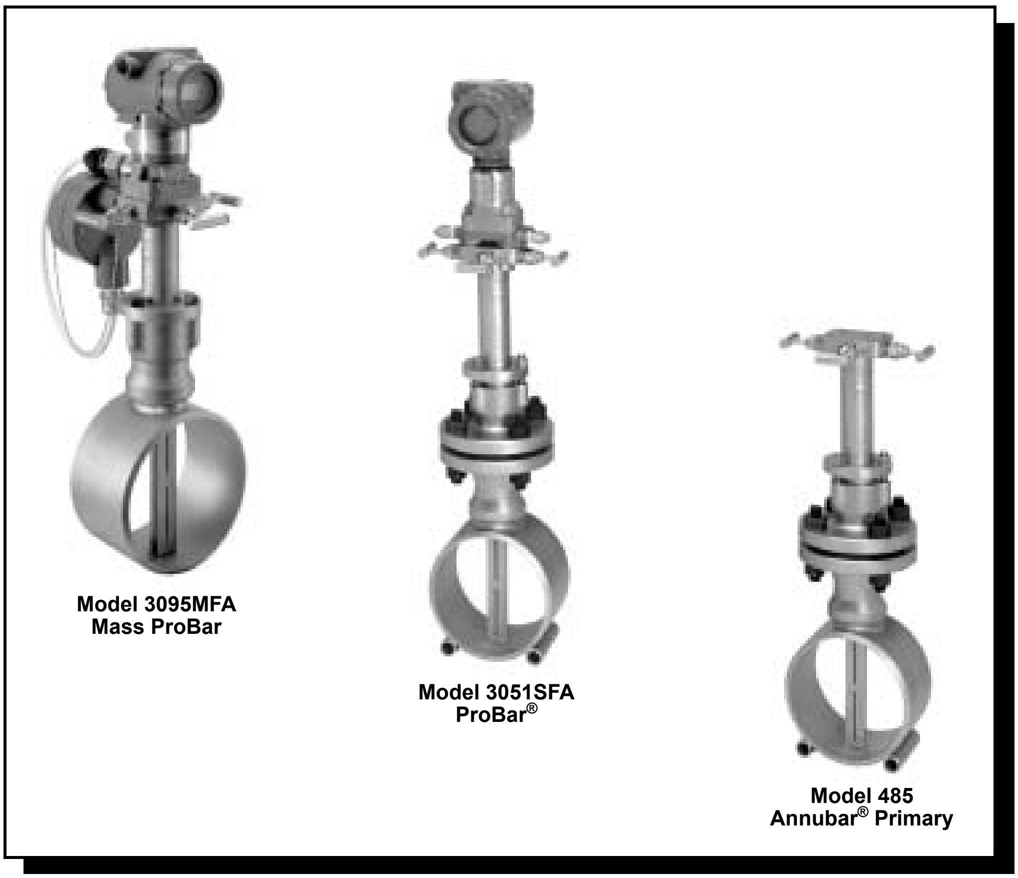
Reference Manual
00809-0100-4809, Rev AA
August 2002

The Annubar® Flowmeter Series



ROSEMOUNT®

EMERSON™
Process Management

www.rosemount.com

The Annubar Flowmeter Series

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

The United States has two toll-free assistance numbers and one International number.

Customer Central
1-800-999-9307 (7:00 a.m. to 7:00 P.M. CST)

International
1-(952) 906-8888

National Response Center
1-800-654-7768 (24 hours a day)
Equipment service needs

⚠CAUTION

The products described in this document are NOT designed for nuclear-qualified applications. Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

This device is intended for use in temperature monitoring applications and should not be used in control and safety applications.

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Approvals**

Section 1 Introduction

USING THIS MANUAL

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

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- Setting the Failure Model Alarm and Write Protect switches
- Orienting, mounting, and installing the flowmeter
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RECEIVING AND INSPECTION

Flowmeters are available in different models and with different options, so it is important to inspect and verify that the appropriate model was delivered before 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.

RETURNING THE PRODUCT

To expedite the return process, call the Rosemount National Response Center toll-free at 800-654-7768. This center, available 24 hours a day, will assist you with any needed information or materials.

⚠ The center will ask for the following information:

- Product model
- Serial numbers
- The last process material to which the product was exposed

The center will provide

- A Return Material Authorization (RMA) number
- Instructions and procedures that are necessary to return goods that were exposed to hazardous substances

NOTE
If a hazardous substance is identified, a Material Safety Data Sheet (MSDS), required by law to be available to people exposed to specific hazardous substances, must be included with the returned materials.

CONSIDERATIONS

Information in this manual applies to circular pipes only. Consult Rosemount Customer Central for instructions regarding use in square or rectangular ducts.

Limitations

Structural

Structural limitations are printed on the sensor tag. Exceeding structural limitations may cause sensor failure.

Functional

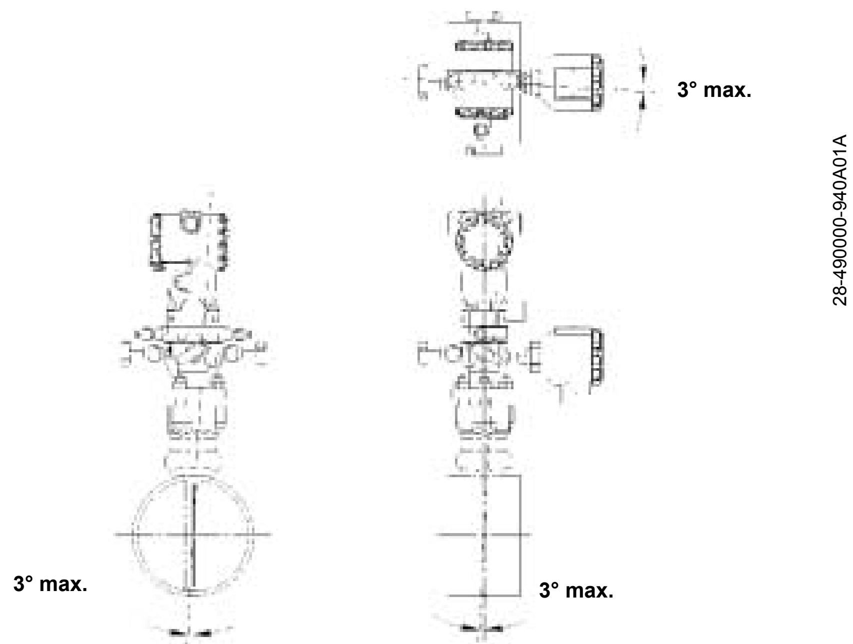
The most accurate and repeatable flow measurement occurs in the following conditions:

- The structural limit differential pressure, as printed on the sensor tag, is not exceeded.
- The instrument is not used for two-phase flow or for steam service below saturation temperature.

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

The flowmeter can be installation with a maximum misalignment of 3 degrees (see Figure 1-1). Misalignment beyond 3 degrees will cause flow measurement errors.

Figure 1-1. Permissible Misalignment



Environmental

Mount the flowmeter in a location with minimal ambient temperature changes. Appendix A: Specifications and Reference Data lists the temperature operating limits. Mount to avoid vibration, mechanical shock, and external contact with corrosive materials.

Access Requirements

Consider the need to access the flowmeter when choosing an installation location and orientation.

Process Flange Orientation

Orient the process flanges on a remote mounted flowmeter so that process connections can be made. For safety reasons, orient the drain/vent valves so that process fluid is directed away from technicians when the valves are used. In addition, consider the possible need for a testing or calibration input.

Housing Rotation

The electronics housing may be rotated up to 180 degrees (left or right) to improve field access to the two compartments or to better view the optional LCD meter. To rotate the housing, release the housing rotation set screw and turn the housing up to 180 degrees.

NOTE
Rotating the housing more than 180 degrees will damage the sensor module and void the warranty.

