FOXBORO®

Instruction

MI 020-321
March 1998

IDP10-A and IDP10-I
Intelligent Differential Pressure Transmitters

with 4 to 20 mA Output Signal

Installation, Calibration, Configuration, and Maintenance
Style A

File Name: Foxboro_Transmitter_IDP10A_IDP10I_instr_D398

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1. Introduction

General Description

The IDP10-A and IDP10-I Differential Pressure Transmitters measure the difference between two pressures applied to opposite sides of a silicon strain gauge microsensor within the sensor assembly. This microsensor converts differential pressure to a change in resistance. The resistance change is then converted to a 4 to 20 mA signal proportional to differential pressure or to the square root of differential pressure. This measurement signal is transmitted to remote receivers over the same two wires that supply power to the transmitter electronics.

The transmitters are often used for measuring fluid flow across a primary device such as an orifice plate, but can also be used for other types of differential pressure measurements such as liquid level, interface level, or density measurements. For more detailed information on the principle of operation of the transmitter, refer to document TI 037-096, available from Foxboro.

Reference Documents

This document (MI 020-321) contains descriptions and instructions for transmitter installation, configuration, calibration, and maintenance. For further information relating to the use of this transmitter, refer to Table 1.

Table 1. Reference Documents

Document	Description
DP 020-446	Dimensional Print – IDP10 d/p Cell Transmitters
MI 022-137	Instruction – Bypass Manifolds - Installation and Maintenance
MI 020-328	Instruction – Bubble Type Installation for Liquid Level
PL 009-005	Parts Lists – IDP10 Differential Pressure Transmitter
TI 037-096	Technical Information – I/A Series Pressure Transmitters
SI 0-00467	Retrofit of Anti-Rotation Bracket for IDP10 and IGP20 CENELEC Flameproof I/A Series Pressure Transmitters

Transmitter Identification

See Figure 1 for transmitter data plate contents. For a complete explanation of the Model Number code, see PL 009-005. When the transmitter is powered, the firmware revision is shown on the top line of the display.

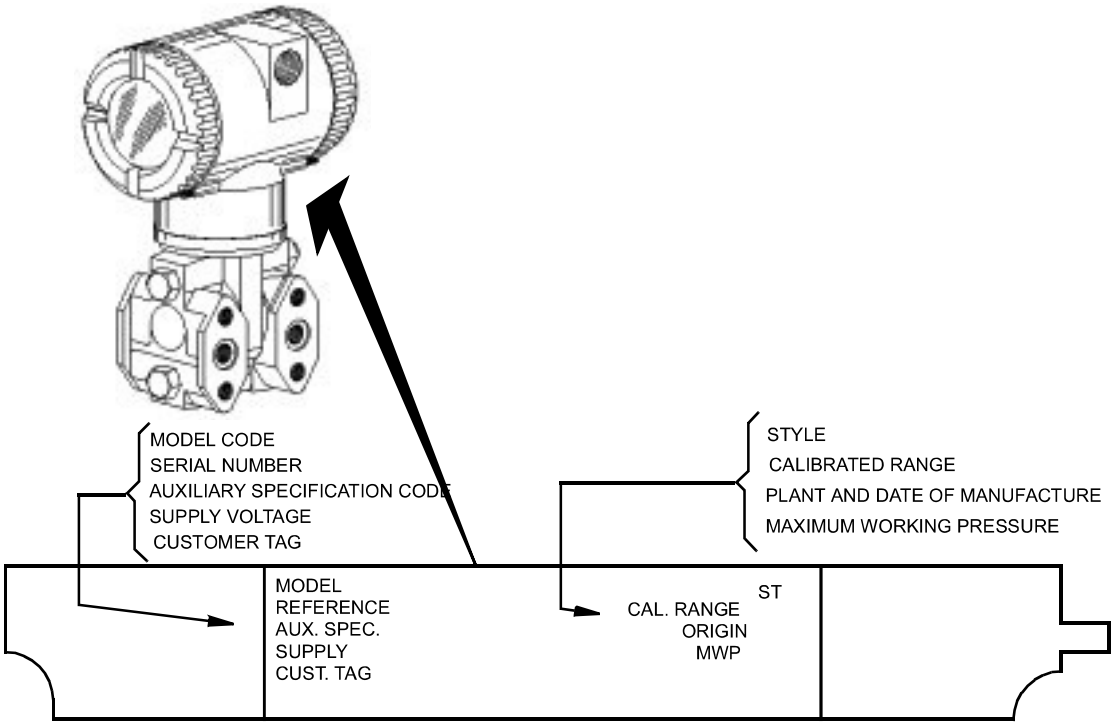

Figure 1. Transmitter Identification

Standard Specifications

Span and Range Limits

Span Limit Code	Span Limits ΔP	Range Limits ΔP
A	0.12 and 7.5 kPa (0.5 and 30 inH_2O)	-7.5 and +7.5 kPa (-30 and +30 inH_2O)
B	0.87 and 50 kPa (3.5 and 200 inH_20)	-50 and +50 kPa (-200 and +200 inH_20)
C	7.0 and 210 kPa (28 and 840 inH_20)	-210 and +210 kPa (-840 and +840 inH_20)
D	0.07 and 2.1 MPa (10 and 300 psi)	-0.21 and +2.1 MPa (-30 and +300 psi)
E	0.7 and 21 MPa (100 and 3000 psi)	-0.21 and +21 MPa (-30 and +3000 psi)

Negative values of differential pressure indicate *low side* of sensor at the high pressure.
Positive values indicate *high side* of sensor at the high pressure.

Elevated Zero and Suppressed Zero

For applications requiring an elevated or suppressed zero, the maximum span and the upper and lower range limits of the transmitter can not be exceeded.

