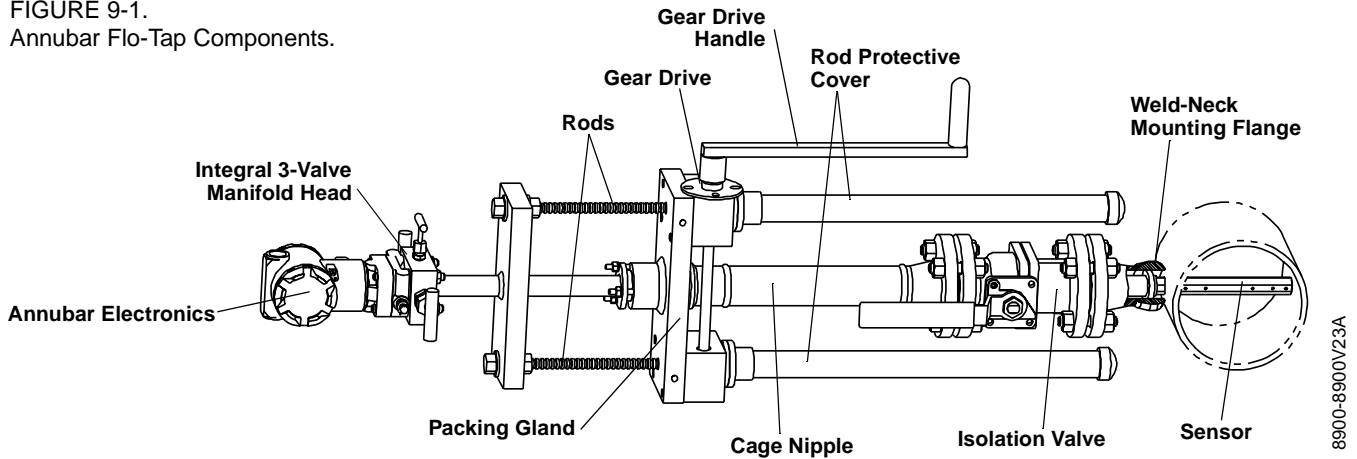
##### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

## ANNUBAR FLO-TAP COMPONENTS

Figure 9-1 identifies the components of the Annubar Flo-Tap.

FIGURE 9-1.  
Annubar Flo-Tap Components.



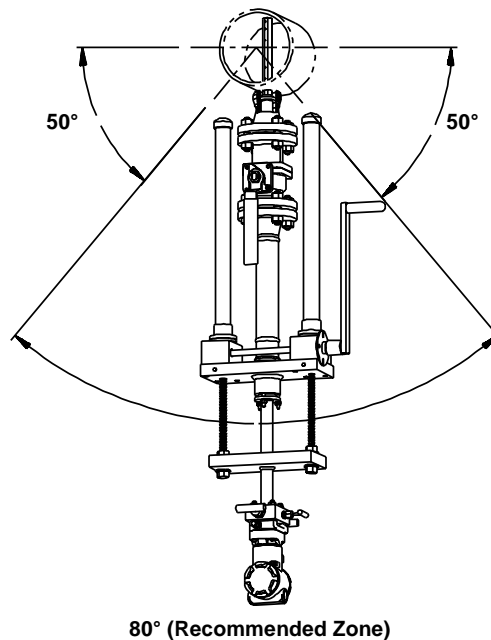
### STEP 1: DETERMINE THE PROPER ORIENTATION OF THE ANNUBAR

The orientation of the Annubar depends upon two factors: the orientation of the pipe that will receive the flowmeter, and the service that uses the pipe. The following sections provide illustrations of the possible pipe orientations and services. After determining the Annubar's orientation, proceed with step 2 on page 9-4.

#### Liquid or Steam Service in a Horizontal Pipe

Install the Annubar within 40 degrees of the vertical axis to prevent air from becoming entrapped within the sensor probe. *Do not position the Annubar within 50 degrees of the horizontal axis unless full bleeding of air from the probe is possible.* Figure 9-2 illustrates the recommended location for the Annubar when used with liquid or steam service.

FIGURE 9-2.  
Liquid or Steam Service  
in a Horizontal Pipe.

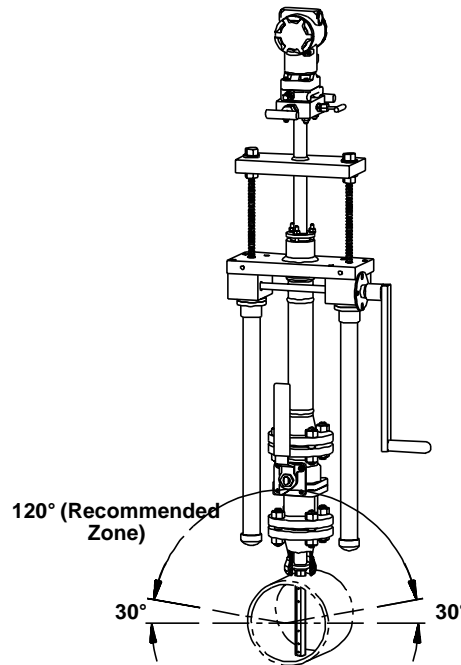




### Gas Service in a Horizontal Pipe

Install the Annubar Flo-Tap in the upper half of the pipe, *but not within 30 degrees of the horizontal axis*. This orientation will prevent condensate from becoming entrapped in the sensor probe. Figure 9-3 illustrates the recommended location of the Annubar when used with gas service.

FIGURE 9-3.  
Gas Service in a Horizontal Pipe.



8900-8900V27A

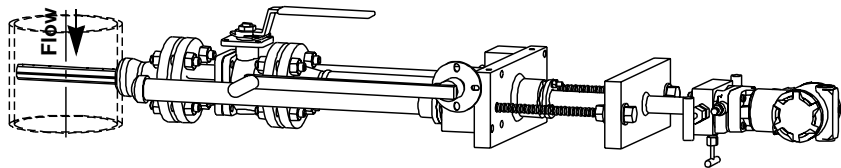
### Liquid or Gas Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 9-4.

#### NOTE

Verify that the pipe pressure and temperature are within the rated limits of the Flo-Tap Annubar as shown on the Annubar tag or by the flow calculation provided by the factory.

FIGURE 9-4.  
Liquid or Gas Service in a Vertical Pipe.



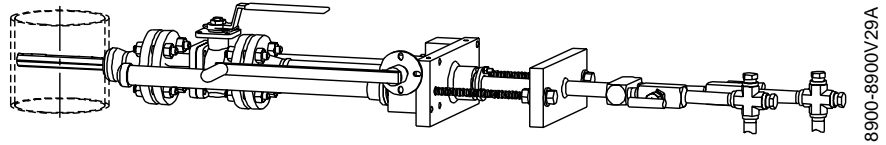
8900-8900V28A

## Steam Service in a Vertical Pipe

Install the Annubar anywhere around the circumference of the pipe, as shown in Figure 9-5.

- Annubar electronics must be remote mounted when used with steam service in a vertical pipe installations. See **Section 8: ProBar Remote Mounting** for instructions.

FIGURE 9-5.  
Steam Service in a Vertical Pipe.



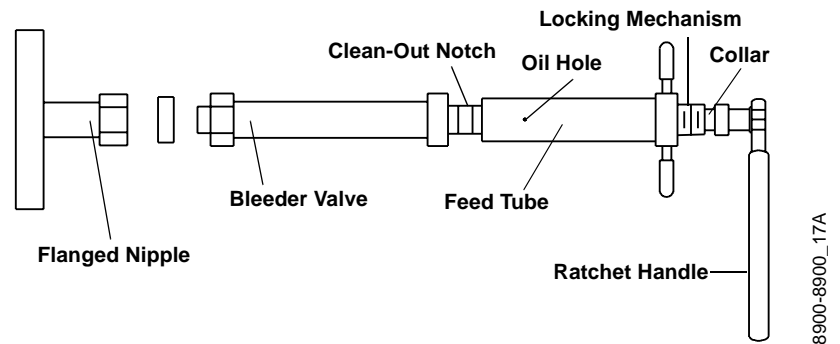
## STEP 2: OBTAIN THE REQUIRED WELDING EQUIPMENT AND HARDWARE

All hardware required for installation under pressure is furnished with the Flo-Tap. The required hardware is shown in Figure 9-6.

### NOTE

During insertion and retraction, the flow rate must be reduced below the limits shown on the Annubar tag.

FIGURE 9-6.  
Pressure Installation Hardware.



The additional welding equipment, pressure drilling machine and the special tooling required is as follows.

1. Welding equipment.
2. Pressure (hot-tap) drilling machine: Mueller D-5, T.D. Williamson T-101, 360 or equivalent.  
Maximum working pressure = 1440 psig @ 100 °F, or  
700 psig @ 700 °F.
3. A threaded machine adapter nipple that fits the isolation valve, such as those available from Mueller or T.D. Williamson.
4. Drill bit:  $\frac{7}{16}$ -in,  $\frac{7}{8}$ -in,  $1\frac{5}{16}$ -in.
5. Drill holder:  $\frac{7}{16}$ -in,  $\frac{7}{8}$ -in,  $1\frac{5}{16}$ -in.

Items 2 through 5 are available from a drilling machine manufacturer, such as Mueller Co., in Decatur, IL. or T.D. Williamson, in Tulsa, OK. This equipment can usually be purchased locally, or the local utility company may be able to provide pressure drilling, or “hot-tapping” services.

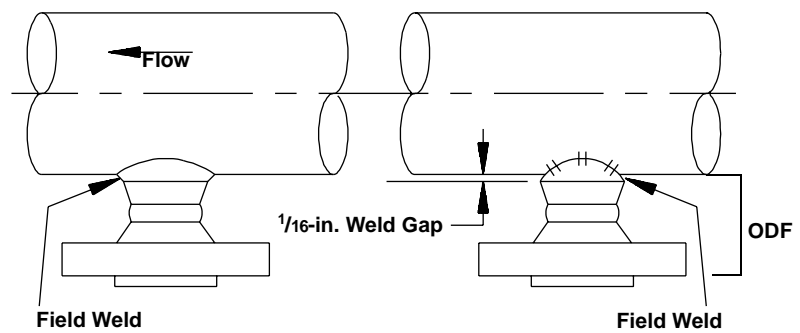
**STEP 3:  
PREPARE THE WELD-  
NECK FLANGE ASSEMBLY**

1. Grind off any paint or other coatings from the pipe in the area where the weld fitting is to be positioned.
2. Position the weld fitting and the tack weld in place using the proper weld gap.
3. Complete the welding of the weld fitting. Install the close nipple using the proper thread sealant compound.
4. Tack weld the weld-neck in place with the proper weld gap.

**CAUTION**

The close nipple threaded connection must be leak-tight; it can not be serviced after hot-tapping.

FIGURE 9-7.  
Weld Fitting Assembly for  
Liquid or Steam Service.