Electronics Housing

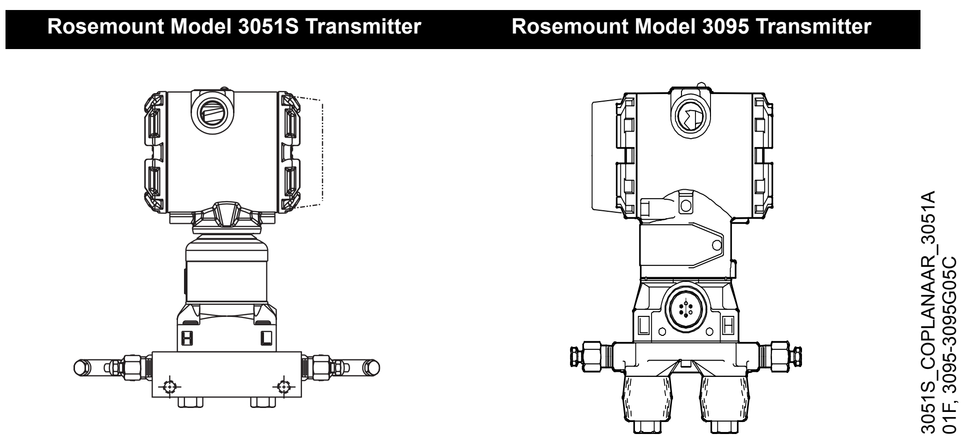
Terminal Side
The circuit compartment should not routinely need to be opened when the unit is in service. Wiring connections are made through the conduit openings on the top side of the housing. The field terminal side is marked on the electronics housing. Mount the flowmeter so that the terminal side is accessible. A 0.75-in. (19 mm) clearance is required for cover removal. Use a conduit plug on the unused side of the conduit opening. A 3-in. (76 mm) clearance is required for cover removal if a meter is installed.

Exterior
The integral span and zero push-buttons are located under the certifications plate on the top of the ProBar. The plate will be blank if no certifications are ordered.

Cover Installations

Always install the electronics housing covers metal-to-metal to ensure a proper seal.

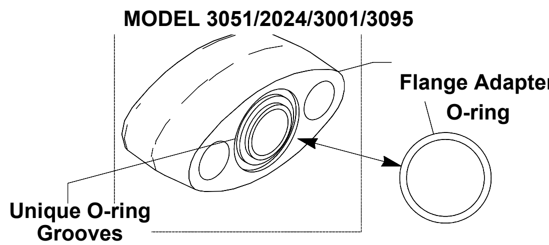
Figure 1-2. Electronics Housing



Process Considerations

The process connections on the transmitter flange are $\frac{1}{4}$–18 NPT. Flange adapter unions with $\frac{1}{2}$–14 NPT connections are available as options. These are Class 2 threads; use the plant-approved lubricant or sealant when making the process connections. The process connections on the transmitter flange are on $2\frac{1}{8}$–in. (54 mm) centers to allow direct mounting to a three- or five-valve manifold. By rotating one or both of the flange adapters, connection centers of 2–, $2\frac{1}{8}$–, or $2\frac{1}{4}$–in. (51, 54, or 57 mm) may be obtained.

Failure to install proper flange adapter O-rings can cause process leaks, which can result in death or serious injury. There are two styles of Rosemount flange adapters, each requiring a unique O-ring, as shown below. Each flange adapter is distinguished by its unique groove.



Use only the O-ring designed to seal with the corresponding flange adapter. Refer to the factory for the correct part numbers of the flange adapters and O-rings designed for the flowmeter.

Teflon® (PTFE) O-rings tend to cold flow when compressed, which aids in their sealing capabilities. Whenever flanges or adapters are removed, visually inspect the Teflon (PTFE) O-rings. Replace them if there are any signs of damage. If the O-rings are replaced, the flange bolts may need to be retorqued after installation to compensate for cold flow.

Electrical

The signal terminals are located in a compartment of the electronics housing. Connections for the Model 275 HART Communicator are located below the signal terminals. The Model 272 Field Calibrator can be connected at the signal terminals to provide temporary power to the electronics for calibration or diagnostic purposes. Otherwise, the calibrator may be attached to the test connections on the terminal block of the electronics for indication purposes.

Power Supply

The dc power supply should provide power with less than 2% ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of the controller, indicator, and related pieces. Note that the resistance of intrinsic safety barriers, if used, must be included.

NOTE
A loop resistance between 250-1100 ohms is required to communicate with a personal computer. With 250 ohms of loop resistance, a power supply voltage of at least 16.5 V dc is required.(1)

If a single power supply is used to power more than one Model 3095MFA Mass ProBar, the power supply used, and circuitry common to the Mass ProBars, should not have more than 20 ohms of impedance at 1200 Hz.

(1) Quick troubleshooting check: There must be at least 11.0 V DC across the Model 3095MFA Mass ProBar electronics terminals.

Section 2 Installation

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 live.
- Before connecting a Model 275 HART 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.

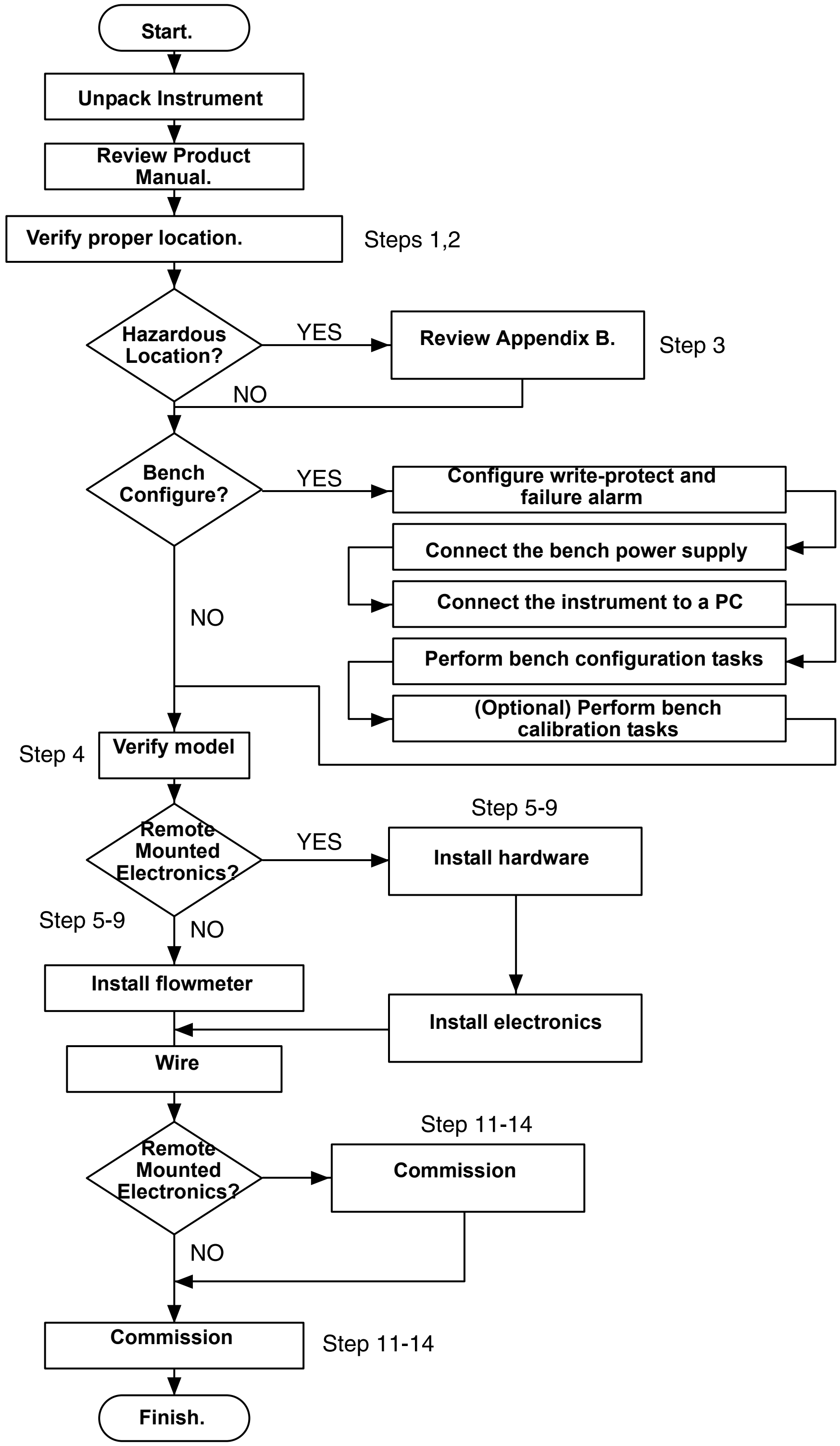
Failure to follow these installation guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.

INSTALLATION FLOWCHART AND CHECKLIST

Figure 2-1 is an installation flowchart that provides guidance through the installation process. Following the figure, an installation checklist has been provided to verify that all critical steps have been taken in the installation process. The checklist numbers are indicated in the flowchart.