Maximum Static, Overrange, and Proof Pressure

Transmitter Configuration (Bolting Material)	Maximum Static and Overrange Pressure Rating[a]		Proof Pressure Rating[b]	
	MPa	Psi	MPa	Psi
Standard (B7 steel), Option '-B2" (17-4 PH ss), Option "-D3" or "-D7"[c]	25	3625	100	14500
Option "B1" (316 ss) or Option "-D5"[c]	15	2175	60	8700
Option AS-B7M (B7M)	25	3625	100	14500
Option "-D1"[c]	16	2320	64	9280
Option "-D2", "-D4", "-D6", or "-D8"[c,d]	10	1500	40	6000

(a) Either side may be at higher pressure during overrange.
(b) Meets ANSI/ISA Standard S82.03-1988.
(c) -D1 = DIN Single ended process cover with M10 bolting.
-D2 = DIN Double ended process cover with M10 bolting
-D3 = DIN Single ended process cover with 7/16 in bolting.
-D4 = DIN Double ended process cover with 7/16 in bolting.
-D5 = DIN Single ended process cover with 7/16 in 316 ss bolting.
-D6 = DIN Double ended process cover with 7/16 in 316 ss bolting.
-D7 = DIN Single ended process cover with 7/16 in 17-4 ss bolting.
-D8 = DIN Double ended process cover with 7/16 in 17-4 ss bolting.
(d) Limited to operating temperatures ranging from 0 to 60°C (32 to 140°F)

NOTE: Static pressure zero shift for all calibrated spans can be eliminated by readjusting the zero output.

CAUTIONS:
1. Exceeding the maximum overrange pressure can cause damage to the transmitter degrading its performance.
2. The transmitter may be nonfunctional after application of the proof pressure.

Output Signal

4 to 20 mA dc linear, or 4 to 20 mA dc square root, software selectable, locally configurable using pushbuttons on the transmitter.

Zero and Span Adjustments

Adjustable at the transmitter using the local display. An optional external self-contained moisture sealed pushbutton assembly allows local resetting of zero without removing housing cover.

Field Wiring Reversal

Accidental reversal of field wiring will not damage the transmitter, provided the current is limited to 1 A or less by active current limiting or loop resistance. Sustained currents of 1 A may damage the terminal block assembly, but will not damage the electronics module or sensor.

Mounting Position

The transmitter may be mounted in any orientation. It may be supported by the process piping. It may also be mounted directly to a vertical or horizontal pipe or surface mounted using an optional mounting bracket. The housing can be rotated up to one full turn to any desired position for access to adjustments, display, or conduit connections. See "Positioning Housing" on page 14. The display can also be rotated in the housing to any of four different positions at 90° increments. See "Positioning Display" on page 14.

NOTE: Position effect zero shift for all calibrated spans can be eliminated by readjusting zero output.

Adjustable Damping

The transmitter response time is normally 0.5 second or the electronically adjustable setting of 0.00 (none), 2, 4, or 8, seconds, whichever is greater, for a 90% recovery from an 80% input step as defined in ANSI/ISA S51.1.

Operative Limits

Influence	Operative Limits
Sensor Body Temperature	
Silicone Fill Fluid	-46 and +121°C (-50 and +250°F)
Fluorinert Fill Fluid	-29 and +121°C (-20 and +250°F)
Electronics Temperature	-40 and +85°C (-40 and +185°F)
With LCD Display	-40 and +85°C (-40 and +185°F)[a]
Relative Humidity	0 and 100%
Supply Voltage	11.5 and 42 V dc[b]
Output Load	0 and 1450 ohms
Mounting Position	No Limit

(a) Display updates will be slowed and readability decreased below temperatures of -20°C (-4°F).
(b) 11 V dc with optional shorting block (AS code SB-11)

Sensor Fill Fluid

Silicone Oil (DC 200), or Fluorinert (FC-43).

Minimum Allowable Absolute Pressure vs. Process Temperature

With Silicone Fill Fluid — At full vacuum: Up to 121°C (250°F)
With Fluorinert Fill Fluid — Refer to Figure 2.

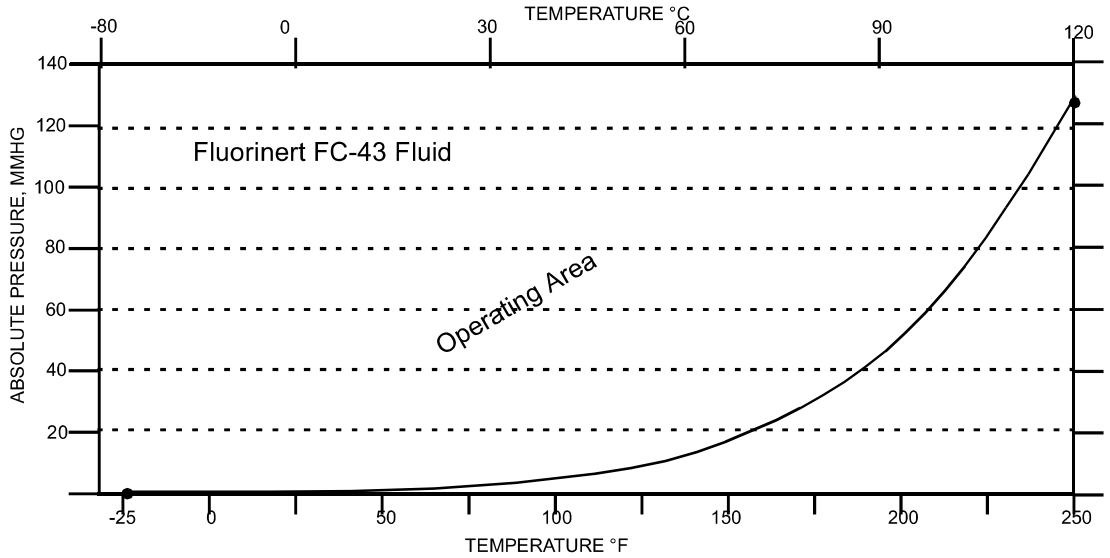

Figure 2. Minimum Allowable Absolute Pressure vs. Process Temperature with Fluorinert Fill Fluid

Power-up Time

Less than 2.0 seconds for output to reach approximately 3.5 mA, and then at the electronic damping rate to the final measured variable value.

Electrical Connections

Field wires enter through PG 13.5 or 1/2 NPT threaded entrances on either side of the electronics housing. Leads terminate under screw terminals and washers on the terminal block in the field terminal compartment. To maintain RFI/EMI, environmental, and explosionproof ratings, unused conduit connection must be plugged with metal plug (provided), inserted to five full turns.

Process Connections

IDP10 transmitters are connected to the process via a 1/4 NPT thread or any one of a number of optional process connectors.

Supply Current

Power supply must be capable of providing 22 mA current. Ripple of up to 2 V pp (50/60/100/120 Hz) is tolerable, but instantaneous voltage must remain within specified range.

Electrical Ground Connections

The transmitter is equipped with an internal ground connection within the field wiring compartment and an external ground connection at the base of the electronics housing. To minimize galvanic corrosion, place the wire lead or contact between the washer and sems screw on the external ground connection.