Weld-Neck Flange Alignment is Critical

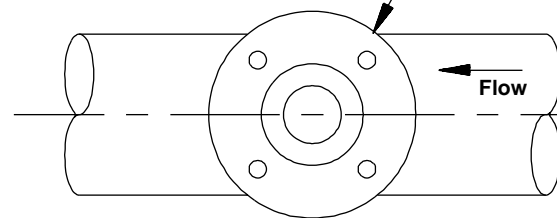
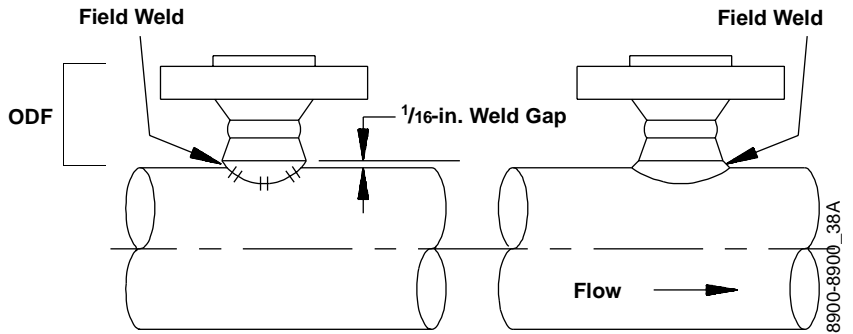
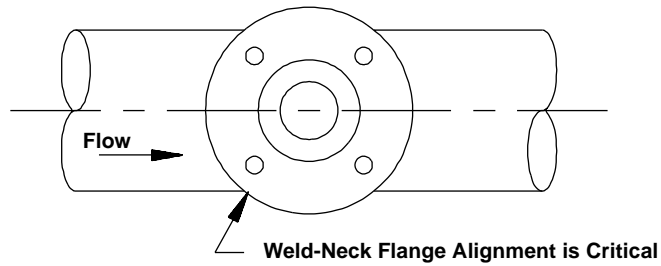


FIGURE 9-8.  
Weld Fitting/Weld-Neck Flange  
Assembly for Gas Service.



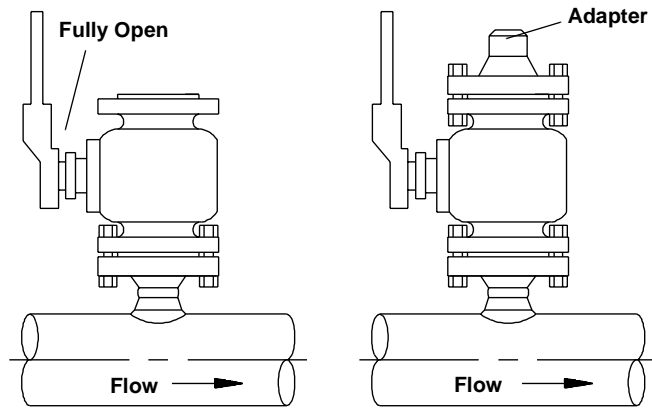
**STEP 4:  
ATTACH THE UNIT  
ISOLATION VALVE**

Install the unit isolation valve to the close nipple using proper thread sealant. The valve stem must be positioned to provide clearance for the Flo-Tap insert/retract mechanism, as shown in Figure 9-9. Verify the isolating valve is in the fully open position.

**STEP 5:  
ATTACH THE ADAPTER**

Fasten the special adapter flanged nipple to the unit isolation valve, as shown in Figure 9-9.

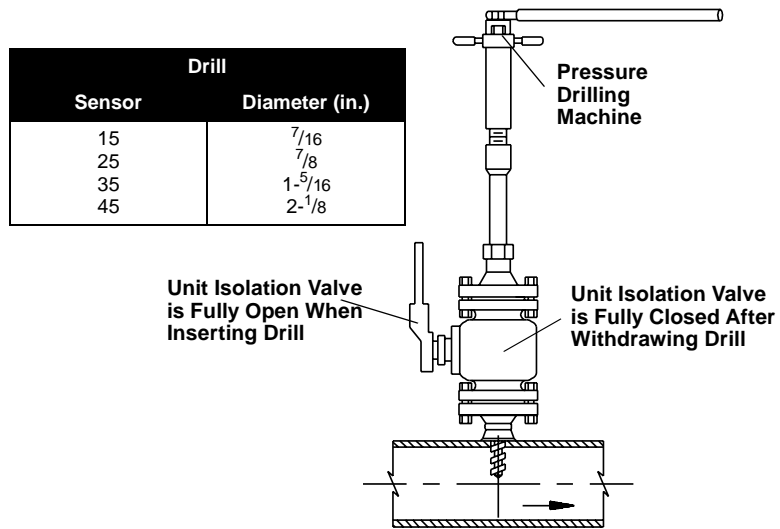
FIGURE 9-9.  
Valve Stem and Adapter Positioning.



**STEP 6:  
ATTACH THE PRESSURE  
DRILLING MACHINE**

Install the drill bit and adapter nipple into the pressure drilling machine. Use the chart in Figure 9-10 to determine the drill bit size according to the size of the sensor. Attach the machine to the special flanged nipple, as shown in Figure 9-10.

FIGURE 9-10.  
Pressure Drilling Diagram.



8900-8900\_08A

**STEP 7:  
DRILL THE HOLE**

Drill the hole through the pipe wall in accordance with the instructions supplied with the drilling machine.

The hole is completely drilled when resistance to the hand cranking reduces, or when the air or hydraulic drilling motor speeds up. After the hole is drilled, retract the drill fully beyond the unit isolation valve.

**STEP 8:  
REMOVE THE  
DRILLING MACHINE**

1. Withdraw the drill past the valve.
2. Close the unit isolation valve.
3. Bleed and remove the drilling machine and special flanged nipple.
4. Check the unit isolation valve and welds for leakage.

**STEP 9:  
INSTALL THE  
FLO-TAP ASSEMBLY**

Install the complete Flo-Tap assembly onto the unit isolation valve as shown in Figure 9-11 below.

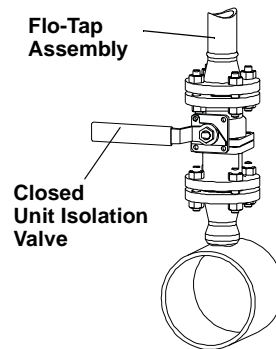
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**NOTE**

When installing the Flo-Tap assembly, take care not to scratch or dent any portion of the sealing surfaces.

---

FIGURE 9-11.  
Flo-Tap Assembly on the Closed  
Unit Isolation Valve.



8900-8900\_09A

1. Install the complete Flo-Tap assembly (fully retracted) on the unit isolation valve by threading the close nipple into the valve using the proper thread sealant compound. The flow arrow on the head must point in the direction of the flow
2. Point the arrow in the direction of the flow.
3. Use the gasket and flange bolts supplied to fasten the Flo-Tap assembly to the isolation valve.
4. Tighten the nuts in a cross pattern to compress the gasket evenly.
5. Ensure that the vent valves on the Annubar are *closed* before proceeding with the next step.

**STEP 10:  
OPEN THE  
ISOLATION VALVE**

1. Slowly open the isolation valve.
2. Check the entire installation for leakage.
3. Tighten connections as required or reapply thread sealant to repair any leakage.

**STEP 11:  
TIGHTEN THE BOLTS**

Alternately tighten the packing gland bolts as required to eliminate leakage. *Do not overtighten.*

**STEP 12:  
INSERT THE SENSOR**

Insert the sensor with one of the two drive options available on the Annubar Flo-Tap; standard drive (IHR) or gear drive (IHD). Follow the instructions for the drive option used by your Annubar, then proceed with step 12 on page 9-10.

**Standard Drive (IHR)**

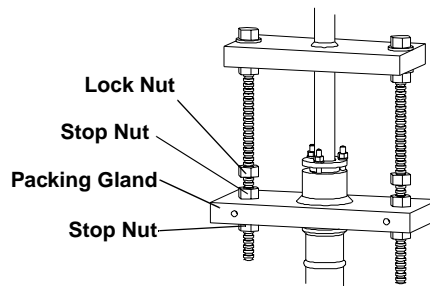
1. Position the retract drive nuts near the orange stripe on the threaded rods before initiating insertion.
2. Insert the sensor by rotating the insert drive nuts clockwise as viewed from the top. The nuts must be tightened alternately, about two turns at a time, to prevent binding caused by unequal loading.
3. Continue this procedure until the sensor firmly contacts the opposite pipe wall.

**NOTE**

Do not over-insert the sensor as damage to the sensor or pipe may occur.

4. After the sensor is fully inserted, with the tip solidly against the pipe wall, set the insertion stop nuts in place.
5. Tighten the nuts on either side of the packing gland against the gland.
6. Tighten the second nut against the first as a lock nut, as shown in Figure 9-12.

FIGURE 9-12.  
Setting the Stop Nut and Lock Nut.



8900-8900\_10A

**NOTE**

Refer to the tag attached to the Annubar for insertion stop nut location instructions. The orange paint stripe on the rods alert the installer that the sensor is approaching full insertion.

### Gear Drive (IHD)

1. Insert the Annubar sensor by rotating the crank clockwise. If a power drill with an adapter is used, do not exceed 200 rpm.
2. Continue rotating the crank until the sensor firmly contacts the opposite side of the pipe.
3. Secure the drive by inserting the drive lock pin, as shown in Figure 9-13.

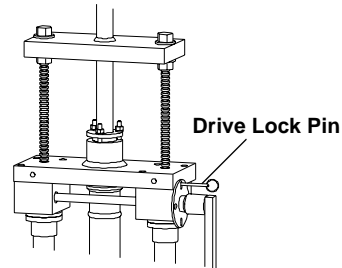
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#### NOTE

For operating and maintenance procedures for the gear drive option, see DS-1635.

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FIGURE 9-13.  
Insert the Drive Lock Pin.



8900-8900\_11A

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#### NOTE

Refer to the tag attached to the Annubar for insertion stop nut location instructions. The orange paint stripe on the rods alert the installer that the sensor is approaching full insertion. Remove the drill and complete the insertion manually until the sensor firmly contacts the pipe wall.

---

### STEP 13: CHECK FOR LEAKAGE

Inspect the packing gland for leakage. Tighten any bolts as required to stop leakage.