Figure 2-1. Installation Chart



The following list is a summary of the steps required to complete a flowmeter installation. If this a 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 (see Table 2-3 on page 2-13) and begin with step 5.

1. Determine where the flowmeter is to be placed within the piping system.
2. Establish the proper orientation as determined by the intended application.
3. Review Appendix B: Approvals and determine if the flowmeter is located in a hazardous location.
4. Confirm the configuration.
5. Drill the correct sized hole into the pipe.

- For instruments equipped with opposite-side support, drill a second hole 180° 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).

NOTE
To maintain published flowmeter accuracy, provide the pipe ID when purchasing the flowmeter.

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

MOUNTING

Tools and Supplies

Tools required include the following:

- Open end or combination wrenches (spanners) to fit the pipe fittings and bolts: 9/16-in., 5/8-in., 7/8-in.
- Adjustable wrench: 15-in. (1½-in. jaw).
- Nut driver: 3/8-in. for vent/drain valves (or 3/8-in. wrench).
- Phillip's screwdriver: #1.
- Standard screwdrivers: ¼-in., and 1/8-in. wide.
- Pipe wrench: 14-in.
- Wire cutters/strippers
- 7/16-in. box wrench (required for the ferry head bolt design)

Supplies required include the following:

- ½-in. tubing (recommended) or ½-in. pipe to hook up the electronics to the sensor probe. The length required depends upon the distance between the electronics and the sensor.
- Fittings including (but not limited to)
  - Two tube or pipe tees (for steam or high temperature liquid) and
  - Six tube/pipe fittings (for tube)
- Pipe compound or Teflon (PTFE) tape (where local piping codes allow).

Mounting Brackets

Optional mounting brackets available with the instrument facilitate mounting to a panel, wall, or 2-in. (50.8 mm) pipe. The bracket option for use with the Coplanar flange is 316 SST with 316 SST bolts. See "Mounting" on page A-31 for bracket dimensions.

When installing the transmitter to one of the mounting brackets, torque the bolts to 125 in-lb (169 n-m).

Bolt Installation Guidelines

The following guidelines have been established to ensure a tight flange, adapter, or manifold seal. Only use bolts supplied with the instrument or sold by the factory.

The instrument is shipped with the coplanar flange installed with four 1.75-in. (44.5 mm) flange bolts. The following bolts also are supplied to facilitate other mounting configurations:

- Four 2.25-in. (57.2 mm) manifold/flange bolts for mounting the coplanar flange on a three-valve manifold. In this configuration, the 1.75-in. (44.5 mm) bolts may be used to mount the flange adapters to the process connection side of the manifold.
- (Optional) If flange adapters are ordered, four 2.88-in. (73.2 mm) flange/adapter bolts for mounting the flange adapters to the coplanar flange.

Stainless steel bolts supplied by Rosemount Inc. are coated with a lubricant to ease installation. Carbon steel bolts do not require lubrication. Do not apply additional lubricant when installing either type of bolt. Bolts supplied by Rosemount Inc. are identified by the following head markings:

Carbon Steel Head Markings (CS)

Stainless Steel Head Markings (SST)

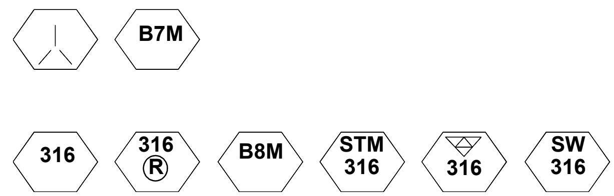
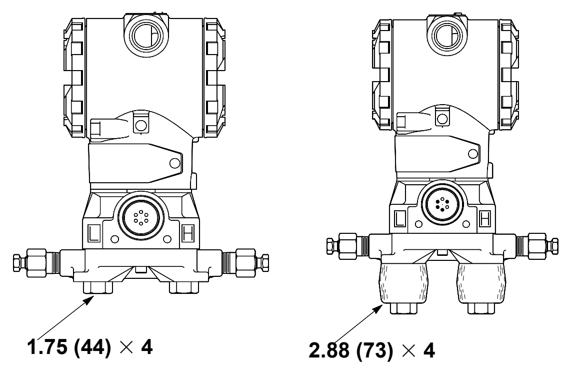
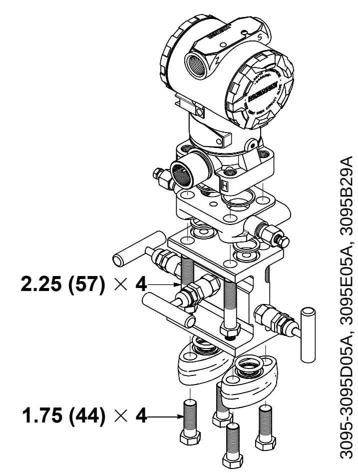


Figure 2-2. Coplanar Mounting Bolts and Bolting Configurations for Coplanar Flange.

Transmitter with Flange Bolts	Transmitter with Optional Flange Adapters and Flange/Adapter Bolts	Transmitter with 3-Valve Manifold, Manifold/Flange Bolts, Flange Adapters and Flange/Adapter bolts





Description	Size in. (mm)
Flange bolts (4)	1.75 -in. (44 mm)
Flange/adapter bolts (4)	2.88 -in. (73 mm)
Manifold/flange bolts (4)	2.25 -in. (57 mm)

Instrument Manifolds

Figure 2-3 on page 2-6 identifies the valves on a 5-valve and a 3-valve manifold. Table 2-1 on page 2-6 explains the purpose of these valves.

An instrument manifold is recommended for all installations. A manifold allows an operator to equalize the pressures prior to the zero calibration of the electronics as well as to isolate the electronics 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.

5-valve manifolds provide a positive method of indicating a partially closed or faulty equalizer valve. A closed faulty equalizer valve will block the DP signal and create errors that may not be detectable otherwise. The labels for each valve will be used to identify the proper valve in the procedures to follow.

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 to provide the necessary isolation and equalization functions.

Figure 2-3. Valve Identification for 5-valve and 3-Valve Manifolds

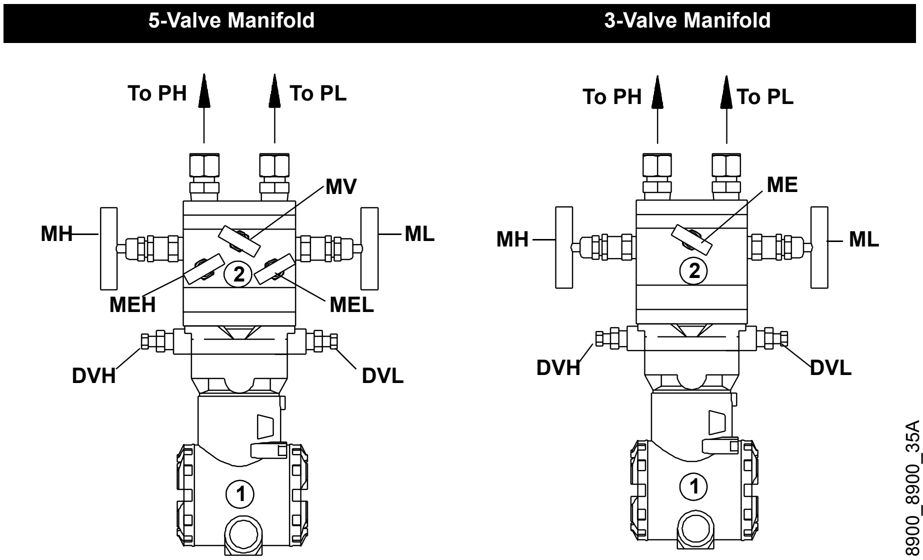


Table 2-1. Description of Impulse Valves and Components

Name	Description	Purpose
Manifold and Impulse Pipe Valves		
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 DP electronics chambers
MH ML	Manifold – High Pressure Manifold – Low Pressure	Isolates high side or low side pressure from the process.
MEH MEL	Manifold Equalizer – High Pressure Manifold Equalizer – Low Pressure	Allows high and low pressure side access to the vent valve, or for isolating the process fluid
ME	Manifold Equalizer	Allows high and low side pressure to equalize
MV	Manifold Vent Valve	Vents process fluid
Components		
1 2	Electronics Manifold	Reads Differential Pressure Isolates and equalizes electronics.
3	Vent Chambers	Collects gases in liquid applications.
4	Condensate Chamber	Collects condensate in gas applications.