Test Points

The banana plug receptacles (designated "CAL") can be used to check transmitter output. Measurements should be 100 to 500 mV dc for 0 to 100% transmitter output. Refer to Figure 9.

Approximate Mass

Without Process Connectors	3.5 kg (7.8 lb)
With Process Connectors	4.2 kg (9.2 lb)

Process Wetted Materials

Diaphragm: 316L ss, Co-Ni-Cr, Hastelloy C, or Monel
Covers and Process Connections: 316 ss, carbon steel, Hastelloy C, or Monel

Product Safety

DANGER: To prevent possible explosions and to maintain explosionproof, dust-ignitionproof protection, observe applicable wiring practices. Plug unused conduit opening with the provided metal pipe plug, which engages a minimum of five full threads.

WARNING: To maintain IEC IP66 and NEMA Type 4X protection, the unused conduit opening must be plugged. In addition, the threaded housing covers must be installed. Turn covers until O-ring contacts housing; then continue to hand tighten as much as possible (at least 1/4 turn).

NOTE: These transmitters have been designed to meet the electrical safety description listed in Table 2. For detailed information or status of testing laboratory approvals/certifications, contact Foxboro.

Table 2. Electrical Safety Specifications

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
CENELEC intrinsically safe, Gas Group IIC, Zone 0.	Temperature Class T4-T6. IDP10-I only.	E
CENELEC flameproof, Gas Group IIC, Zone 1.	Temperature Class T6. Requires installation of anti-rotation bracket. See "CENELEC Flameproof Installations" on page 19.	D
European nonsparking, Zone 2.	Temperature Class T4-T6. IDP10-I only.	N

Table 2. Electrical Safety Specifications (Continued)

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
CSA intrinsically safe for Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1.	Connect per TI 005-105. Temperature Class T5 at 40°C (104°F) and T4 at 85°C (185°F) maximum ambient. IDP10-I only.	C
CSA explosionproof for Class I, Division 1, Groups B, C, and D; dust-ignitionproof for Class II, Division 1, Groups E, F, and G; Class III, Division 1 .	Temperature Class T6.	
CSA for Class I, Division 2, Groups A, B, C, and D; Class II, Division 2, Groups F and G; Class III, Division 2.	Connect to source not exceeding 42.4 V. Temperature Class T6 at 80°C (176°F) and T5 at 85°C (185°F) maximum ambient. IDP10-I only.	
FM intrinsically safe for Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1.	Connect per TI 005-101. Temperature Class T5 at 40°C (104°F) and T4 at 85°C (185°F) maximum ambient. IDP10-I only.	F
FM explosionproof for Class I, Division 1, Groups B, C, and D; dust-ignitionproof for Class II, Division 1, Groups E, F, and G; Class III, Division 1.	Temperature Class T6.	
FM nonincendive for Class I, Division 2, Groups A, B, C, and D; Class II, Division 2, Groups F and G; Class III, Division 2.	Connect to source not exceeding 42.4 V. Temperature Class T6 at 80°C (176°F) and T5 at 85°C (185°F) maximum ambient. IDP10-I only.	
SAA intrinsically safe, Gas Group IIC, Zone 0.	Temperature Class T4. IDP10-I only.	A
SAA flameproof, Gas Group IIC, Zone 1.	Temperature Class T6.	
SAA nonincendive, Gas Group IIC, Zone 2.	Temperature Class T6. IDP10-I only.	

2. Installation

The following material provides information and procedures for installing the IDP10-I Differential Pressure Cell Transmitter. For dimensional information, refer to DP 020-446.

CAUTION: To avoid damage to the transmitter sensor, do not use any impact devices, such as an impact wrench or stamping device, on the transmitter.

NOTE: Use a suitable thread sealant on all connections.

Transmitter Mounting

The transmitter may be supported by the process piping as shown in Figure 3, or mounted to a vertical or horizontal pipe or surface using the optional mounting bracket shown in Figure 4.

NOTES:
1. If the transmitter is not installed in the vertical position as shown in Figure 3 or Figure 4, readjust zero output to eliminate the position zero effect.
2. The transmitter should be mounted so that any moisture condensing or draining into the field wiring compartment can exit through one of the two threaded conduit connections.

Process-Mounted Transmitter

Figure 3 shows the transmitter mounted to and supported by the process piping.

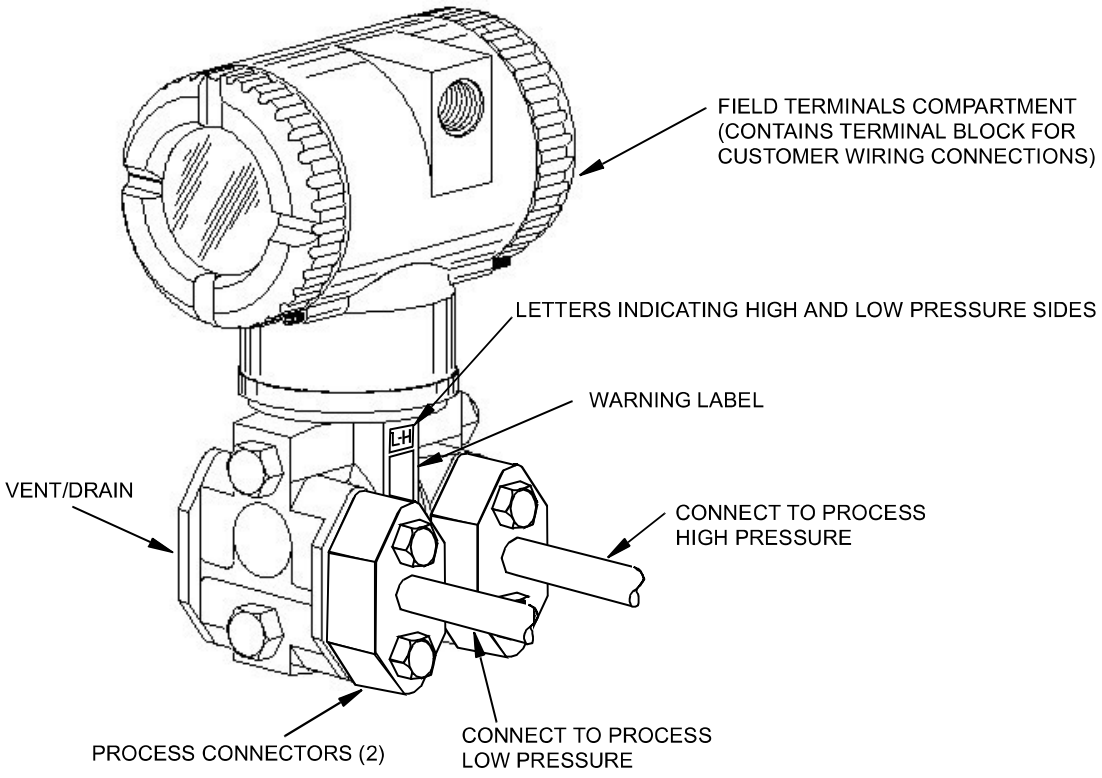

Figure 3. Process-Mounted Transmitter

Pipe- or Surface-Mounted Transmitter

To mount the transmitter to a pipe or surface, use the Optional Mounting Set (Model Code Option -M).