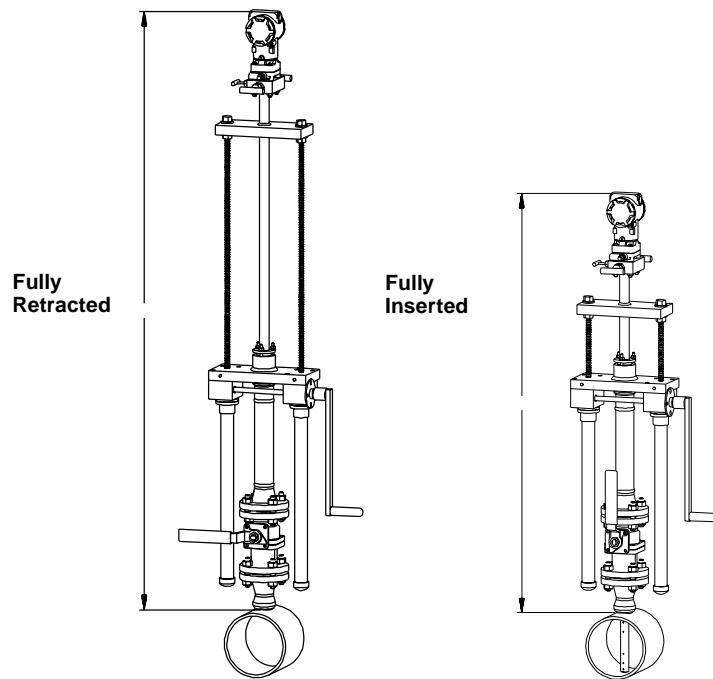
**STEP 14:  
RETRACT THE SENSOR**

Retract the sensor with one of two drive options available on the Annubar Flo-Tap; standard drive (IHR) or gear drive (IHD). Follow the instructions for the drive option used by your Annubar, then proceed with step 16 on page 9-11.

**Standard Drive (IHR)**

1. Retract the Flo-Tap by rotating the retract drive nuts clockwise as viewed from the top. The nuts must be turned alternately, about two turns at a time, to prevent binding caused by unequal loading.
2. Continue this procedure until the rod end nuts are against the packing body mechanism.

FIGURE 9-14.  
Annubar Flo-Tap at Full  
Retraction and Insertion.



8900-8900V25A, 8900V26A

**⚠ WARNING**

Personal hazard! To prevent injury, remove pressure and drain pipe or cage nipple assembly before installing or removing sensor.

**Gear Drive (IHD)**

1. Remove the drive lock pin.
2. Retract the sensor by rotating the crank counterclockwise. If a power drill with adapter is used, do not exceed 200 rpm.
3. Retract until the rod end nuts are against the packing body mechanism.

**STEP 16: CLOSE THE  
ISOLATION VALVE**

After the sensor is fully retracted, the Flo-Tap unit isolation valve may be closed to isolate the probe from the pipe.

**STEP 17: REMOVE THE  
FLO-TAP ASSEMBLY**

The Flo-Tap may be removed entirely if desired by unbolting the cage nipple from the unit isolation valve. If the Annubar is to be removed entirely from the isolation valve, the cage nipple must be depressurized. Open the equalizer valve on the Annubar head, then open the vent valve on either the high or low side of the Annubar.



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## **Annubar Remote Mounting**

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**NOTE**

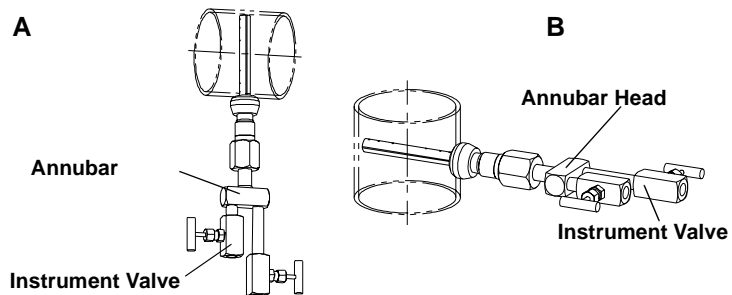
This section provides instructions for remote mounting the Annubar transmitter after having installed the Annubar sensor probe. If you have not installed the sensor probe assembly, please return to the appropriate section and complete the necessary steps.

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This section provides remote mounting installation instructions for the Annubar transmitter for liquid, gas or steam service in either horizontal or vertical pipes.

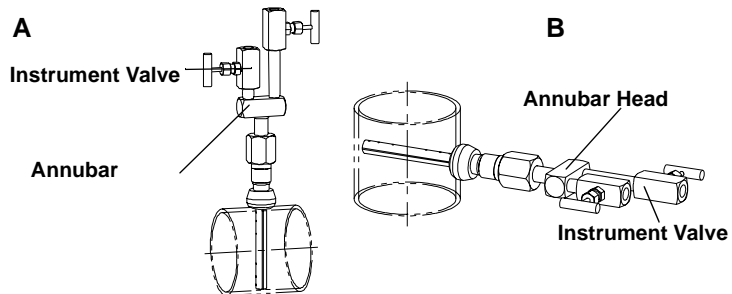
Figures 10-1 through 10-3 illustrate how the Annubar sensor should be aligned for a specific service and pipe orientation prior to remote mounting.

FIGURE 10-1.  
Liquid Service: A (Horizontal Pipe) and B (Vertical Pipe).



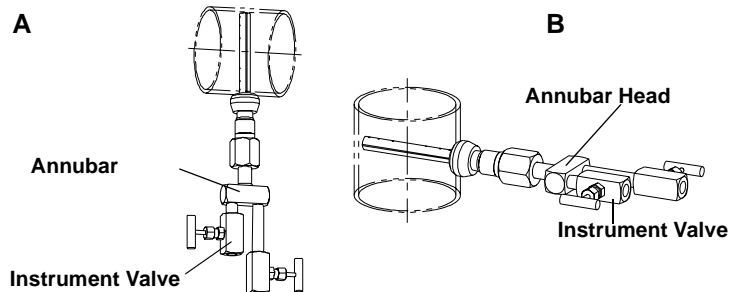
8900-8900\_32A, 8900\_03A

FIGURE 10-2.  
Gas Service: A (Horizontal Pipe) and B (Vertical Pipe).



8900-8900\_33A, 8900\_03A

FIGURE 10-3.  
Steam Service: A (Horizontal Pipe) and B (Vertical Pipe).



8900-8900\_32A, 8900\_03A

## Annubar Valves and Fittings

Throughout the remote mounting process:

- Use only valves and fittings rated for the service pipeline design pressure and temperature as specified in **Section 12: Specifications and Reference Data**.
- Use a pipe thread sealant compound that is rated for use at the service temperature and pressure for all valves and fittings.
- Verify that all connections are tight and that all instrument valves are fully closed.
- Verify that the sensor probe is properly oriented for the intended type of service: liquid, gas or steam (see Figures 10-1, 10-2, and 10-3).

## Impulse Piping

A remote mounted transmitter is connected to the sensor by means of *impulse piping*. Temperatures in excess of 250 °F (121 °C) at the electronics will damage transmitter components; impulse piping allows service flow temperatures to decrease to a point where the transmitter is no longer vulnerable.

Each service uses a different impulse piping arrangement to maintain a single phase of fluid in the piping and Annubar transmitter. For example, liquid applications must maintain a liquid state and allow any air or gas formation to travel up and away from the Annubar transmitter, and gas applications must maintain a gaseous state and allow the formation of liquids to drain down and away from the Annubar transmitter.

The piping used to connect the sensor probe and transmitter must be rated for continuous operation at the pipeline-designed pressure and temperature. A minimum of one-half inch (½-in., 12mm) O.D. stainless steel tubing with a wall thickness of at least 0.035-in. (0.889 mm) is recommended. Threaded pipe fittings are not recommended because they create voids where air can become entrapped and have more possibilities for leakage.

The following restrictions and recommendations apply to impulse piping location.

1. Impulse piping that runs horizontally must slope at least 1-in. per foot (83mm/m).
  - It must slope downwards (toward the Annubar transmitter) for liquid and steam applications.
  - It must slope up (away from the Annubar transmitter) for gas applications.
2. For applications where the pipeline temperature is below 250 °F (121 °C), the impulse piping should be as short as possible to minimize flow temperature changes. Insulation may be required.
3. For applications where pipeline temperature is above 250 °F (121 °C), the impulse piping should have a minimum length of 1-ft. for every 100 °F (38 °C) over 250 °F, which is the maximum operating Annubar transmitter temperature. Impulse piping must be uninsulated to reduce fluid temperature. All threaded connections should be checked after the system comes up to temperature, because connections may be loosened by the expansion and contraction caused by temperature changes.
4. Outdoor installations for liquid, saturated gas, or steam service may require insulation and heat tracing to prevent freezing.
5. For installations where the Annubar transmitter are more than 6-ft. (1.8 m) from the sensor probe, the high and low impulse piping must be run together to maintain equal temperature. They must be supported to prevent sagging and vibration.
6. Run impulse piping in protected areas or against walls or ceilings. If the impulse piping is run across the floor, ensure that it is protected with coverings or kick plates. Do not locate the impulse piping near high temperature piping or equipment.
7. Use an appropriate pipe sealing compound rated for the service temperature on all threaded connections. When making threaded connections between stainless steel fittings, Loctite PST Sealant is recommended.

## EQUIPMENT REQUIRED TO REMOTE MOUNT THE ANNUBAR TRANSMITTER

Proper installation of the Annubar transmitter requires the following tools and equipment.

### Tools Required

Tools required include the following:

1. Open end or combination wrenches (spanners) to fit the pipe fittings and bolts:  $\frac{9}{16}$ -in.,  $\frac{5}{8}$ -in.,  $\frac{7}{8}$ -in.
2. Adjustable wrench: 15-in. (1- $\frac{1}{2}$ -in. jaw).
3. Nut driver:  $\frac{3}{8}$ -in. for vent/drain valves (or  $\frac{3}{8}$ -in. wrench).
4. Phillip's screwdriver: #1.
5. Standard screwdrivers:  $\frac{1}{4}$ -in., and  $\frac{1}{8}$ -in. wide.
6. Pipe wrench: 14-in.
7. Wire cutters/strippers.

### Supplies Required

Supplies required include the following:

1.  $\frac{1}{2}$ -in. tubing (recommended) or  $\frac{1}{2}$ -in. pipe to hook up the Annubar transmitter to the sensor probe. The length required depends upon the distance between the transmitter and the sensor.
2. Fittings including, but not limited to:
  - a. Two tube or pipe tees (for steam or high temperature liquid)
  - b. Six tube/pipe fittings (for tube)
3. Pipe compound or teflon tape (where local piping codes allow).

## INSTRUMENT MANIFOLDS

An instrument manifold is recommended for all installations. A manifold allows an operator to equalize the pressures prior to the zero calibration of the Annubar transmitter as well as to isolate the transmitter from the rest of the system without disconnecting the impulse piping. Although a 3-valve manifold can be used, a 5-valve manifold is recommended. Figure 10-4 identifies the valves on a 5-valve and a 3-valve manifold.

5-valve manifolds provide a positive method of indicating a partially closed or faulty equalizer valve. A closed or faulty equalizer valve will block the DP signal and create errors that may not be detectable otherwise. Figure 10-4 shows the DP manifold assembly and identifies the valves on both types of manifolds, and Table 10-1 provides a description of the valves. The labels for each valve will be used to identify the proper valve in the procedures to follow.

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### NOTE

Some recently-designed instrument manifolds have a single valve actuator, but cannot perform all of the functions available on standard 5-valve units. Check with the manufacturer to verify the functions that a particular manifold can perform. In place of a manifold, individual valves may be arranged so as to provide the necessary isolation and equalization functions.