Straight Run Requirements

Use the following to aid in determining the straight run requirements

NOTE

- **For gas service, multiply values from Table 2-2 on page 2-7 by 1.5.**
- If longer lengths of straight run are available, position the mounting such that 80% of the run is upstream and 20% is downstream.
- The information contained in this manual is applicable to circular pipes only. Consult the factory for instructions regarding use in square or rectangular ducts.
- Straightening vanes may be used to reduce the required straight run length.
- Row 5 in Table 2-2 is to be used if a “through type” valve will remain open. Row 6 in Table 2-2 applies to gate, globe, plug, and other throttling valves that are partially opened, as well as control valves.

Table 2-2. Straight Run Requirements

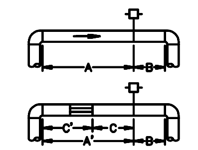
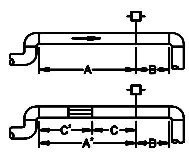
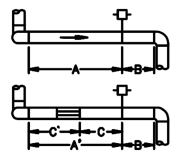
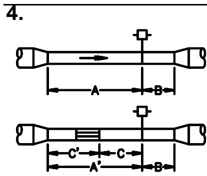
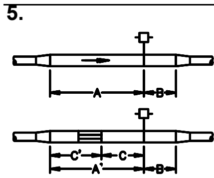
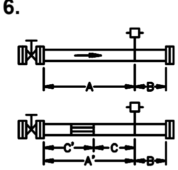
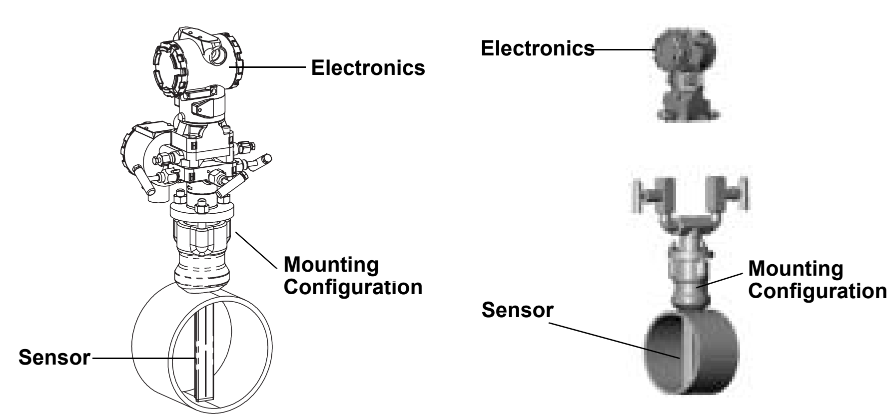
	Upstream dimension					Downstream Dimensions
	Without vanes		With vanes			
	In plane A	Out of plane A	A'	C	C'	B
1.  1295-0573B	8	10	–	–	–	4
	–	–	8	4	4	4
2.  1295-0573C	11	16	–	–	–	4
	–	–	8	4	4	4
3.  1295-0573D	23	28	–	–	–	4
	–	–	8	4	4	4
4.  1295-0573E	12	12	–	–	–	4
	–	–	8	4	4	4
5.  1295-0573F	18	18	–	–	–	4
	–	–	8	4	4	4
6.  1295-0573G	30	30	–	–	–	4
	–	–	8	4	4	4

Figure 2-4. Mounting Configuration

Integral Mount	Remote Mount



28-490000-945A01A, 946A01A

Integral (Direct) Mount

NOTE
The integral mount flowmeter is usually shipped with the electronics bolted directly to the sensor. If this is not so, contact Rosemount Customer Central for more information.

Horizontal Pipes

Liquid or Steam Applications

Due to the possibility of air getting trapped in the probe, the sensor should be located according to Figure 2-5 for liquid or steam applications. The area between 0° and 30° angle should not be used unless full bleeding of air from the probe is possible.

For *liquid* applications, mount the side drain/vent valve upward to allow the gases to vent.

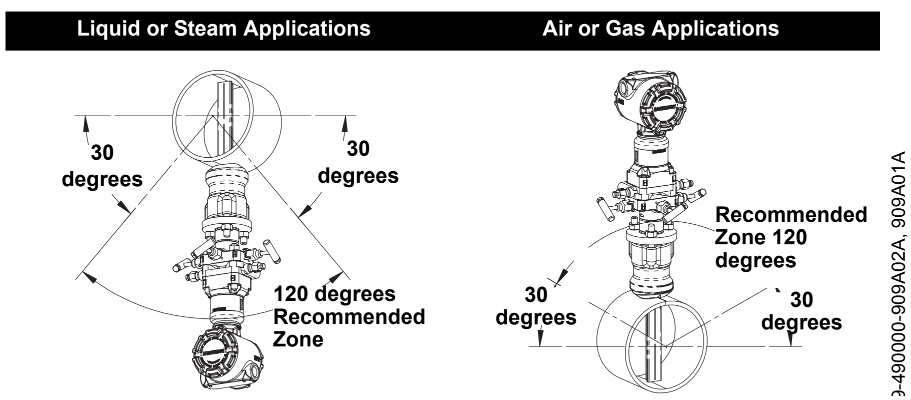
In *steam* applications, fill the lines with water to prevent the steam from contacting the electronics. Condensate chambers are not required because the volumetric displacement of the electronics is negligible.

Air and Gas Applications

Figure 2-5 illustrates the recommended location of the flowmeter in air or gas applications. The sensor should be located on the upper half of the pipe, at least 30° above the horizontal line.

For *air* and *gas* applications, mount the drain/vent valve downward to allow liquid to drain.

Figure 2-5. Horizontal Pipe Applications



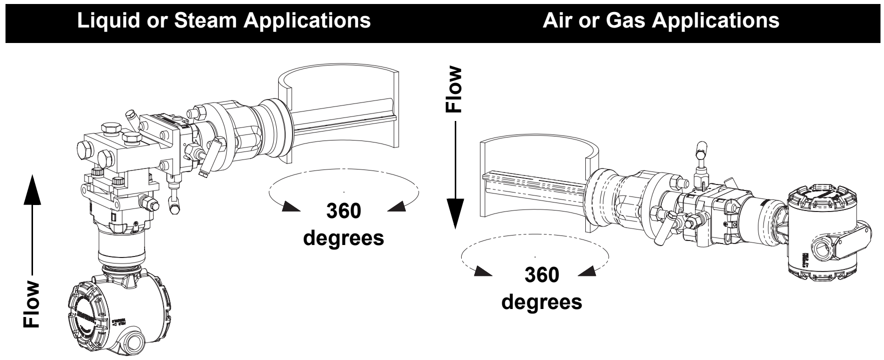
Vertical Pipes

Liquid, Steam, Air, and Gas Applications

Figure 2-6 illustrates the recommended location of the flowmeter in liquid, air, or gas applications.

The sensor 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 2-6. Vertical Pipe Applications



Remote Mount

Instrument head connections differ between horizontal and vertical pipes. Consult your specification **head code number** to confirm the proper pipe orientation.

Valves and Fittings

Throughout the remote mounting process:

- Use only valves, fittings, and pipe thread sealant compounds that are rated for the service pipeline design pressure and temperature as specified in Appendix A: Specifications and Reference Data.
- 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 "Integral (Direct) Mount" on page 2-8 and "Remote Mount" on page 2-9).

Impulse Piping

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

The following restrictions and recommendations apply to impulse piping location.

- Piping used to connect the sensor probe and electronics must be rated for continuous operation at the pipeline-designed pressure and temperature
- Impulse piping that runs horizontally must slope at least 1–in. per foot (83mm/m).
  - It must slope downwards (toward the electronics) for liquid and steam applications.
  - It must slope up (away from the electronics) for gas applications.
- 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.

- For applications where pipeline temperature is above 250 °F (121 °C), the impulse piping should have a minimum length of 1-ft. (0.30 m) for every 100 °F (38 °C) over 250 °F (121 °C), which is the maximum operating electronics 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.
- A minimum of 1/2-in. (12mm) outer diameter (OD) stainless steel tubing with a wall thickness of at least 0.035-in. is recommended.
- Outdoor installations for liquid, saturated gas, or steam service may require insulation and heat tracing to prevent freezing.
- For installations where the electronics are more than 6-ft. (1.8m) 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.
- Threaded pipe fittings are not recommended because they create voids where air can become entrapped and have more possibilities for leakage.
- 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.
- 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.