Referring to Figure 4, secure the mounting bracket to the transmitter using the two lockwashers and screws provided. Mount the transmitter with mounting bracket to a vertical or horizontal, DN 50 or 2-in pipe. To mount to a horizontal pipe, turn U-bolt 90° from the position shown in Figure 4. The mounting bracket may also be used for wall mounting by securing the bracket to a wall using the U-bolt mounting holes.

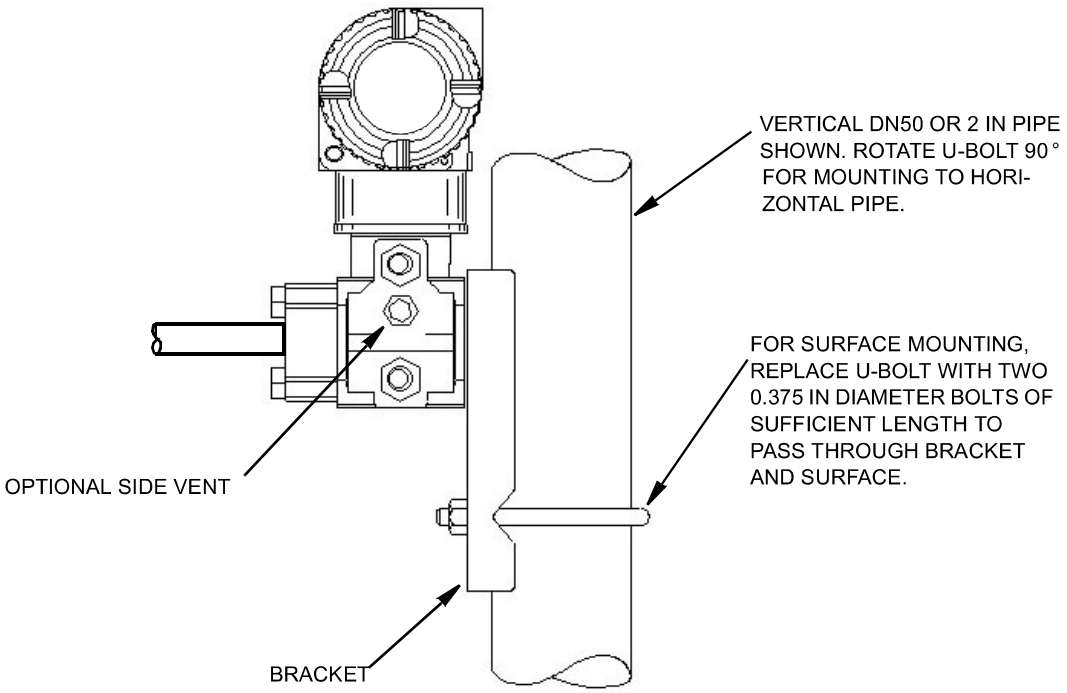

Figure 4. Mounting Transmitter to a Pipe or Surface

Installation of Flow Measurement Piping

Figure 5 and Figure 6 show typical installations with horizontal and vertical process pipes.

The transmitters are shown below the level of the pressure connections at the pipe (usual arrangement, except for gas flow without a seal liquid), and with filling tees in the lines to the transmitter (for a seal liquid).

If the process fluid being measured must not come in contact with the transmitter, the transmitter lines must be filled with a suitable seal liquid (see procedure in next section). In such a case, the transmitter must be mounted below the level of the pressure connections at the pipe. With steam flow, the lines are filled with water to protect the transmitter from the hot steam. The seal liquid (or water) is added to the lines through the filling tees. To prevent unequal heads on the transmitter, the tees must be at the same elevation (as shown in Figure 5) and the transmitter must be mounted vertically (as shown). If a seal liquid is not required, elbows can be used in place of the tees.

Tighten drain plugs and optional vent screws to 20 N·m (15 lb·ft). Tighten the four process connector bolts to a torque of 61 N·m (45 lb·ft).

Note that the high and low pressure sides of the transmitter are identified by an L-H marking on the side of the sensor above the warning label as shown in Figure 3. The higher pressure is applied to the high-pressure side.

With medium-viscosity seal liquids and/or long transmitter lines, larger valve sizes should be used.

NOTES:
1. With a horizontal line, pressure connections at the pipe should be at the side of the line. However, with gas flow without a seal liquid, connections should be at top of line.
2. With a vertical line, flow should be upwards.
3. For liquid or steam flow, the transmitter should be mounted lower than the pressure connections at the pipe.
4. For gas flow without a seal liquid, the transmitter should be mounted above the pressure connections at the pipe; for gas flow with a seal liquid, the transmitter should be mounted below the pressure connections
5. Foxboro recommends the use of snubbers in installations prone to high levels of flow pulsations.