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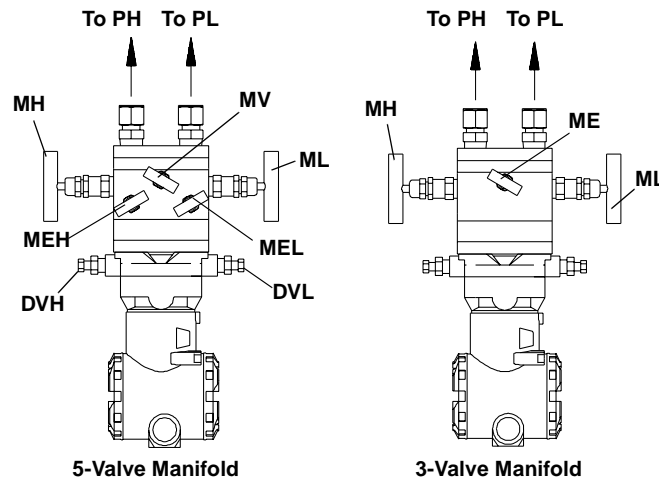
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### NOTE

The Annubar should be shipped with the instrument manifold already bolted to the transmitter.

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FIGURE 10-4.  
Valve Identification for 5-Valve and  
3-Valve Manifolds.



8900-8900\_34A, 8900\_35A

TABLE 10-1.  
Description of Impulse Piping Valves  
and Components.

Name	Description	Purpose
<b>Impulse Piping Valves</b>		
PH PL	Primary Sensor—High Pressure Primary Sensor—Low Pressure	Isolates the flowmeter sensor from the impulse piping system
DVH DVL	Drain/Vent valve—High Pressure Drain/Vent valve—Low Pressure	Drains (for gas service) or vents (for liquid or steam service) the DPtransmitter chambers
BH BL	Blowdown—High Pressure Blowdown—Low Pressure	Allows pipeline pressure to blow and clear sediment from impulse piping
VH VL	Vent Valve—High Pressure Vent Valve—Low Pressure	Allows venting of collected gases from impulse piping in liquid applications
DH DL	Drain Valve—High Pressure Drain Valve—Low Pressure	Allows draining of collect condensate from impulse piping in gas applications
<b>Components</b>		
1	Annubar Transmitter	Reads Differential Pressure
2	Annubar Manifold	Isolates and equalizes Annubar transmitter
3	Vent Chamber	Collects gases in liquid applications
4	Condensate Chamber	Collects condensate in gas applications

Numbers 1–4 in the components section of Table 10-1 are used in Figures 10-5 through 10-10.

## LOCATION FOR THE ANNUBAR TRANSMITTER

### Liquid Service up to 250 °F (121 °C)

#### Recommended Location

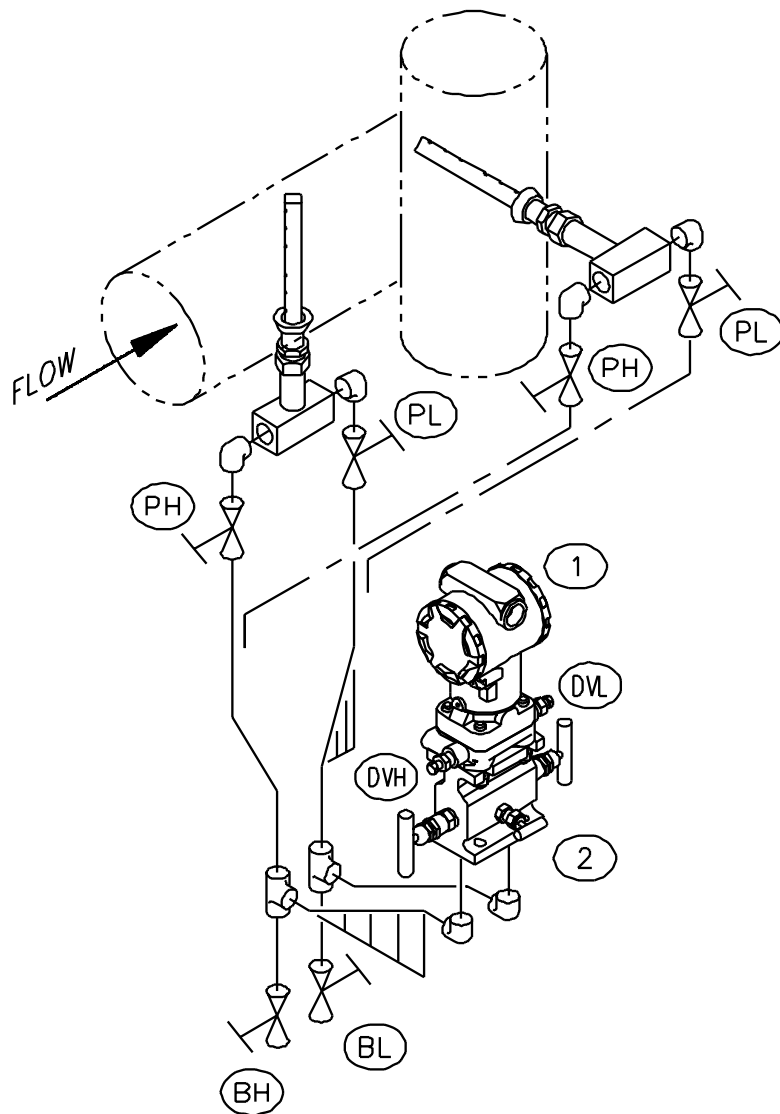
The location for the Annubar transmitter depends upon the service to be used.

(See page 10-10 for liquid service above 250 °F.)

The transmitter may be installed in one of two ways, depending on the space limitations of the installation site. Refer to Figures 10-5 and 10-6 to help you determine which installation variation to use.

The recommended installation mounts the Annubar transmitter below the primary sensor to ensure that air will not be introduced into the impulse piping or the transmitter. Figure 10-5 illustrates the recommended transmitter location for use in either a horizontal or vertical pipe.

FIGURE 10-5.  
Recommended Transmitter  
Installation for Liquid Service  
up to 250 °F (121 °C).



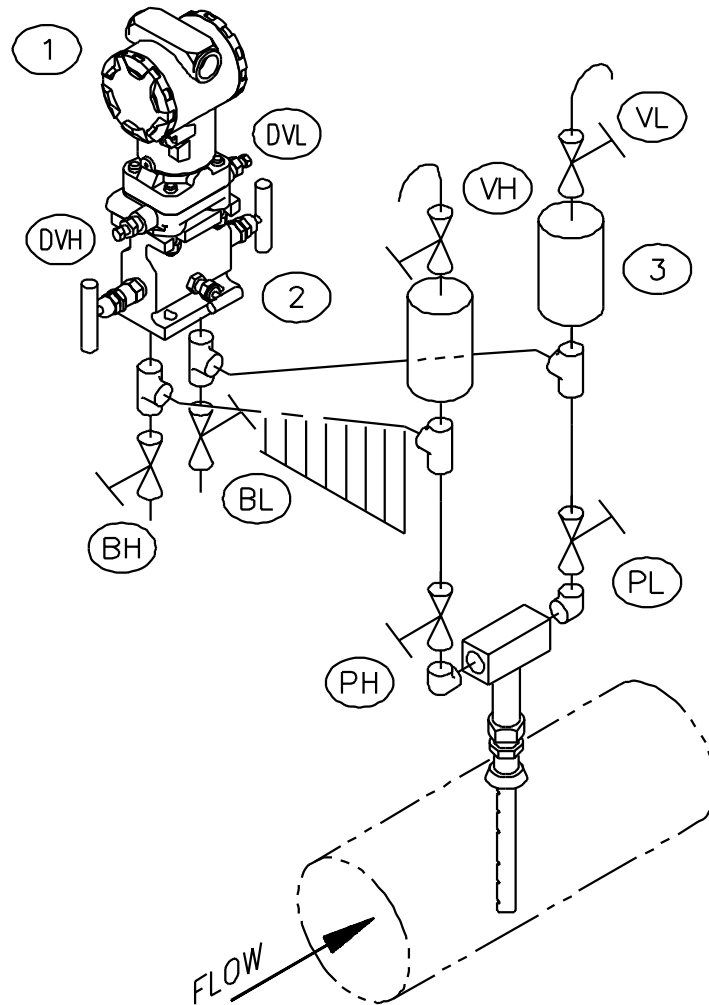
8900-8900\_21A



## Alternate Location

When it is impossible to mount the Annubar transmitter below the pipeline, mount the Annubar transmitter above the pipeline using the arrangement shown in Figure 10-6. The alternate installation requires periodic maintenance to assure that air is vented from the chambers. The alternate location can be used with horizontal pipes only, as shown in Figure 10-6.

FIGURE 10-6.  
Alternate Transmitter Installation for  
Liquid Service up to 250 °F (121 °C).



8900-8900\_22A

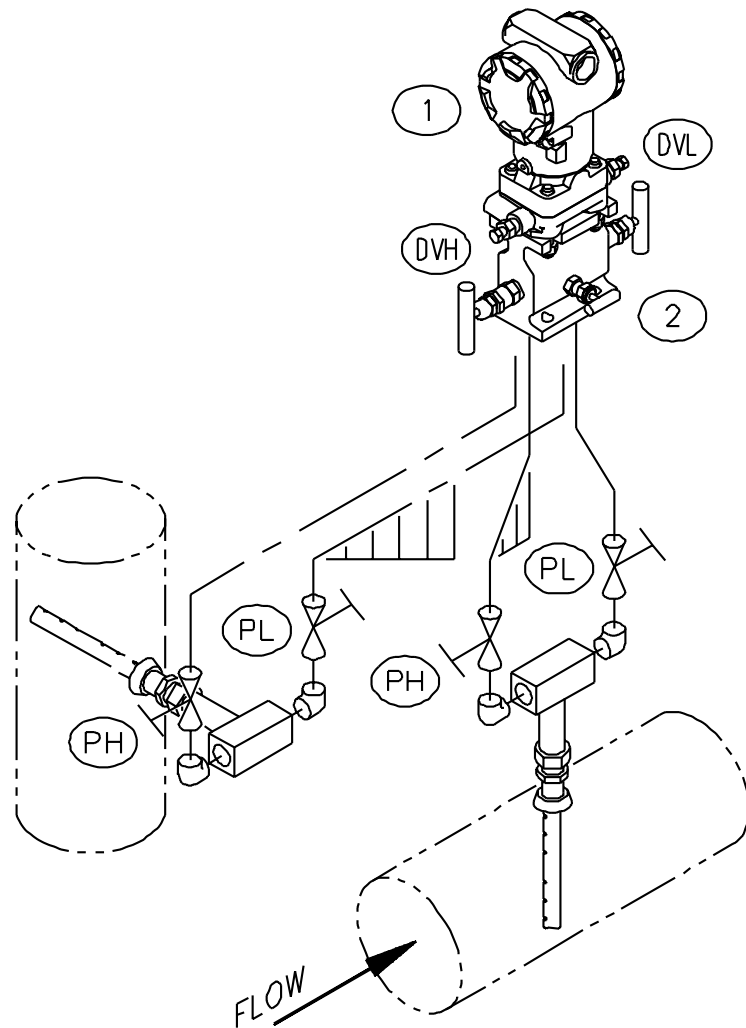
**Gas Service**

The transmitter may be installed in one of two ways, depending on the space limitations of the installation site. Refer to Figures 10-7 and 10-8 to help you determine which installation variation to use.