Figure 2-7. Liquid Service

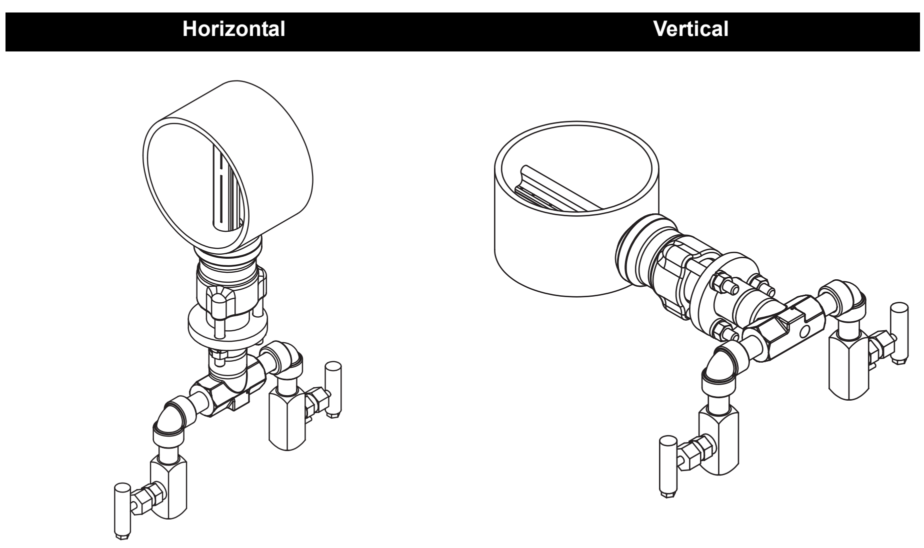


Figure 2-8. Gas Service

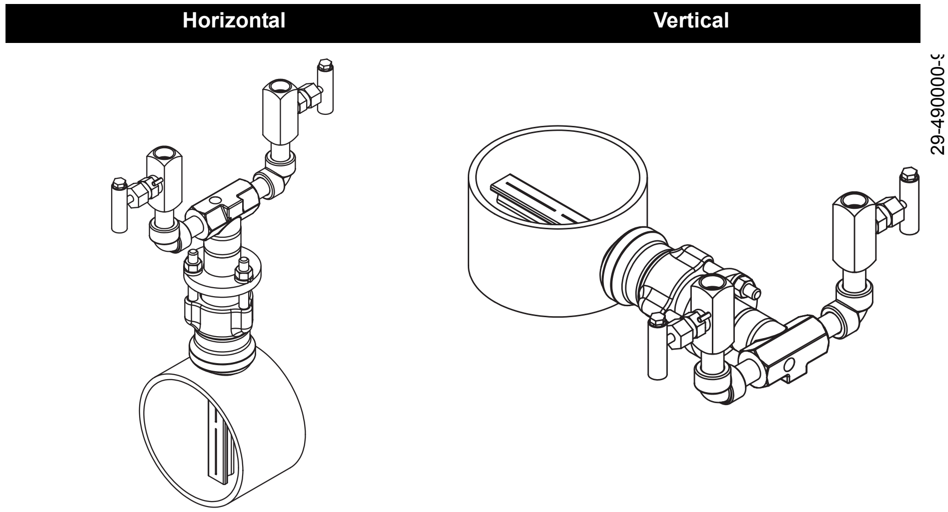
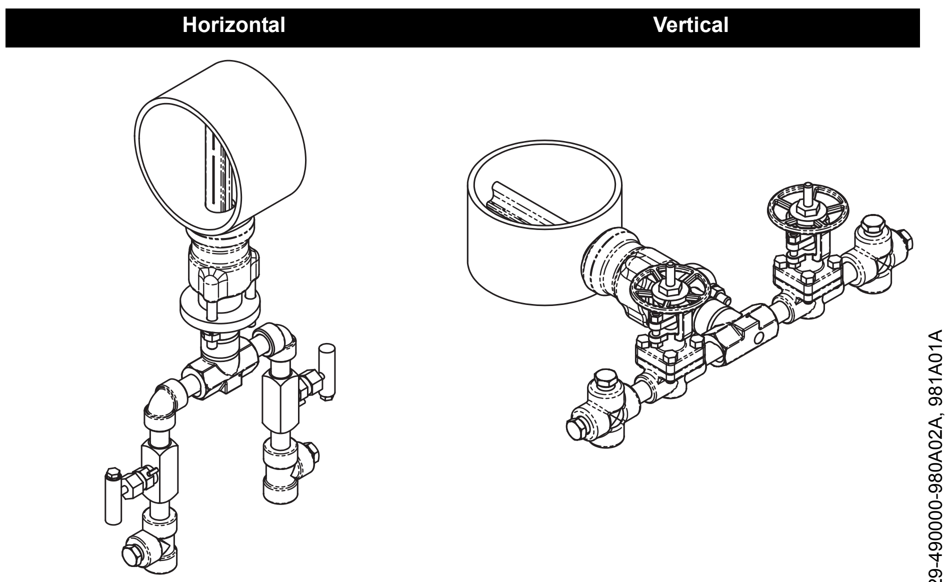


Figure 2-9. Steam Service



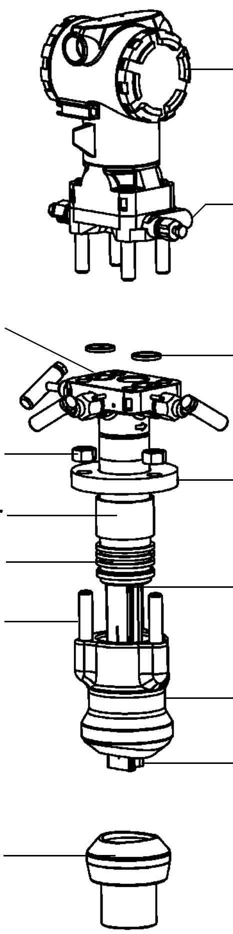
INSTALLATION

This manual contains the horizontal and vertical installation procedures for the Pak-Lok, Flanged, Flange-Lok, and Threaded Flow-Tap Annubar models.

Pak-Lok Model

Figure 2-10 identifies the components of the Pak-Lok assembly.

Figure 2-10. Components



Step 1: Set the Switches

Refer to “Mounting” on page 2-4 for more information

Step 2: Determine the Proper Orientation

Please refer to “Mounting” on page 2-4 for straight run requirements and orientation information.

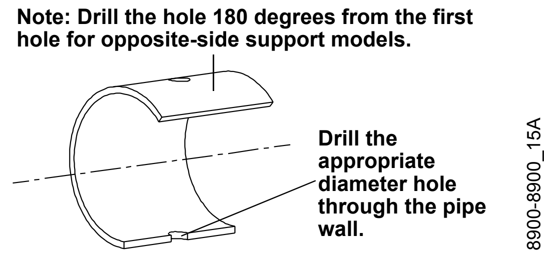
Step 3: Drill a Hole into the Pipe

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

1. Depressurize and drain the pipe.
2. From the previous steps, select the location to drill the hole.
3. Determine the diameter of the hole to be drilled according to the specifications in Table 2-3 and drill the hole. **Do not torch cut the hole.**

Table 2-3. Drill Hole into Pipe

Sensor Size / Hole Diameter Chart		
Sensor	Diameter	
T1	$^{3}/_{4}$-in. (19 mm)	+ $^{1}/_{32}$-in (1 mm) – 0.00
T2	$1^{5}/_{16}$-in. (34 mm)	+ $^{1}/_{16}$-in. (1 mm) – 0.00
T3	$2^{1}/_{2}$-in. (64 mm)	+ $^{1}/_{16}$-in. (1 mm) – 0.00

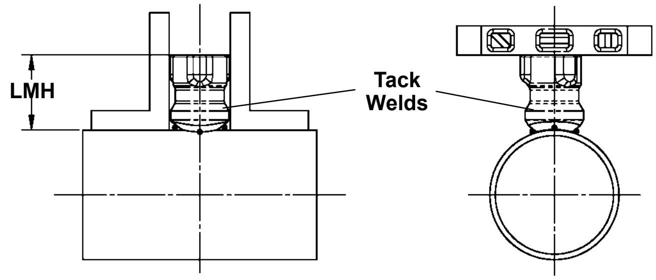


4. If opposite-side support coupling is supplied, a second identically sized hole must be drilled opposite the first hole so that the sensor can pass completely through the pipe. (To determine a opposite-side support model, measure the distance from the tip of the first slot or hole. If the distance is greater than 1-in. (25.4 mm), it is the opposite-side model.) To drill the second hole, follow these steps:
   a. Measure the pipe circumference with a pipe tape, soft wire, or string (for the most accurate measurement the pipe tape needs to be perpendicular to the axis of flow).
   b. Divide the measured circumference by two to determine the location of the second hole.
   c. Rewrap the pipe tape, soft wire, or string from the center of the first hole. Then, using the number calculated in the preceding step, mark the center of what will become the second hole.
   d. Using the diameter determined from Table 2-3, drill the hole into the pipe with a hole saw or drill. Do not torch cut the hole.
5. Deburr the drilled hole(s) on the inside of the pipe.