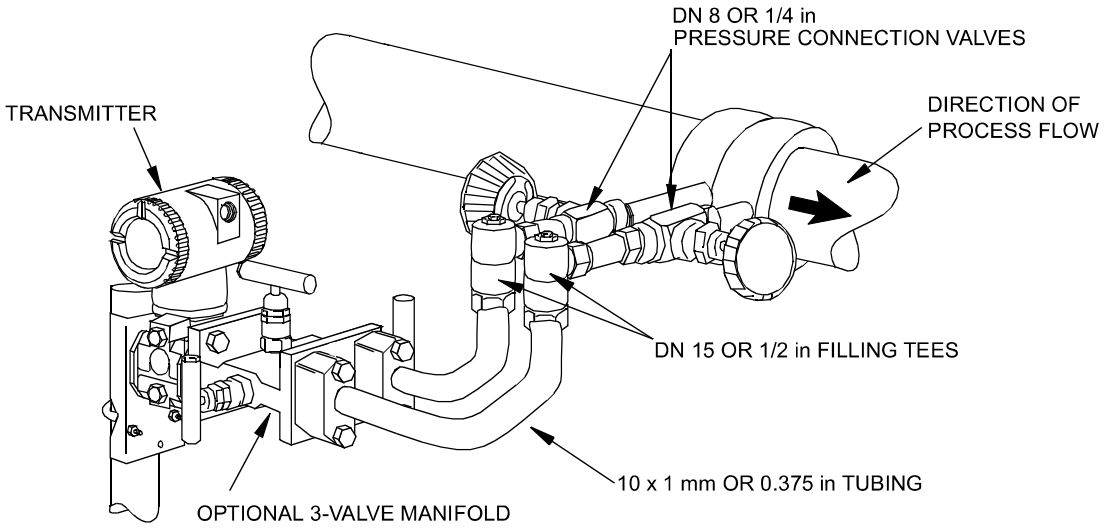

Figure 5. Example of Horizontal Process Line Installation

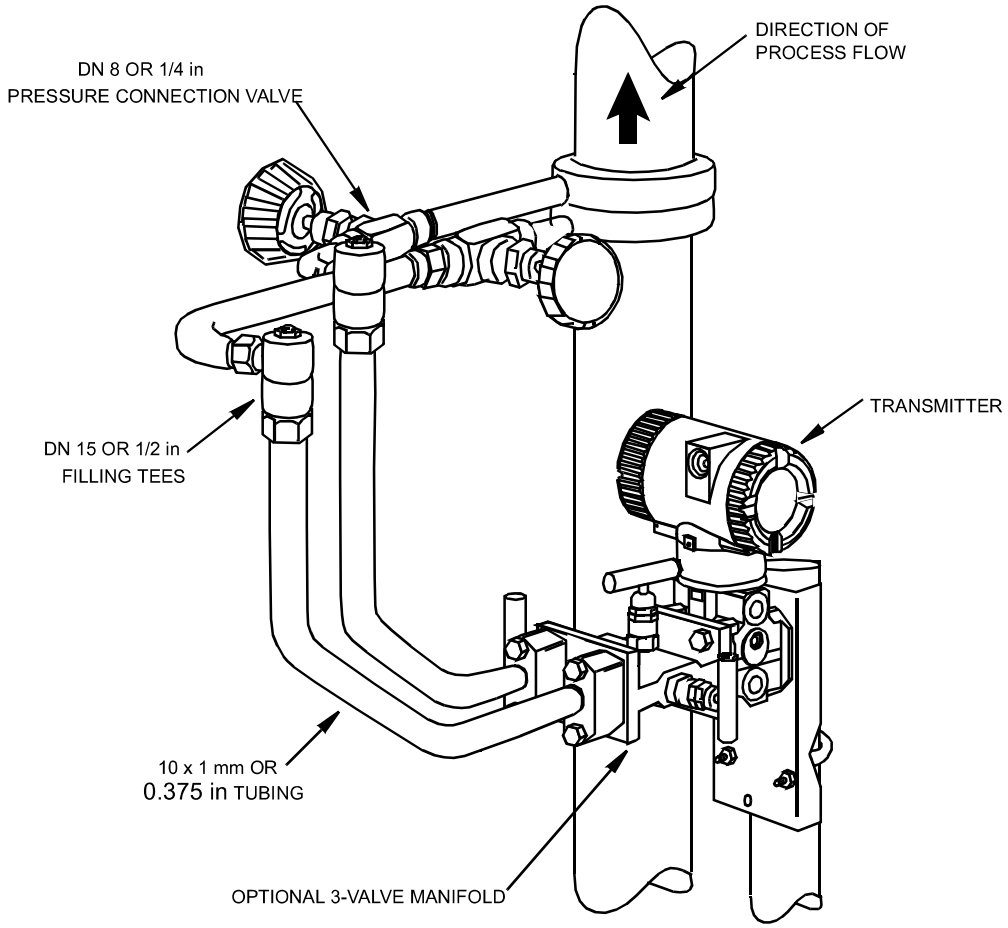

Figure 6. Example of Vertical Process Line Installation

Filling System with Seal Liquid

If the process fluid being measured must not come in contact with the transmitter, the transmitter lines must be filled with a suitable seal liquid. The procedure to do this is as follows:

1. Open bypass valve and close both pressure connection valves.
2. Remove plugs from filling tees and pour in seal liquid until both tees overflow.
3. Partially open vent screws on transmitter until all air has been forced out of transmitter body and lines. Close vent screws.
4. Refill tee connections. Replace plugs and close bypass valve. Check for leaks.

CAUTION: To prevent loss of seal liquid and contamination of process fluid, never open both pressure connection valves at the same time if bypass valve is open.

Positioning Housing

The transmitter housing (topworks) can be rotated up to one full turn in the counterclockwise direction when viewed from above for optimum access to adjustments, display, or conduit connections.

CAUTIONS:

1. Do not rotate the housing more than one turn from the as received position. If there is doubt about the housing rotational position, turn fully clockwise and then back off no more than one full turn.

2. If the transmitter is ordered for CENELEC Flameproof installation, Foxboro supplies a factory-installed anti-rotation bracket mounted on the transmitter. If the electronic housing is removed for any reason, it will be necessary to reinstall the anti-rotation bracket when the housing is reinstalled. To install the bracket, use the procedure described in "CENELEC Flameproof Installations" on page 19.

Positioning Display

The display can be rotated within the housing to any of four positions at 90° increments. To do this, refer to Figure 7 and perform the following:

1. Turn off power source to transmitter.
2. Screw in cover lock (if present) and remove the electronics compartment cover by rotating it counterclockwise.
3. Remove electronics module by unscrewing two screws closest to sides of transmitter and pulling out module.
4. If turning display 180°, turn and return module to housing by reversing Step 3.
5. If turning display 90° in either direction:
   a. Unscrew other two screws from the module.
   b. Rethread the screws into the module at 90° from their original position.
   c. Return module to housing by reversing Step 3.
6. Reinstall the cover onto the housing by rotating it clockwise until the O-ring contacts the housing; then continue to hand tighten as much as possible (at least 1/4 turn). If cover locks are present, align the serration in the cover with the lock and unscrew it until it extends into the cover serration to prevent unwanted cover rotation.
7. Restore power to transmitter.