**Recommended Location**

The recommended installation mounts the Annubar sensor through the top half of the pipe (for horizontal process piping), and the Annubar transmitter above the process piping to prevent condensable liquids from collecting in the impulse piping and DP cell. Figure 10-7 illustrates the recommended transmitter location for use in either a horizontal or vertical pipe.

FIGURE 10-7.  
Recommended Transmitter Installation  
for Gas Service.



8900-8900\_23A



**Steam or Liquid Service  
above 250 °F (121 °C)**

For steam service (at any temperature) or liquid service at temperatures above 250 °F (121 °C), the Annubar transmitter must be installed *below* the process piping.

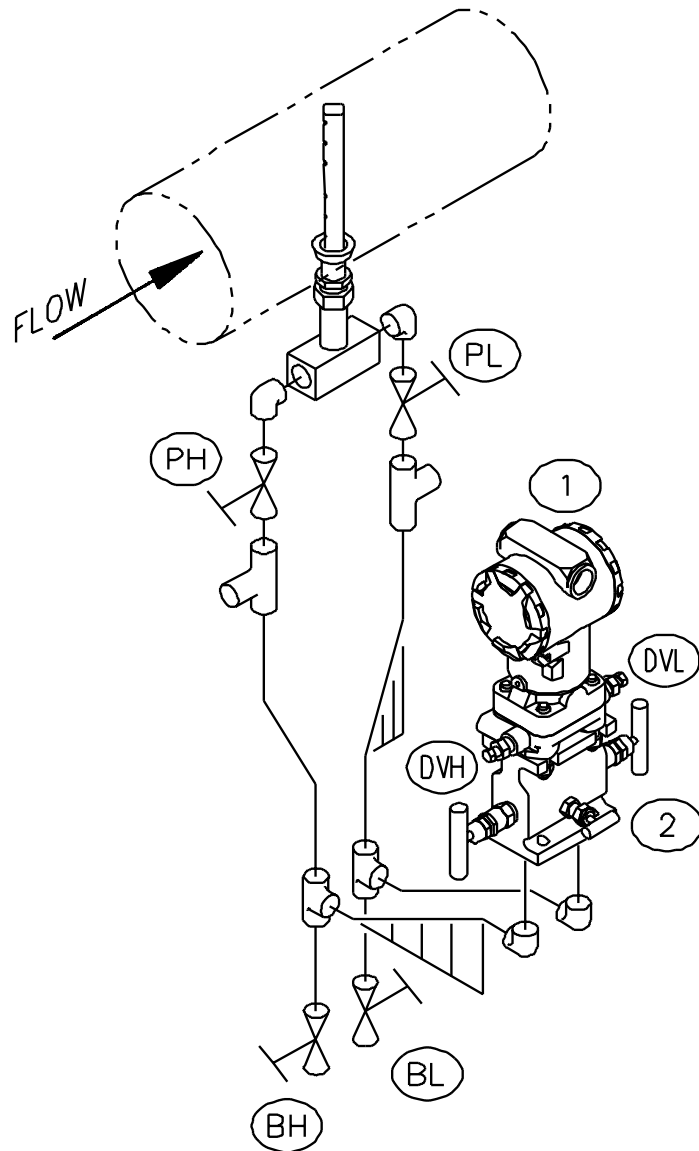
**NOTE**

Steam (or hot water) must not enter the transmitter. Fill the system of impulse piping and Annubar transmitter with cool water before pressurizing the system.

**Horizontal Pipes**

For horizontal steam process piping, the Annubar flow sensor is mounted through the bottom half of the piping, as shown in Figure 10-9. Route impulse piping down to the Annubar transmitter. Fill the system with cool water through the two tee fittings.

FIGURE 10-9.  
Transmitter Installation for Steam or  
Liquid Service above 250 °F (121 °C)  
in a Horizontal Pipe.

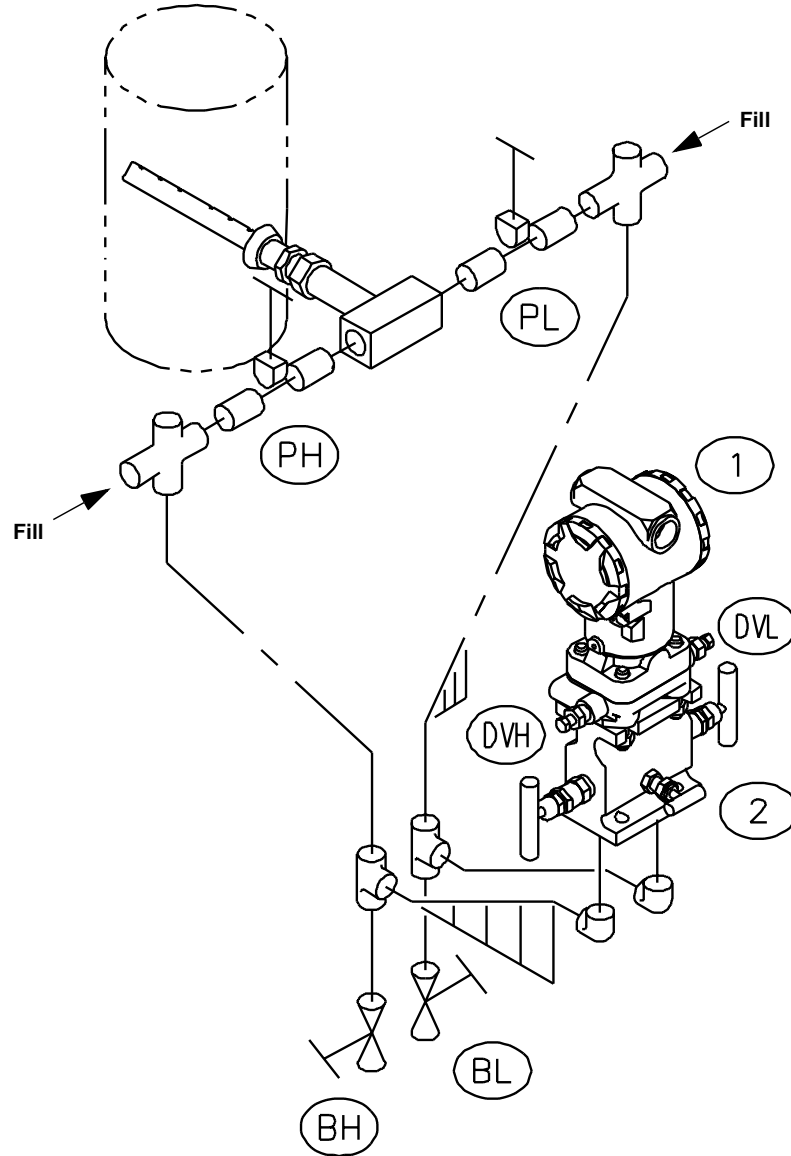


8900-8900\_24A

## Vertical Pipes

Steam service in a vertical pipe uses a Annubar flow sensor constructed specifically for vertical pipelines; it must be mounted through the side of the pipe, as shown in Figure 10-10. Two ½–14 NPT cross fittings are used to fill the system with water. **Insulate the impulse piping from the pipe to and including the PH and PL instrument valves. Do not insulate the NPT cross fittings.**

FIGURE 10-10.  
Transmitter Installation for Steam or  
Liquid Service above 250 °F (121 °C)  
in a Vertical Pipe.



8900-8900\_25A



# Direct Mount Annubar Commissioning

*Commissioning* is the process of testing the Annubar to ensure that it operates accurately and safely.

This section provides instructions for commissioning direct mounted Annubar models in horizontal or vertical pipes.

## NOTE

The commissioning process differs between direct mounted and remote mounted Annubar models. See **Section 12: Remote Mount Annubar Commissioning** for instructions.

## SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

### **WARNING**

#### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

### **WARNING**

#### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

### **DANGER**

If the line is pressurized, serious injury or death could occur by opening valves.

## COMMISSIONING DIRECT MOUNTED ANNUBAR MODELS

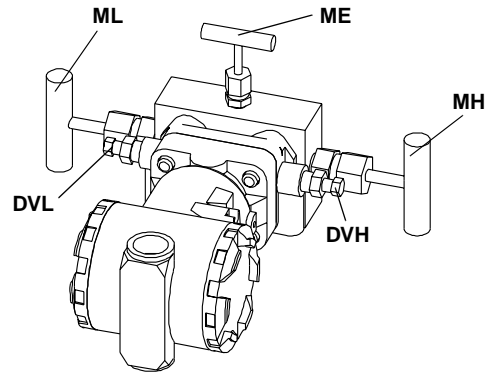
The commissioning process differs according to the service used. The following sections provide commissioning instructions for each type of service.

### Liquid Service

This section provides instructions for commissioning direct mounted Annubar models used for liquid service in horizontal or vertical pipes.

Figure 11-1 identifies the valves used during the commissioning process.

FIGURE 11-1.  
Valve Identification for Direct Mounted Annubar Models in Liquid Service.



8900-8900V01A

Use the following procedure to commission the Annubar.

1. Open the high and low manifold valves MH and ML.
2. Open the equalizer valve ME.
3. Open the drain/vent valves on the transmitter; bleed until no air is apparent in the liquid.
4. Close both drain/vent valves DVL and DVH.
5. Close the high and low manifold valves MH and ML.
6. Check the Annubar zero by noting the transmitter output—this is called a *wet zero*. If the signal reads outside of the range 3.98 mA to 4.02 mA, air is probably still in the system; repeat step 2, and trim zero if necessary.
7. Open the high and low manifold valves ML and MH.
8. Close equalizer valve ME. The system is now operational.

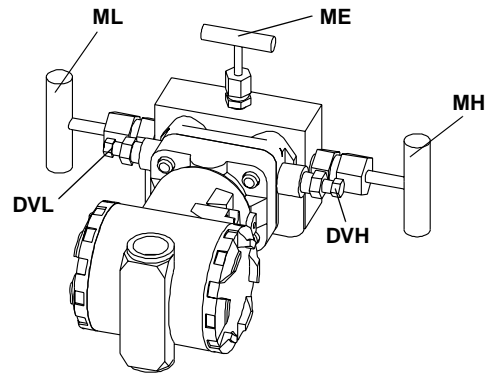


## Gas Service

This section provides instructions for commissioning direct mounted Annubar models used for gas service in horizontal or vertical pipes.

Figure 11-2 identifies the valves used during the commissioning process.

FIGURE 11-2.  
Valve Identification for Direct Mounted  
Annubar Models in Gas Service.



8900-8900V01A

Use the following procedure to commission the Annubar.