Step 4: Weld the Mounting Hardware

1. Center the Pak-Lok body over the mounting hole, gap $^{1}/_{16}$-in. (1.5 mm) and place four $^{1}/_{4}$-in. (6-mm) tack welds at 90° increments. Check alignment of the Pak-Lok body both parallel and perpendicular to the axis of flow. If alignment of mounting is within tolerances (see Figure 2-11), finish weld per local codes. If alignment is outside of specified tolerance make adjustments prior to finish weld.

Figure 2-11. Alignment



2. If opposite side support is being used, center the fitting for the opposite
side support over the opposite side hole, gap 1/16-in. (1.5 mm) and place
four 1/4-in. (6 mm) tack welds at 90° increments. Insert the sensor into the mounting hardware. Verify that the tip of the bar is centered in the opposite side fitting and verify that the plug will fit around bar. If the bar is centered in the fitting and plug fits around the bar, finish weld per local codes. If the alignment of the bar does not allow enough clearance to insert the opposite side plug, make the necessary adjustments prior to making the finish weld.

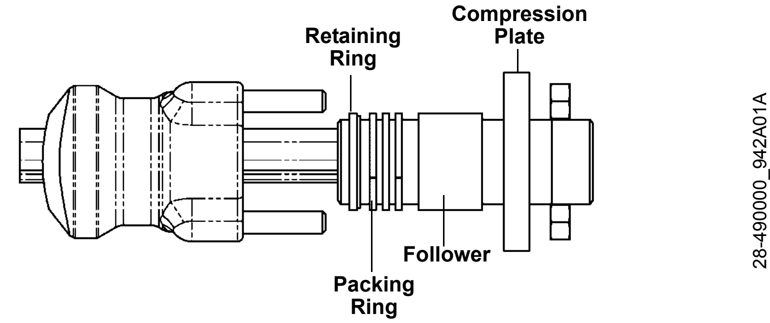
NOTE
To avoid serious burns, allow the mounting hardware to cool before continuing.

Step 5: Insert into the Pipe

After the mounting hardware has cooled, use the following steps for installation.

1. Thread studs into the Pak-Lok body.
2. To ensure that the flowmeter contacts the opposite side wall, mark the
tip of the sensor with a marker. (Do not mark if the sensor was ordered with special-cleaned option code P2.)
3. Rotating the flowmeter back and forth, insert the flowmeter into the Pak-Lok body until the sensor tip contacts the pipe wall (or support plug).
4. Remove the flowmeter.
5. Verify that the sensor tip made contact with the pipe wall by removing the pipe and ensuring that some of the marker has been rubbed off. For special-cleaned bars, look for wear marks on the tip. If the tip did not touch the wall, verify pipe dimensions and the height of mounting body from the OD of the pipe and re-insert.
6. Re-insert the flowmeter into the Pak-Lok body and install the first packing ring on the sensor between the lock ring and the packing follower. Do not damage the split packing rings.
7. Push the packing ring into the Pak-Lok 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°.

Figure 2-12. Packing Ring Detail

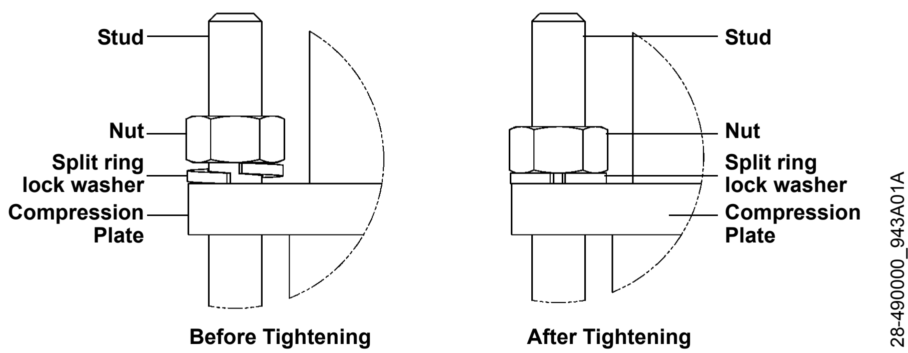


8. Tighten the nuts onto the studs:

- Place the included split-ring lock washer between each of the nuts and the compression plate. Give each nut one half (1/2) turn in succession until the split-ring lock washer is flat between the nut and the compression plate. Inspect the unit for leakage; if any exists, tighten the nuts in one-quarter (1/4) turn increments until there is no leakage.

NOTE
On sensor size (1), failure to use the split-ring lock washers, improper washer orientation, or over-tightening the nuts may result in damage to the flowmeter.

Figure 2-13. Split-Ring Lock Washer Orientation



NOTE
Pak-Lok sealing mechanisms generate significant force at the point where the sensor contacts the opposite pipe wall. Caution needs to be exercised on thin-walled piping (ANSI Schedule 10 and below) to avoid damage to the pipe.

Step 6: Mount the Transmitter

Direct Mount Head

With Valves

- Place Teflon (PTFE) O-rings into grooves on the face of head.
- Align the high side of the transmitter to the high side of the probe ("Hi" is stamped on the side of the head) and install.
- Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Without Valves

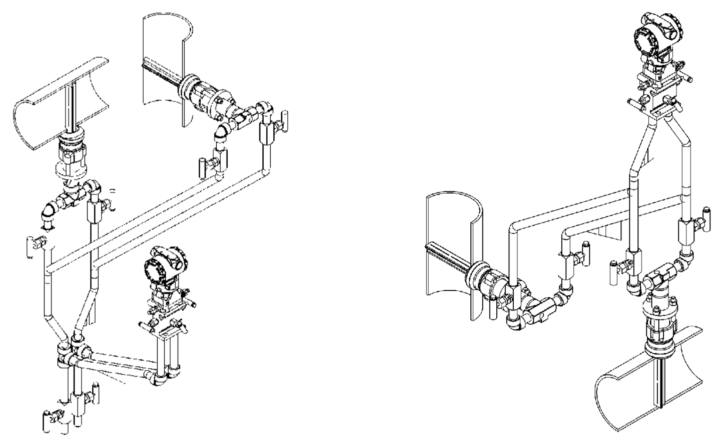
- Place Teflon (PTFE) O-rings into grooves on the face of head.
- Orient the equalizer valve or valves so they are easily accessible. Install manifold with the smooth face mating to the face of the head. Tighten in cross pattern to a torque of 400 in•lb (45 N•m).
- Place Teflon (PTFE) O-rings into grooves on the face of the manifold.
- Align the high side of the transmitter to the high side of the probe (“Hi” is stamped on the side of the head) and install.
- Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Remote Mount Head – temperatures below 250 °F (121 °C)

See “Remote Mount” on page 2-9 for more information.

Liquid Applications
Secure the electronics below the sensor to ensure that air will not be introduced into the impulse piping or the electronics.

Gas Applications
Secure the electronics above the sensor to prevent condensable liquids from collecting in the impulse piping and the DP cell.



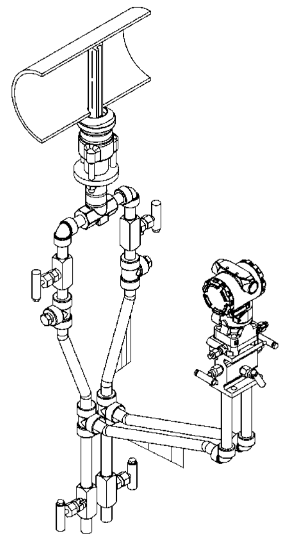
28_490000_931A01A, 932A01A

Remote Mount Head – temperature above 250 °F (121 °C)

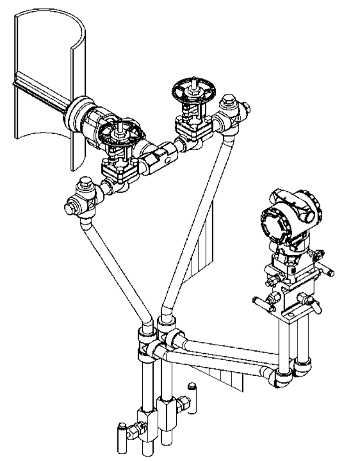
Liquid or Steam Applications

The electronics must be mounted below the process piping. Route the impulse piping down to the electronics and fill the system with cool water through the two tee fittings.