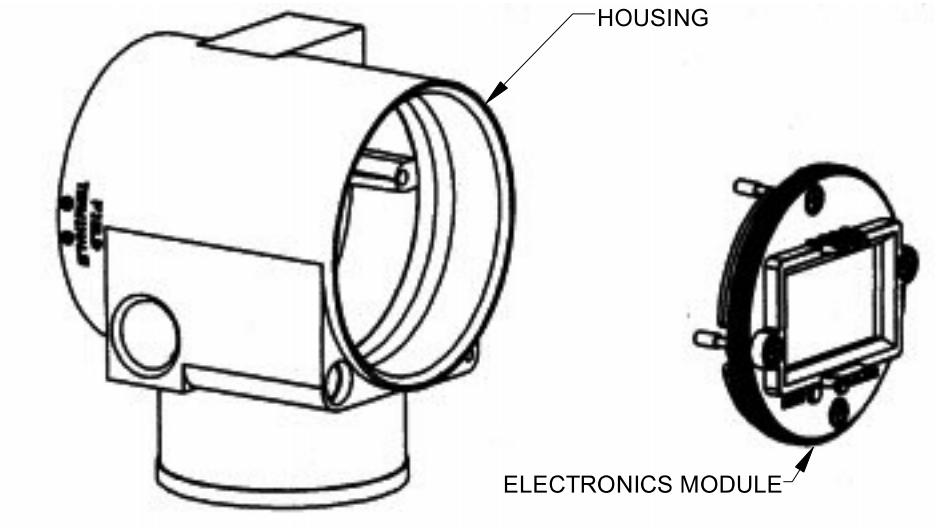

Figure 7. Positioning Display

Cover Locks

Electronic housing cover locks, shown in Figure 8, are provided as standard with certain agency certifications and as part of the Custody Transfer Lock and Seal option.

Transmitter Wiring

NOTE: Foxboro recommends the use of transient/surge protection in installations prone to high levels of electrical transients and surges.

Accessing Transmitter Field Terminals

For access to the field terminals, thread the cover lock (if present) into the housing to clear the threaded cover and remove the cover from the field terminals compartment as shown in Figure 8. Note that the embossed letters "FIELD TERMINALS" identify the proper compartment. Identification of terminals is shown in Figure 9.

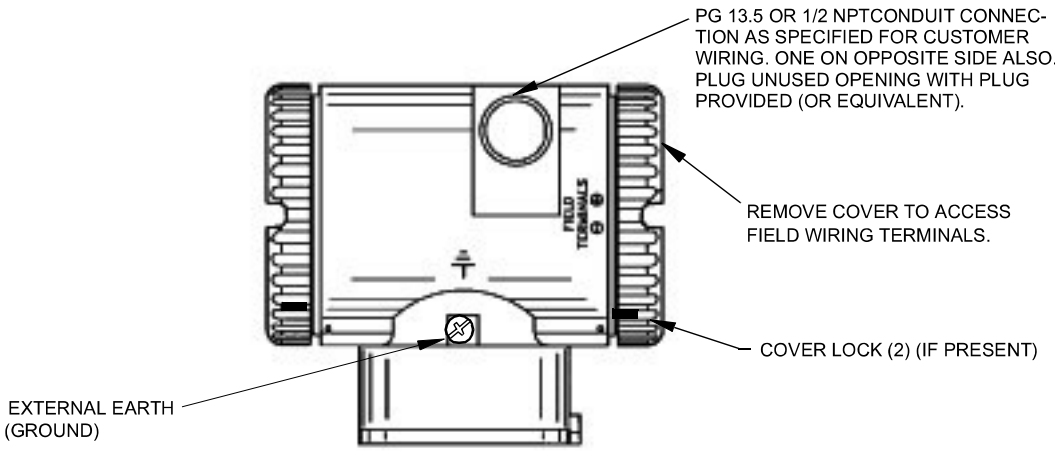

Figure 8. Accessing Field Terminals

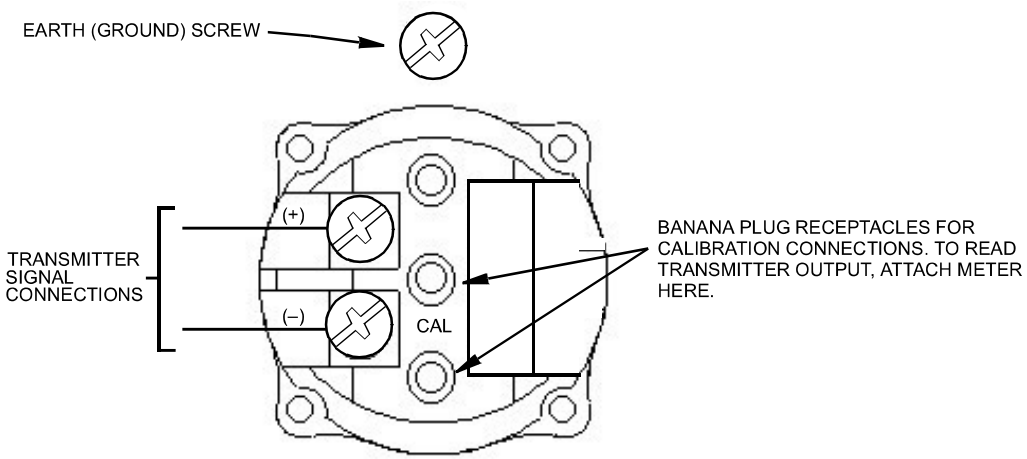

Figure 9. Identification of Field Terminals

Wiring the Transmitter to a Control Loop

When wiring your transmitter, the supply voltage and loop load must be within specified limits. The supply voltage vs. the output load relationship is shown in Figure 10. Any combination of supply voltage and loop load resistance in the shaded area can be used. To determine the loop load resistance (transmitter output load), add the series resistance of each component in the loop, excluding the transmitter. The power supply must be capable of supplying 22 mA of loop current.