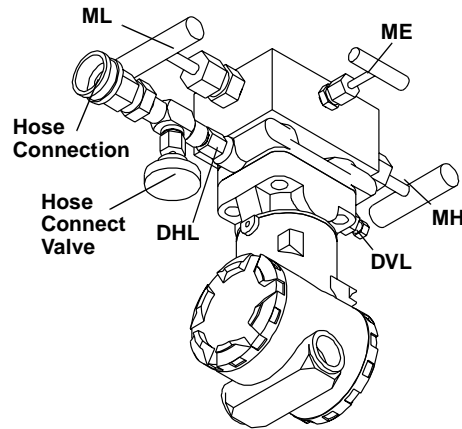
1. Ensure that the pipe is pressurized.
2. Open the drain valves DVL and DVH on the transmitter to ensure that no liquid is present.
3. Open equalization valve ME.
4. Open both high and low side main valves MH and ML.
5. Close drain valves DVL and DVH.
6. Check the transmitter for the 4 mA signal. Trim zero if necessary.
7. Close the equalizer valve ME. The system is now operational.

## Steam Service

This section provides instructions for commissioning direct mounted Annubar models used for steam service in horizontal pipes. Steam service in vertical lines must be remote mounted. Refer to **Section 12: Remote Mount Annubar Commissioning**.

Figure 11-3 identifies the valves used during the commissioning process.

FIGURE 11-3.  
Valve Identification for Direct Mounted  
Annubar Models in Steam Service.



8900-8900V02A

Use the following procedure to commission the Annubar.

1. Ensure that the steam line is depressurized with no steam.
2. Check the transmitter for a dry zero of 4 mA with no water loss.
3. Attach a water supply to the hose connection. The water supply should have a maximum psi of 100.
4. Open the high and low main valves MH and ML and equalizer valve ME.
5. Close low side vent DVL on the transmitter.
6. Open the hose connect valve for a minimum of 30 seconds. Water will flow through both the high and low chambers and into the pipe.
7. Close the high MH for 30 seconds to force water to the ML side.
8. Re-open the MH valve.
9. Open low side vent DVL on the transmitter until no air is observed.
10. Close the vent.
11. Close the hose connect valve.
12. Close both MH and ML.
13. Check the Annubar zero by noting the transmitter output. If the signal reads outside of the range 3.98 mA to 4.02 mA, air is probably still in the system; repeat this procedure from step 2, and trim sensor if necessary.
14. Open MH and ML.
15. Close equalizer valve ME. The system is now operational.

# Remote Mount Annubar Commissioning

*Commissioning* is the process of testing the Annubar to ensure that it operates accurately and safely.

This section provides instructions for commissioning remote mounted Annubar models in horizontal or vertical pipes.

## NOTE

The commissioning process differs between direct mounted and remote mounted Annubar models. See **Section 11: Direct Mount Annubar Commissioning** for instructions.

## SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

### **WARNING**

#### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

### **WARNING**

#### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

### **DANGER**

If the process fluid is caustic or otherwise hazardous, the procedure outlined here must be modified as required to prevent death or serious injury to personnel.

### **DANGER**

If the line is pressurized, serious injury or death could occur by opening valves.

## COMMISSIONING REMOTE MOUNTED FLOWMETERS

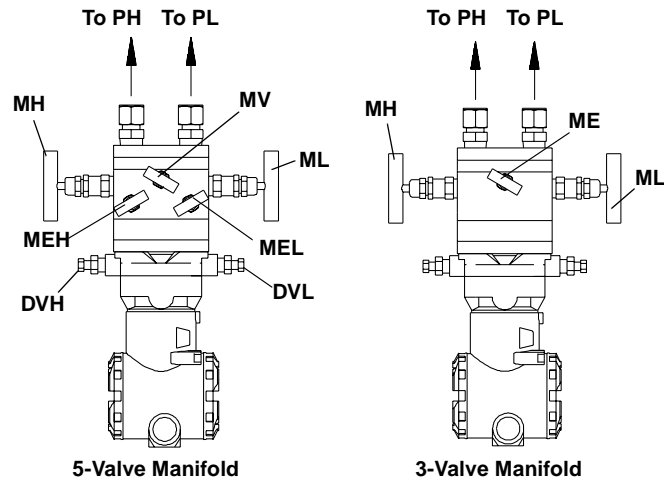
This section contains four procedures to follow in preparation for commissioning a remote mounted Annubar:

1. Identify the location and purpose of manifold valves.
2. Zero the transmitter.
3. Check for system leaks.
4. Perform a zero calibration.

### Annubar Valve Identification

Before beginning the Annubar commissioning process, you should become familiar with the location and purpose of the various valves involved. Figure 12-1 identifies the location of valves for both 5-valve and 3-valve manifolds, and Table 12-1 identifies the purpose of those valves.

FIGURE 12-1.  
Valve Identification: A (5-Valve Manifold) and B (3-Valve Manifold).



8900-8900\_34A, 8900\_35A

TABLE 12-1.  
Description of Impulse Piping Valves and Components

Name	Description	Purpose
<i>Impulse Piping Valves</i>		
PH PL	Primary Sensor—High Pressure Primary Sensor—Low Pressure	Isolates the flowmeter sensor from the impulse piping system
DVH DVL	Drain/Vent valve—High Pressure Drain/Vent valve—Low Pressure	Drains (gases) or vents (liquids) dP transmitter chambers
BH BL	Blowdown—High Pressure Blowdown—Low Pressure	Allows pipeline pressure to blow and clear sediment from impulse piping
VH VL	Vent Valve—High Pressure Vent Valve—Low Pressure	Allows venting of collected gases from impulse piping in liquid applications
DH DL	Drain Valve—High Pressure Drain Valve—Low Pressure	Allows draining of collect condensate from impulse piping in gas applications

## Zero the Transmitter

Before the Annubar transmitter are exposed to line pressure, check the “zero” calibration (or, “dry” zero) by using the following procedure.

1. Open first the equalizer valve(s) MEL and MEH or ME.
2. Close valves MH and ML.
3. Read the Annubar output. It should read within the range 3.98 mA to 4.02 mA. If the output is outside of this range, trim zero.

## Check for System Leaks

Check the system for leaks after installation is complete. A leak in a differential pressure instrument system can produce a difference in pressure that is larger than the signal itself.

Before the system is filled and/or commissioned, it is a simple matter to use compressed air or another inert, compressed gas to check for leaks. The gas pressure must be below the maximum allowed, but at least equal to the normal operating pressure in order to reveal potential leaks. A typical pressure used is 100 psig (690 kPa).

Before pressurizing the system, check for leaks by doing the following:

1. Open equalizer valve(s) MEH, MEL or ME to prevent overpressuring the dP.
2. Close valves PH, PL (unless the piping system is also being pressure-checked), MV, DVH, DVL.
  - If present, also close valves BH and BL or DH and DL.
3. Open valves MH and ML.
4. Install all appropriate tapped plugs.
5. Install a current meter to read the signal, if necessary.

Apply pressure at a convenient point on either the high or low side of the system. Use a suitable leak detection solution and apply to all of the impulse piping, valves, manifold, and connections. A leak is indicated by a continuous stream of bubbles.

### 5-Valve Manifolds

If a 5-valve manifold is installed, the equalizer valves can be tested by performing the following after system leaks are repaired and the system is stable:

1. Close equalizer valves MEH and MEL.
2. Open vent valve MV. There should be no leakage from the manifold vent.
3. Close vent valve MV.
4. Open equalizer valves MEH and MEL.
5. Bleed off the air and remove the source fitting.
6. Return the system to the original configuration. *Use extreme care when bleeding high temperature fluids. Bleed piping may need to be installed.*

## “Calibrate Out” Temperature Effects

Do not begin this procedure until the system leak check has been completed and all leaks have been fixed.

The Annubar’s proportional output-to-flow ratio makes a true “zero” calibration critical for producing accurate measurements. The “zero” calibration procedure is affected by static pressure and ambient temperature, but these effects can be removed by calibrating them “out.”

The effect of static pressure is calibrated out by exposing the Annubar transmitter to the line pressure and performing a “zero” or wet calibration, as described below. In order to calibrate out the effect of ambient temperature, two aspects should be taken into consideration:

1. The transmitter should be located in a place where the ambient temperature does not change rapidly or vary by more than 10 to 15 °F (26 to 29 °C).
2. When commissioning the transmitter, the flowing fluid (condensate/water for steam service) could bring the sensor to a temperature significantly different than the temperature during normal operations. In this situation, perform another “zero” calibration at least 60 minutes after the Annubar has been commissioned. The sensor temperature can be monitored using a HART-based communicator, as described in the Wet Calibration section below.

Although the above effects are relatively small, they significantly affect the accuracy of the Annubar when used with low flows.

Periodic “zero” calibration and/or commissioning is recommended to maintain the accuracy of Annubar. The frequency of this type of maintenance should be established for each individual application.

## Zero or Wet Calibration

Follow this procedure to obtain a true zero at static or “*pipe*” pressure:

1. Open equalizer valves:
  - For 5-valve manifolds, open valves MEH and MEL
  - For 3-valve manifolds, open valves ME and high side MH
2. Close low side valve ML to prevent generating differential pressure.

**COMMISSIONING**

Complete the following tasks before beginning the commissioning procedure:

1. Power the Annubar, if required.
2. Connect an appropriate readout instrument so the differential pressure signal can be monitored.
3. Identify the manifold equalizer valves by their ME prefix.
  - 5-valve manifolds have two equalizer valves, MEH and MEL.
  - 3-valve manifolds have one equalizer valve, ME.
4. Close all valves before commissioning the system.

**Liquid Service below 250 °F (121 °C)**

Refer to Figures and for transmitter location and valve identification for liquid service at temperatures of 250 °F (121 °C) or less. See page 12-7 to commission a remote mounted Annubar for liquid service above 250 °F (121 °C).

1. Ensure that primary instrument valves PH and PL are *closed*.
2. Open valves ME, ML, and MH.
  - For 5-valve manifolds, open valves MEH and MEL.
3. Slowly open valve PL and then PH, which are the primary instrument valves.
4. Open drain/vent valves DVL and DVH to bleed air out of system. Bleed until no air is apparent in the liquid.
5. Close valves DVL and DVH.

**NOTE**

For the alternate transmitter location shown in, open vent valves VH and VL and bleed until no air is apparent in the liquid.

6. Slowly open vent valve MV to bleed out any entrapped air in manifold. Bleed until no air is apparent in the liquid.
  7. Close vent valve MV.
  8. Gently tap the transmitter body, valve manifold, and impulse piping with a small wrench to dislodge any remaining entrapped air.
  9. Repeat steps 2, 2A, and 3.
  10. Close valve PH.
  11. Check the Annubar zero by noting the transmitter output — this is called a *wet zero*. The transmitter should indicate a zero dP (Differential Pressure) signal. If the signal reads outside the range 3.98 mA to 4.02 mA, air is probably still in the system; repeat the procedure from step 2. Trim zero if necessary.
  12. Close equalizer valve(s).
    - For 3-valve manifolds, close valve ME.
    - For 5-valve manifolds, close valves MEH and MEL.
  13. Slowly open valve PH. The system is now operational.
- For 5-valve manifolds only:**
14. Open valve MV. If valve MV is leaking, valves MEH and/or MEL are not fully closed or require repair. This must be done before taking any readings.