Horizontal Line



Vertical Line

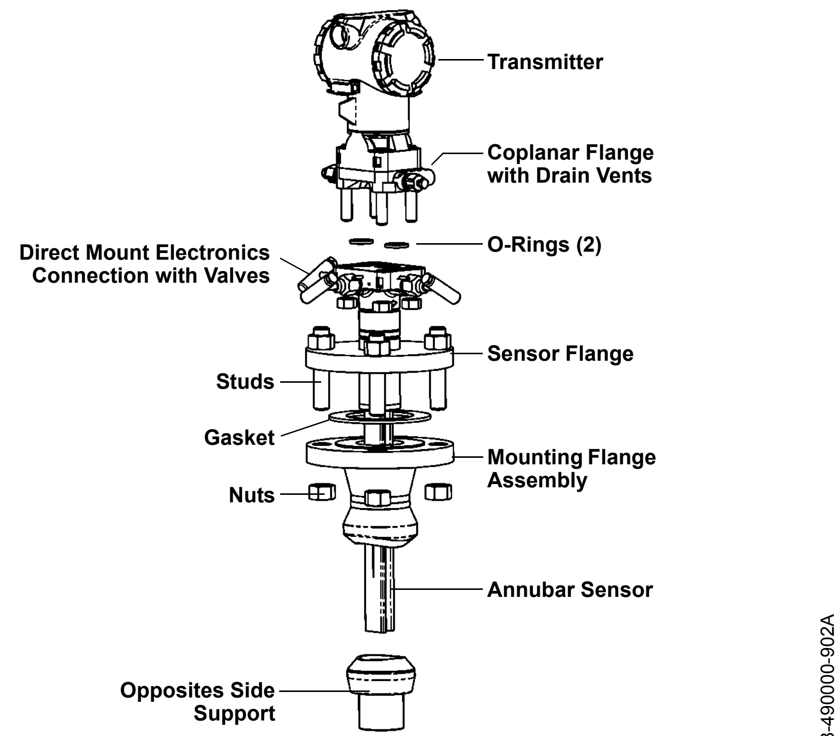


28_490000_933A01A, 934A01A

Flanged Model

Figure 2-14 identifies the components of the Flanged assembly.

Figure 2-14. Components



Step 1: Set the Switches

Refer to "Mounting" on page 2-4 for more information

Step 2: Determine the Proper Orientation

Please refer to "Mounting" on page 2-4 for straight run requirements and orientation information.

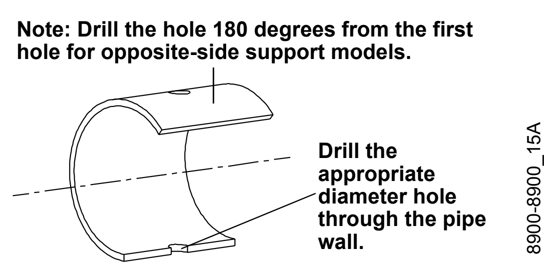
Step 3: Drill a Hole into the Pipe

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

1. Depressurize and drain the pipe.
2. From the previous steps, select the location to drill the hole.
3. Determine the diameter of the hole to be drilled according to the specifications in Table 2-4 and drill the hole with a hole saw or a drill. **Do not torch cut the hole**.

Table 2-4. Drill Hole into Pipe

Sensor Size / Hole Diameter Chart		
Sensor	Diameter	
T1	3/4-in. (19 mm)	+ 1/32-in (1 mm) – 0.00
T2	1 5/16-in. (34 mm)	+ 1/16-in. (1 mm) – 0.00
T3	2 1/2-in. (64 mm)	+ 1/16-in. (1 mm) – 0.00



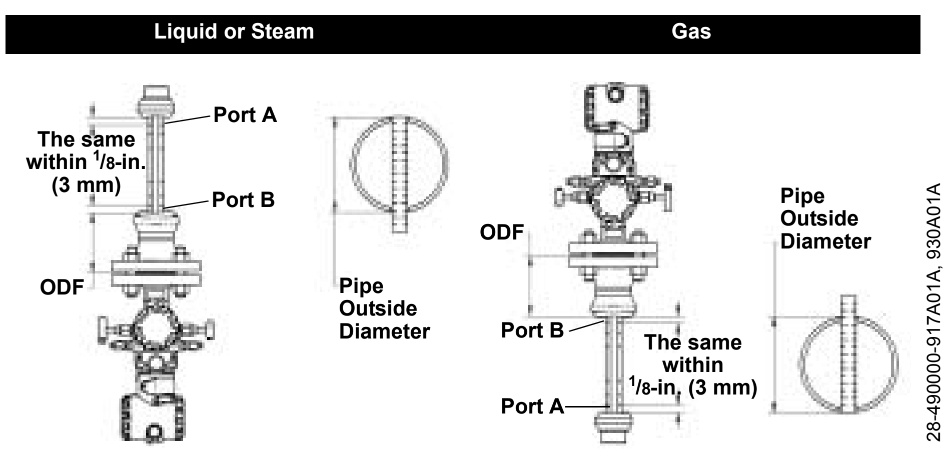
4. If opposite-side support coupling is supplied, a second identically sized hole must be drilled opposite the first hole so that the sensor can pass completely through the pipe. (To determine a opposite-side support model, measure the distance from the tip of the first slot or hole. If the distance is greater than 1-in. (25.4 mm), it is the opposite-side model.) To drill the second hole, follow these steps:
   a. Measure the pipe circumference with a pipe tape, soft wire, or string (for the most accurate measurement the pipe tape needs to be perpendicular to the axis of flow).
   b. Divide the measured circumference by two to determine the location of the second hole.
   c. Rewrap the pipe tape, soft wire, or string from the center of the first hole. Then, using the number calculated in the preceding step, mark the center of what will become the second hole.
   d. Using the diameter determined from Table 2-4, drill the hole into the pipe with a hole saw or drill. Do not torch cut the hole.
5. Deburr the drilled hole or holes on the inside of the pipe.

Step 4: Assemble and check Fit-Up

1. Assemble the bar to the mounting hardware with the gaskets and bolts.
2. Hand tighten the bolts just enough to hold the position of the sensor centered in the mounting hardware.
3. Check the fit of the assembly to the pipe by inserting a rule, stick, or stiff wire through both mounting holes. Note the measured distance.
4. Add $^{1}/_{16}$-in. (1.5 mm) to the measured distance and transfer to the assembly starting at the high point of the weldolet.
5. Measure the distance from the high point of the weldolet to the first sensing hole, port B, then subtract $^{1}/_{16}$-in. (1.5 mm).
6. Measure the distance from the end of the transferred length in step 4 to the last sensing hole, port A.
7. Compare the numbers obtained in steps 5 and 6.

Small discrepancies can be compensated for with the fit-up of the mounting hardware. Large discrepancies may cause installation problems or error.

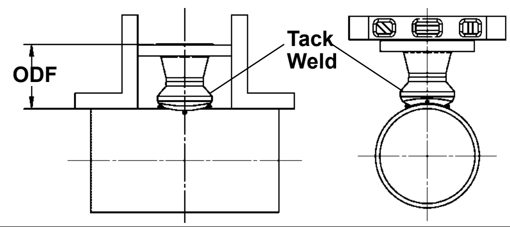
Figure 2-15. Fit-up Check for Annubar with Opposite Side Support



Step 5: Weld the Mounting Hardware

1. Center the Flanged body over the mounting hole, gap 1/16-in. (1.5 mm) and measure the distance from the OD of the pipe to the face of the flange. Compare this to the table below and adjust the gap as necessary.
2. Place four 1/4-in. (6-mm) tack welds at 90° increments. Check alignment of the mounting both parallel and perpendicular to the axis of flow (see Figure 2-16). If alignment of the mounting is within tolerances, finish weld per local codes. If outside of specified tolerance, make adjustments prior to making the finish weld.