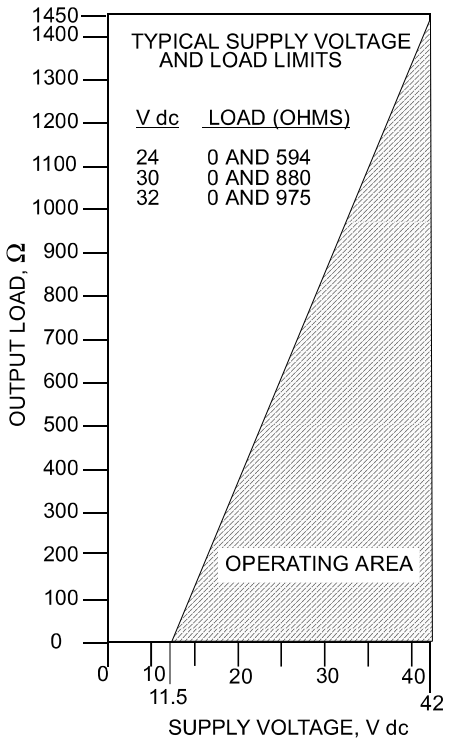

Figure 10. Supply Voltage and Loop Load

Examples:

1. For a loop load resistance of 860 Ω, the supply voltage can be any value from 30 to 42 V dc.
2. For a supply voltage of 24 V dc, the loop load resistance can be any value from zero to 565 Ω.

To wire one or more transmitters to a power supply, proceed with the following steps.

1. Screw in cover lock (if present) and remove the field terminals compartment cover by rotating it counterclockwise.
2. Run signal wires (0.50 mm^2 or 20 AWG, typical) through one of the transmitter conduit connections as shown in Figure 8. Use twisted pair to protect the 4 to 20 mA output from electrical noise. Maximum recommended length for signal wires is 1800 m (6000 ft). Screened (shielded) cable may be required in some locations.

NOTE: Do not run transmitter wires in same conduit as mains (ac power) wires.

3. If shielded cable is used, earth (ground) the shield at the power supply only. Do not ground the shield at the transmitter. Cut and/or tape the shield so it cannot contact the metal housing.
4. Plug unused conduit connection with the PG 13.5 or 1/2 NPT metal plug provided (or equivalent). To maintain specified explosionproof and dust-ignition-

proof protection, plug must engage a *minimum* of five full threads. Thread sealant is recommended.

5. Connect an earth (ground) wire to the earth terminal in accordance with local practice.

CAUTION: If the signal circuit must be earthed (grounded), it is preferable to do so at the negative terminal of the dc power supply. To avoid errors resulting from earth loops or the possibility of short-circuiting groups of instruments in a loop, there should be only one earth in a loop.

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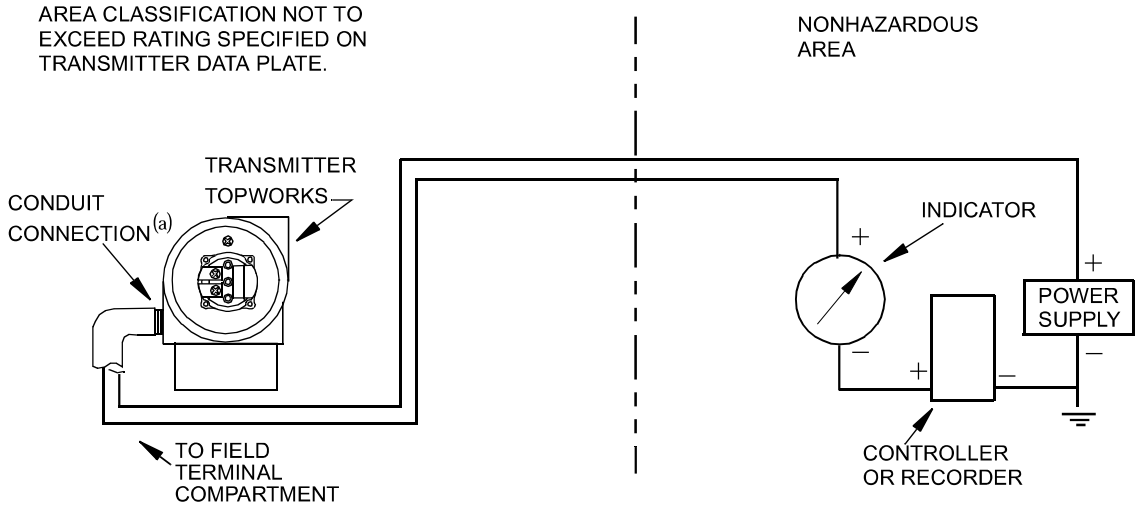
6. Connect the power supply and receiver loop wires to the "+" and "–" terminal connections shown in Figure 9.
7. Connect receivers (such as controllers, recorders, indicators) in series with power supply and transmitter as shown in Figure 11.
8. Reinstall the cover onto the housing by rotating it clockwise until the O-ring contacts the housing. Then continue to hand tighten as much as possible (at least 1/4 turn). If cover locks are present, align the serration in the cover with the lock and unscrew it until it extends into the cover serration to prevent unwanted cover rotation.
9. If wiring additional transmitters to the same power supply, repeat Steps 1 through 8 for each additional transmitter. The setup with multiple transmitters connected to a single power supply is shown in Figure 12.



(a) Run conduit down to avoid moisture buildup in terminals compartment.

Figure 11. Loop Wiring

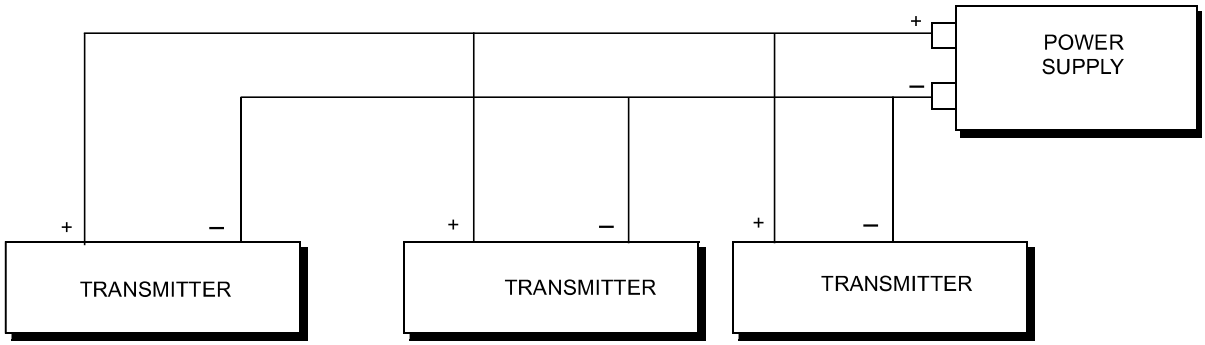


Figure 12. Wiring Several Transmitters to a Common Power Supply

Putting Transmitter into Operation

The following procedure explains how to sequence the valves in your flow measurement piping or optional bypass manifold to ensure that your transmitter is not overranged. Refer to Figure 5 or Figure 6.