## Gas Service

Follow this procedure for commissioning a remote mounted Annubar for gas service. Refer to Figures and for transmitter location and valve identification.

1. For an impulse piping arrangement as shown in (vertical pipe) only, open primary instrument valves PH and PL.
2. Open drain valves DH and DL slowly to allow the condensate to drain.
3. Close valves DH and DL.
4. Ensure that primary instrument valves PH and PL *closed*.
5. Open valves ME, ML and MH.
  - For 5-valve manifolds, open valves MEH and MEL.
6. Slowly open valve PL, the primary high pressure instrument valve.
7. Check transmitter zero by noting the transmitter reading. The transmitter should indicate a “zero” DP signal. If the signal reads outside of the range 3.98 mA to 4.02 mA, condensate may be in the DP transmitter or system; repeat the procedure from step 1 to remove any condensate. A signal outside the range 3.98 mA to 4.02 mA can also be caused by system leaks; check for leaks in the system.
8. Close equalizer valve(s).
  - For 3-valve manifolds, close valve ME.
  - For 5-valve manifolds, close valves MEH and MEL.
9. Slowly open valve PH. The system is now operational.

**For 5-valve manifolds only:**

10. Open valve MV. If valve MV is leaking, valves MEH and/or MEL are not fully closed or require repair. This must be done before taking any readings.



---

**Steam Service or  
Liquid Service above  
250 °F (121 °C)**

Follow this procedure for commissioning a remote mounted Annubar for steam service or for liquid service at a temperature above 250 °F (121 °C). Refer to Figures and for transmitter location and valve identification.

1. Ensure that primary instrument valves PH and PL *closed*; ME, ML and MH are *closed*; and DVL and DVH are *closed*.
    - For 5-valve manifolds, ensure that valves MEH and MEL are *closed*.
  2. Fill tees with water on each side until water overflows.
  3. Open valves MH, ML and equalizer valve ME.
    - For 5-valve manifolds, open equalizer valves MEH and MEL.
  4. Open valves DVL and DVH.
  5. Tap manifold until no air bubbles are visible.
  6. Close both valves DVL and DVH.
  7. Refill tees with water.
  8. Gently tap transmitter body, valve manifold, and impulse piping with a small wrench to dislodge any remaining entrapped air.
  9. Check Annubar zero by noting the transmitter output — this is called a *wet zero*. The transmitter should indicate a “zero” DP signal. If the signal reads outside of the range 3.98 mA to 4.02 mA, air is probably still in the system; repeat this procedure from step 2. Trim zero if necessary.
  10. Close equalizer valve ME.
    - For 5-valve manifolds, close equalizer valves MEH and MEL.
  11. Replace plugs in tees.
  12. Slowly open valves PH and PL. The system is now operational.
- For 5-valve manifolds only:**
13. Open valve MV. If valve MV is leaking, valves MEH and/or MEL are not fully closed or require repair. This must be done before taking any readings.



## Optional RTD Maintenance: Model 3051 Transmitter

### ANNUBAR RTD MAINTENANCE

This section covers maintenance procedures for the RTD option available with Model 3051 transmitters.

### SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

#### **WARNING**

**Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

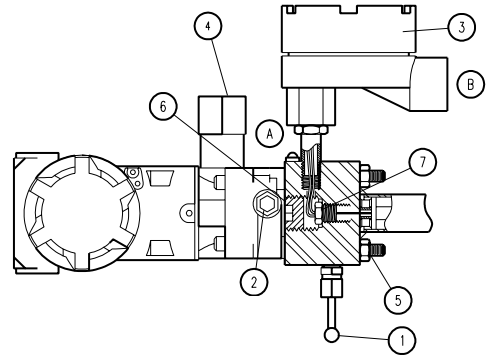
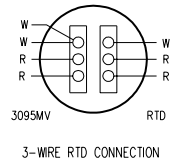
#### **WARNING**

**Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

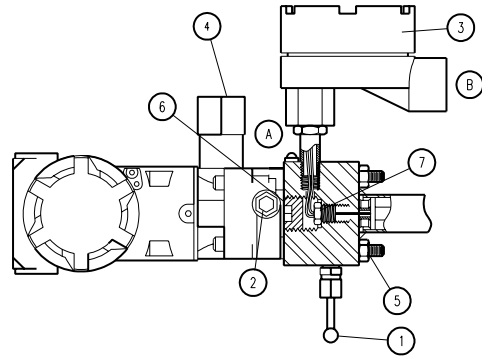
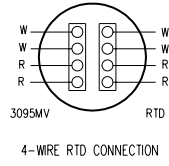
# Annubar Averaging Pitot Tube

FIGURE 13-1.  
3-Wire Integral RTD Drawing.



1295-34MIS1A3

FIGURE 13-2.  
4-Wire Integral RTD Drawing.



1295-34MIS1A2

## Replacing a Direct Mount RTD

If an RTD needs to be replaced on a direct mounted Annubar, proceed as follows:

1. Close instrument valves to ensure that the pressure is disconnected from the transmitter.
2. Open the bleed valves on the transmitter to remove all pressure.
3. Remove the cap.
4. Remove the RTD wiring only from the terminal.
5. Remove the hex nuts.
6. Remove the transmitter.
7. Remove the ½-14 NPT plug.
8. Pull the RTD wire out of the nipple and remove the RTD. The RTD is in a thermowell, so no live line pressure will be present.
9. Install the new RTD and thread the wires through the nipple.
10. Reinstall the ½-in. NPT plug.
11. Use the same teflon gaskets to reinstall the transmitter to the Annubar sensor head.
12. Use a torque wrench to tighten the stainless steel hex nuts in a cross pattern to 300 in-lbs (650 in-lbs for carbon steel hex nuts).
13. Reconnect the RTD wires to the terminal. This diagram is for a typical RTD transmitter wiring connection.
14. Refasten the transmitter hex nut to the transmitter and tighten.
15. Open the instrument valves.

## Replacing a Remote Mount RTD

If an RTD needs to be replaced on a remote mounted Annubar, proceed as follows:

1. Close instrument valves to ensure that the pressure is disconnected from the transmitter.
2. Open the bleed valves on the transmitter to remove all pressure.
3. Remove the cap.
4. Remove the RTD wiring only from the terminal.
5. Remove the Terminal Housing from the Annubar head.
6. Pull the RTD wire out of the nipple and remove the RTD. The RTD is in a thermowell, so no live line pressure will be present.
7. Install the new RTD and thread the wires through the nipple.
8. Install the Terminal Housing onto the Annubar head.
9. Reconnect the RTD wires to the terminal. This diagram is for a typical RTD transmitter wiring connection.
10. Open the instrument valves.



# Optional RTD Maintenance: Model 3095 Transmitter

## ANNUBAR RTD MAINTENANCE

This section covers RTD maintenance procedures.

## SAFETY MESSAGES

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Please refer to the following safety messages before performing any operation in this section.

### **WARNING**

#### **Explosions could result in death or serious injury:**

- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.
- Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

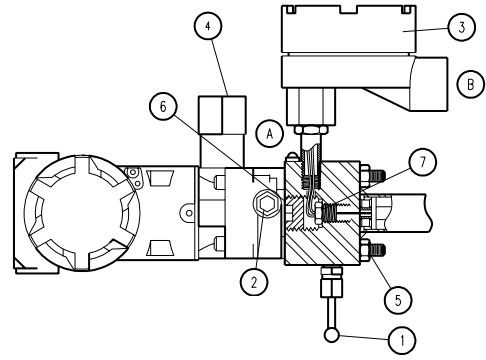
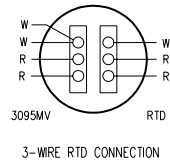
### **WARNING**

#### **Failure to follow these installation guidelines could result in death or serious injury:**

- Make sure only qualified personnel perform the installation.

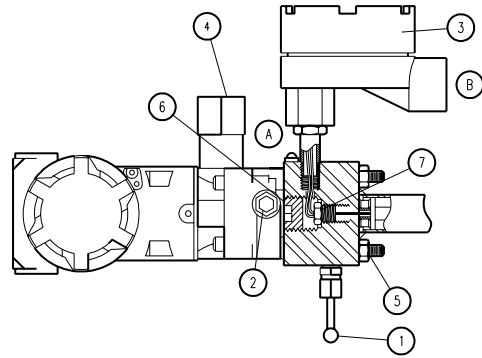
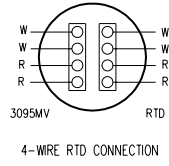
# Annubar Averaging Pitot Tube

FIGURE 14-1.  
3-Wire Integral RTD Drawing.



1295-34MIS1A3

FIGURE 14-2.  
4-Wire Integral RTD Drawing.



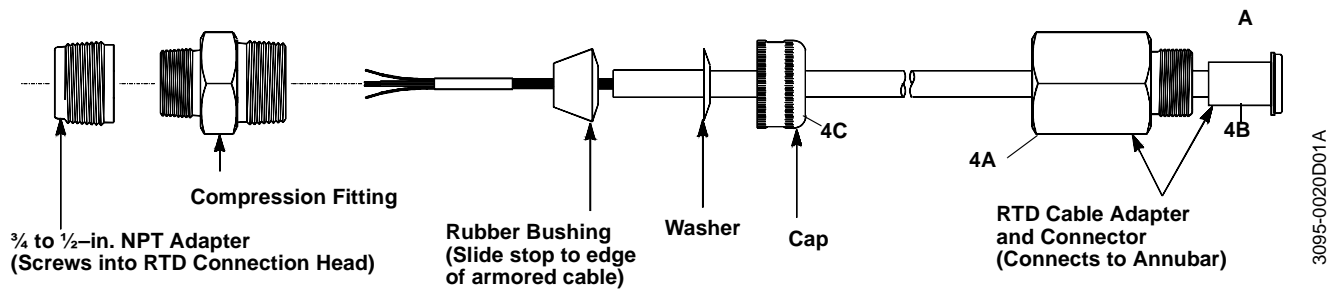
1295-34MIS1A2



## Replacing a Direct Mount RTD

If an RTD needs to be replaced on a direct mounted Annubar, proceed as follows:

1. Close instrument valves to ensure that the pressure is disconnected from the transmitter.
2. Open the bleed valves on the transmitter to remove all pressure.
3. Remove the cap and the RTD wiring only from the terminal. See Figure Figure 14-1 and Figure 14-2.
4. Remove the RTD cable as follows:
  - a. Unscrew the cable adapter.
  - b. Remove the black cable connector.
  - c. Unscrew the cap from the compression fitting.
  - d. Remove the cable.



5. Remove the hex nuts.
6. Remove the transmitter.
7. Remove the 1/2-14 NPT plug.
8. Pull the RTD wire out of the nipple and remove the RTD. The RTD is in a thermowell, so no live line pressure will be present.
9. Install the new RTD and thread the wires through the nipple.
10. Reinstall the 1/2-in. NPT plug.
11. Use the same teflon gaskets to reinstall the transmitter to the Annubar sensor head.
12. Use a torque wrench to tighten the stainless steel hex nuts in a cross pattern to 300 in-lbs (650 in-lbs for carbon steel hex nuts).
13. Reconnect the RTD wires to the terminal. This diagram is for a typical RTD transmitter wiring connection.
14. Refasten the transmitter hex nut to the transmitter and tighten.
15. Open the instrument valves.

## Replacing a Remote Mount RTD

If an RTD needs to be replaced on a remote mounted Annubar, proceed as follows:

1. Close instrument valves to ensure that the pressure is disconnected from the transmitter.
2. Open the bleed valves on the transmitter to remove all pressure.
3. Remove the cap.
4. Remove the RTD wiring only from the terminal.
5. Remove the Terminal Housing from the Annubar head.
6. Pull the RTD wire out of the nipple and remove the RTD. The RTD is in a thermowell, so no live line pressure will be present.

7. Install the new RTD and thread the wires through the nipple.
8. Install the Terminal Housing onto the Annubar head.
9. Reconnect the RTD wires to the terminal. This diagram is for a typical RTD transmitter wiring connection.
10. Open the instrument valves.

# Troubleshooting

## SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

### ⚠ WARNING

Explosions can result in death or serious injury.

- Do not remove the instrument cover in explosive environments when the circuit is alive.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.
- Before connecting a communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices.

### ⚠ WARNING

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and the terminals.

Table 15-1 provides summarized troubleshooting suggestions for the most common Annubar operating problems.

If you suspect a malfunction despite the absence of any diagnostic messages on the communicator display, follow the procedures described below to verify that the Annubar hardware and process connections are in good working order. Always approach the most likely and easiest-to-check conditions first.

TABLE 15-1. Troubleshooting Chart.

Symptom	Possible Cause	Corrective Action
Questionable accuracy or erroneous flow signal	Improper installation	<ul style="list-style-type: none"> <li>Is the Annubar flow arrow pointed in the direction of the flow?</li> <li>Verify that the cross reservoirs are perfectly level with one another.</li> <li>Is there sufficient straight run upstream and downstream of the Annubar?</li> </ul>
	System leaks	Check for leaks in instrument piping. Repair and seal all leaks.
	Contamination/plugging	Remove the Annubar and check for contamination.
	Closed valve	Verify that both Annubar (PH & PL) or (MH & ML) valves are open. Verify that vent, equalizer, and line valves are properly positioned per the "start up procedure."
	Annubar calibration	Is the Annubar calibration too high or low for the flow rate?
	Annubar connections (remote mount only)	Verify that the high side of the Annubar transmitter is connected to the high side of the Annubar. Check the same for the low side.
	Entrapped air (liquid applications)	Are there uneven water legs caused by air entrapment in the instrument connections? If so, bleed air.
	Annubar misalignment	Misalignment of the Annubar beyond 3° will cause an erroneous signal.
	Opposite-side support Annubar	If the Annubar is an opposite-side support model, is it installed through the pipe wall and into the support plug?
	Operating conditions	Are the operating conditions in compliance with those given at the time the flowmeter was purchased? Check the flow calc and the fluid parameters for accuracy. Double-check pipe inside diameter for proper Annubar sizing. <i>Note: For the multipoint flow calibrated Annubar, refer to the Annubar Flow Handbook for corrections.</i>
Spiking flow signal	Two-phase flow	The Annubar is a head measurement device and will not accurately measure a two-phase flow.
Spiking flow signal (Stream Service)	Improper insulation (Vertical pipes only) Excessive vibration	Added insulation may be required to ensure that a phase change occurs at the cross reservoirs. Check the impulse piping for vibration.
Vibration of sensor or leakage at Pak-Lok fitting	Pak-Lok Compression nut(s) loose	Tighten compression nut(s) until condition is corrected and then ½ turn more only.
Milliamp reading is zero		<ul style="list-style-type: none"> <li>Check if power polarity is reversed</li> <li>Verify voltage across terminals (should be 10–55V dc)</li> <li>Check for bad diode in terminal block</li> <li>Replace transmitter terminal block</li> </ul>
Annubar transmitter not in communication		<ul style="list-style-type: none"> <li>Check power supply voltage at transmitter (10.5V minimum)</li> <li>Check load resistance (250 ohms minimum)</li> <li>Check if unit is addressed properly</li> <li>Replace transmitter board</li> </ul>
Milliamp reading is low or high		<ul style="list-style-type: none"> <li>Check pressure variable reading for saturation</li> <li>Check if output is in alarm condition</li> <li>Perform 4–20 mA output trim</li> <li>Replace transmitter board</li> </ul>
No response to changes in applied flow		<ul style="list-style-type: none"> <li>Check test equipment</li> <li>Check impulse piping for blockage</li> <li>Check for disabled span adjustment</li> <li>Check transmitter security jumper</li> <li>Verify calibration settings (4 and 20 mA points)</li> <li>Contact factory for replacement</li> </ul>
Low reading/high reading		<ul style="list-style-type: none"> <li>Check impulse piping for blockage</li> <li>Check test equipment</li> <li>Perform full sensor trim (if software revision is 35 or higher)</li> <li>Contact factory for replacement</li> </ul>
Erratic reading for pressure variable		<ul style="list-style-type: none"> <li>Check impulse piping for blockage</li> <li>Check damping</li> <li>Check for EMF interference</li> <li>Contact factory for replacement</li> </ul>

# Specifications and Reference Data

## ORDERING INFORMATION

Ordering information is available in the *Annubar Averaging Pitot Tube* Product Data Sheet, publication number 00813-0100-4760.

## FUNCTIONAL SPECIFICATIONS

### Service

Liquid, gas, and steam applications.

### Pipe Sizes

½- to 36-in. (12 to 900 mm).

### Flow Sensor Sizes (SST and Monel Sensors)

Sensor 10: For line Sizes ½- to 1½-in. (12.5 to 37.5 mm).

Sensor 15/16: For line sizes 2- to 5-in. (50 to 125 mm).

Sensor 25/26: For line sizes 4- to 36-in. (100 to 900 mm).

Sensor 35/36: For line sizes 8- to 36-in. (200 to 900 mm).

Sensor 45/46: For line sizes 10- to 36-in. (250 to 900 mm).

### Flow Sensor Sizes (Hastelloy C)

Sensor 10: For Line Sizes ½- to 1½-in. (12.5 to 37.5 mm).

Sensor 25/26: For line sizes 4- to 36-in. (100 to 900 mm).

Sensor 45/46: For line sizes 10- to 36-in. (250 to 900 mm).

### Operating Process Temperature Limits

#### Integral Electronics Mounting

-40 to 500 °F (-40 to 260 °C).

#### Remote Electronics Mounting

-40 to 850 °F (-40 to 454 °C).

#### Pressure limits

0-1440 psig (100barg) @ 100 °F (37.8 °C).

Contact factory for higher pressures.

## PERFORMANCE SPECIFICATIONS

### Accuracy<sup>(1)</sup>

±1% of flow coefficient.

### Repeatability

±0.1%.

Model	Minimum Reynold's Number ( $Re_{rod}$ )
10	2000
15/16	5000
25/26	10000
35/36	15000
45/46	25000

(1) When used in closed loop-control applications, higher damping values are recommended.

**Where:**

$$Re_{rod} = \frac{dV\rho}{\mu}$$

$\rho$  = fluid density in lb<sub>m</sub>/ft<sup>3</sup>  
 $d$  = probe width in feet  
 $V$  = velocity of fluid in ft /sec  
 $\mu$  = fluid viscosity in lb<sub>m</sub>/ft-sec

See DSI Annubar Flow Handbook for detailed information.

**PHYSICAL SPECIFICATIONS**

**Sensor**

316/316L SST. (Optional Hastelloy C or Monel for Product Type F only.)

**Electronics Mounting — Integral Instrument, Three and Five Valves**

**Material**

316 SST.

**O-Rings**

Teflon<sup>®</sup>.

**Bolts**

316 SST.

**Electronics Mounting — Remote, Instrument Valves**

**Material**

316 SST or CS based on pipe mounting material.

**Flange**

316L SST. Flange pressure limits are per ANSI B16.5 for 316 SST and material per SA182.

Flange face finish ANSI B16.5, 125 to 250 RMS.

**Packing Gland Assembly**

**Packing Gland**

316 SST.

**Packing**

Graphite AFP-127.

**Flange Mounting Hardware (Includes nuts, bolts and gasket)**

316 SST or CS.

**Optional Flanged Pipe Section**

TABLE 16-1.  
Minimum and Maximum Face-to-Face  
Lengths for Optional Flanged  
Pipe Section.

Line Size in in. (mm)	Minimum Length in in. (mm)	Maximum Length in in. (mm)
2	6.5 (165)	11.0 (279)
3	7.5 (191)	13.5 (343)
4	8.0 (203)	15.0 (381)
6	8.5 (216)	20.0 (508)
8	10.0 (254)	20.0 (508)

60.

# Standard ODF Dimensions

## STANDARD ODF DIMENSIONS

<b>15/16 Sensor</b>	<b>ODF</b>	<b>35/36 Sensor</b>	<b>ODF</b>
1-in.-150# flg.	3.377-in.	2-in.-150# flg.	4.126-in.
1-in.-300# flg.	3.627-in.	2-in.-300# flg.	4.38-in.
1-in.-600# flg.	3.877-in.	2-in.-600# flg.	4.75-in.

<b>25/26 Sensor</b>	<b>ODF</b>	<b>45/46 Sensor</b>	<b>ODF</b>
1-½-in.-150# flg.	3.375-in.	3-in.-150# flg.	4.63-in.
1-½-in.-300# flg.	4.13-in.	3-in.-300# flg.	5.0-in.
1-½-in.-600# flg.	4.439-in.	3-in.-600# flg.	5.376-in.





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Flo-Tap Installation Hardware

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Flo-Tap Isolation Valve

6-6, 6-7, 6-10, 8-6, 8-8, 8-11, 9-6, 9-8, 9-11

Flo-Tap Standard Drive (IHR)

6-8, 6-10, 8-9, 8-11, 9-9, 9-11

Flo-Tap Welding Equipment

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Gas Service in a

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Liquid or Steam Service

in a Horizontal Pipe

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Liquid Service in a

Vertical Pipe 6-3, 8-3, 9-3

Steam Service in a

Vertical Pipe 6-4, 8-4, 9-4

Pak-Lok Flanged Models

Gas Service in a

Horizontal Pipe 5-3

Gas Service in a

Vertical Pipe 5-3

Liquid Service in a

Horizontal Pipe 5-2

Liquid Service in a

Vertical Pipe 5-3

Steam Service in a

Horizontal Pipe 5-2

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Flo-Tap Models

Gas Service in a

Horizontal Pipe 6-3, 8-3, 9-3

Gas Service in a

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Liquid or Steam Service

in a Horizontal Pipe

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Liquid Service in a

Vertical Pipe 6-3, 8-3, 9-3

Steam Service in a

Vertical Pipe 6-4, 8-4, 9-4

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Gas Service in a

Horizontal Pipe 5-3

Gas Service in a

Vertical Pipe 5-3

Liquid Service in a

Horizontal Pipe 5-2

Liquid Service in a

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