1. Close upstream and downstream valves and then open bypass valve.
2. Slowly open upstream valve.
3. Close bypass valve.
4. Slowly open downstream valve.

Taking Transmitter Out of Operation

The following procedure explains how to sequence the valves in your flow measurement piping or optional bypass manifold to ensure that your transmitter is not overranged. Refer to Figure 5 or Figure 6.

1. Open bypass valve.
2. Close downstream and then upstream valve.

WARNING: Carefully open vent screw to release any residual pressure before disconnecting lines.

CENELEC Flameproof Installations

Foxboro supplies a factory-installed anti-rotation bracket on all transmitters specified for CENELEC flameproof installation to meet CENELEC agency requirements. As installed at the factory, this bracket ensures that the number of engaged threads meets the minimum CENELEC requirement.

If the electronics housing is removed for any reason, the user must reinstall the anti-rotation bracket when the electronics housing is reinstalled, so that the CENELEC requirements are met.

To install the bracket, execute the following procedure:

CAUTION: Before proceeding, make sure that power is removed from the transmitter and that the loop is in manual control.

Refer to Figure 13 through Figure 15.

1. Turn the electronics housing in a clockwise direction (looking down) handtight until it bottoms. Then rotate the electronics housing in a counterclockwise direction (less than one full turn) so that the boss on the electronics housing moves past the first process cover. Slide the bracket over this process cover, with the tab up, and secure the bracket to the cover by tightening the 8-32 UNC set screw with a hex (Allen) wrench. (Installing the bracket on this process cover prevents the electronics housing from being unscrewed and violating the CENELEC flameproof specifications.)
2. Reposition the housing in the desired orientation and reconnect the conduit and/or cable to the electronics housing. Reapply power to the transmitter and place the loop back on automatic control. This completes the bracket installation procedure.

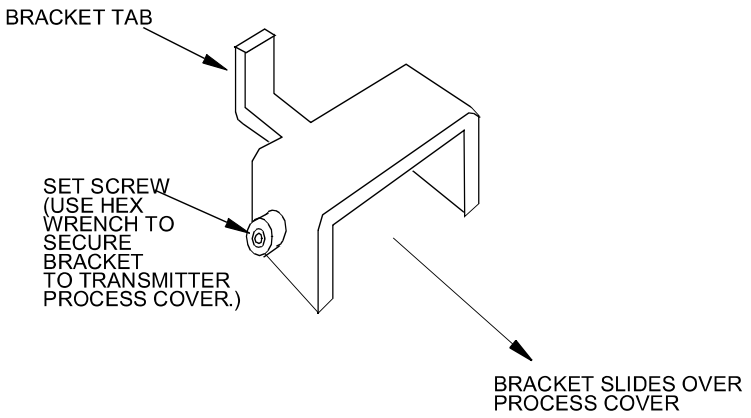


Figure 13. Anti-Rotation Bracket

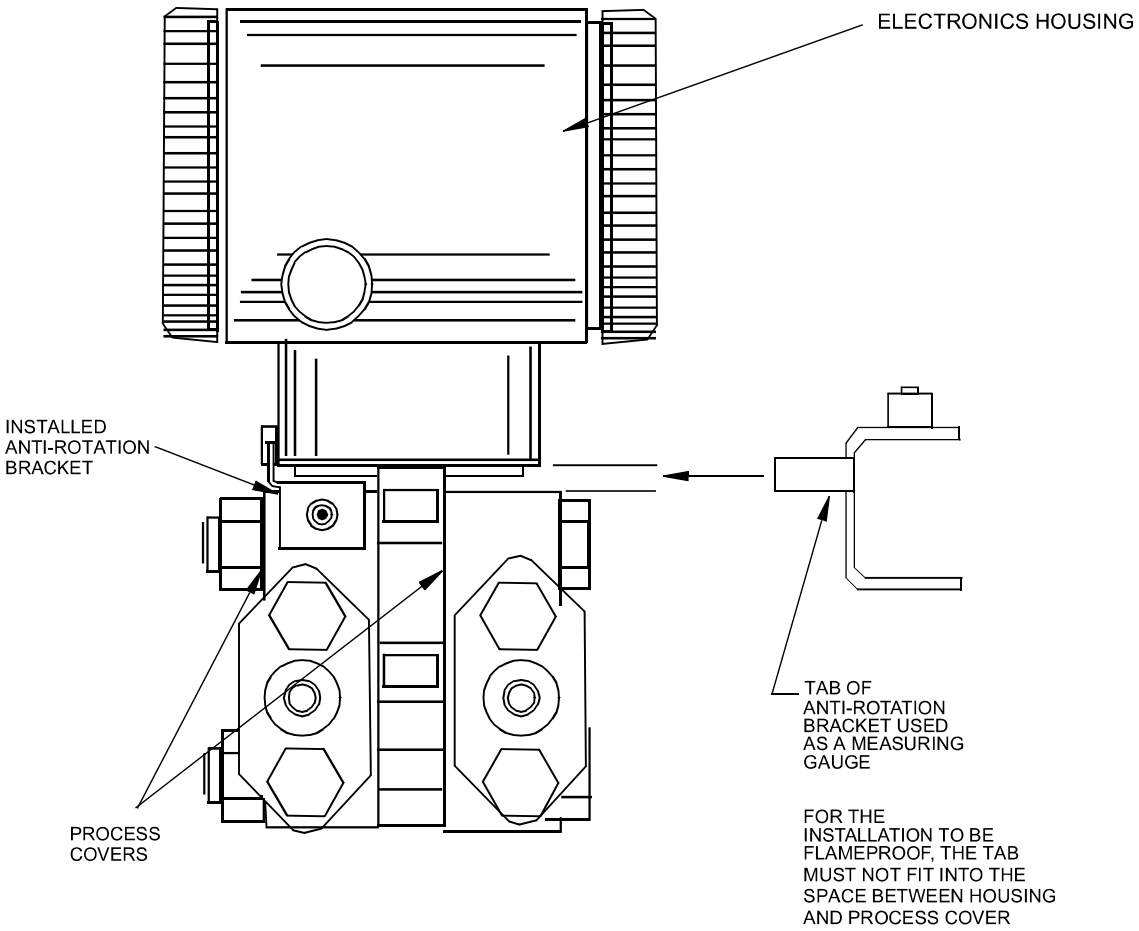


Figure 14. Anti-Rotation Bracket Installed on Transmitter