Figure 2-16. Alignment



Size	ODF (in.)	Size	ODF (mm)
1.0-in. 150#	3.38-in. (85.8 mm)	DN25 PN16	2.68-in. (68.2 mm)
1.0-in. 300#	3.63-in. (92.2 mm)	DN25 PN40	2.76-in. (70.2 mm)
1.0-in. 600#	3.88-in. (98.5 mm)	DN25 PN100	3.47-in. (88.2 mm)
2.0-in. 150#	4.13-in. (104.8 mm)	DN50 PN16	3.40-in. (86.3 mm)
2.0-in. 300#	4.38-in. (111.2 mm)	DN50 PN40	3.51-in. (89.3 mm)
2.0-in. 600#	4.76-in. (120.8 mm)	DN50 PN100	4.30-in. (109.3 mm)
3.0-in. 150#	4.63-in. (117.5 mm)	DN80 PN16	3.84-in. (97.6 mm)
3.0-in. 300#	5.00-in. (126.9 mm)	DN80 PN40	4.16-in. (105.6 mm)
3.0-in. 600#	5.38-in. (136.6 mm)	DN80 PN100	4.95-in. (125.6 mm)

3. If opposite side support is being used, center the fitting for the opposite side support over the opposite side hole, gap 1/16-in. (1.5 mm) and place four 1/4-in. (6 mm) tack welds at 90° increments. Insert the sensor into the mounting hardware. Verify that the tip of the bar is centered in the opposite side fitting and that the plug will fit around bar. If the bar is centered in the fitting and plug fits around the bar, finish weld per local codes. If alignment of the bar does not allow enough clearance to insert the opposite side plug, make the necessary adjustments prior to making the finish weld.

NOTE:
To avoid serious burns, allow the mounting hardware to cool before continuing.

Step 6: Insert into Pipe

After the mounting hardware has cooled, use the following steps for installation.

1. Assemble the bar to the mounting flange using a gasket, bolts, and nuts.
2. Tighten the nuts in a cross pattern to allow even compression of the gasket.
3. If opposite side support is threaded, apply an appropriate thread sealing compound to the support plug threads and tighten until no leakage occurs.
4. If opposite side support is a socket weld fitting, insert the plug into the sockolet fitting until the parts contact. Retract the plug $^1/_{16}$-in. (1.5 mm) and apply fillet weld per local codes.

Step 7: Mount the Transmitter

Direct Mount Head

With Valves

1. Place Teflon (PTFE) O-rings into grooves on the face of head.
2. Align the high side of the transmitter to the high side of the probe ("Hi" is stamped on the side of the head) and install.
3. Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Without Valves

1. Place Teflon (PTFE) O-rings into grooves on the face of head.
2. Orient the equalizer valve or valves so they are easily accessible. Install manifold with the smooth face mating to the face of the head. Tighten in cross pattern to a torque of 400 in•lb (45 N•m).
3. Place Teflon (PTFE) O-rings into grooves on the face of the manifold.
4. Align the high side of the transmitter to the high side of the probe ("Hi" is stamped on the side of the head) and install.
5. Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Remote Mount Head – temperature below 250 °F (121 °C)

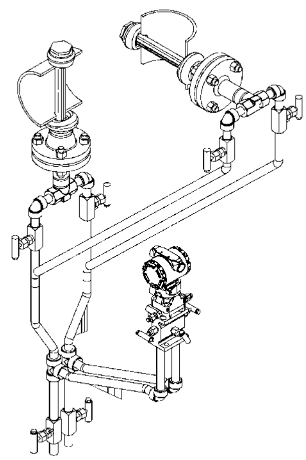
See “Remote Mount” on page 2-9 for more information

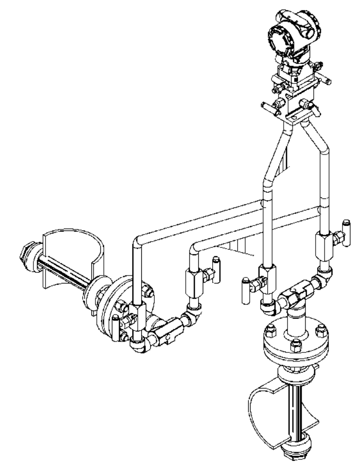
Liquid Applications

Secure the electronics below the sensor to ensure that air will not be introduced into the impulse piping or the electronics.

Gas Applications

Secure the electronics above the sensor to prevent condensable liquids from collecting in the impulse piping and the DP cell.





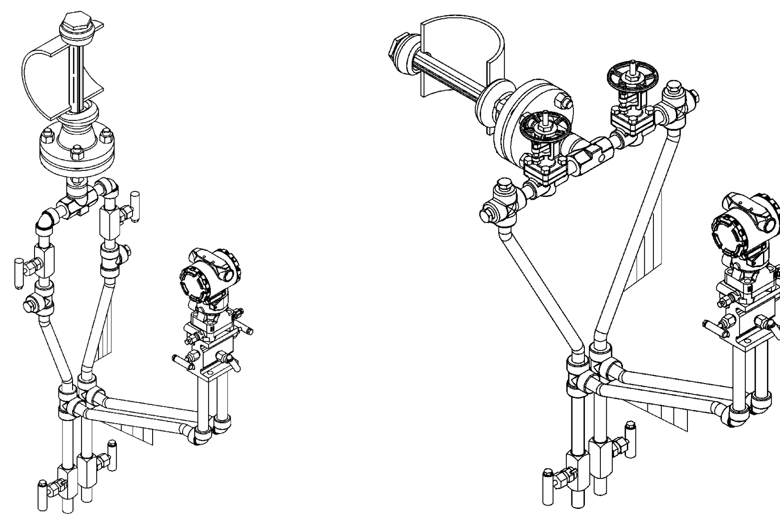
28_490000_950A01A, 951A01A

Remote Mount Head – temperature above 250 °F (121 °C)

Liquid or Steam Applications

The electronics must be mounted below the process piping. Route the impulse piping down to the electronics and fill the system with cool water through the two tee fittings.

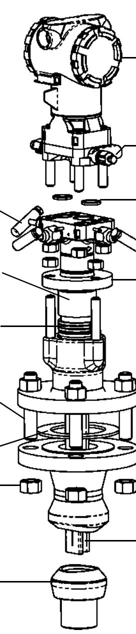
Horizontal Line *Vertical Line*



Flange-Lok Model

Figure 2-17 identifies the components of the Flange-Lok assembly.

Figure 2-17. Components



Step 1: Set the Switches

Refer to “Mounting” on page 2-4 for more information

Step 2: Determine the Proper Orientation

Please refer to “Mounting” on page 2-4 for straight run requirements and orientation information.

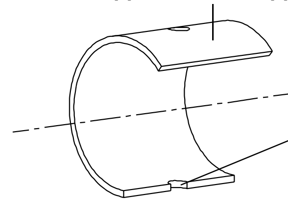
Step 3: Drill a Hole into the Pipe

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

1. Depressurize and drain the pipe.
2. From the previous steps, select the location to drill the hole.
3. Determine the diameter of the hole to be drilled according to the specifications in Table 2-5 and drill the hole with a hole saw or a drill. **Do not torch cut the hole**.

Table 2-5. Drill Hole into Pipe

Sensor Size / Hole Diameter Chart		
Sensor	**Diameter**	
T1	3/4-in. (19 mm)	+ 1/32-in (1 mm) – 0.00
T2	1 5/16-in. (34 mm)	+ 1/16-in. (1 mm) – 0.00
T3	2 1/2-in. (64 mm)	+ 1/16-in. (1 mm) – 0.00

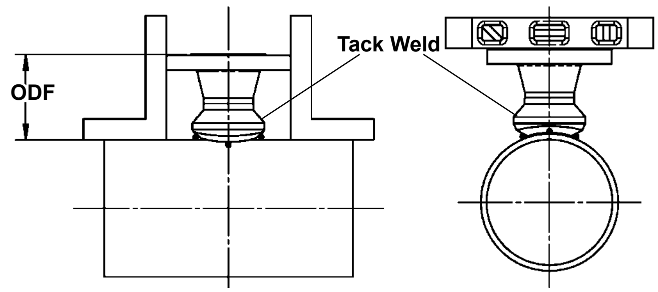


4. If opposite-side support coupling is supplied, a second identically sized hole must be drilled opposite the first hole so that the sensor can pass completely through the pipe. (To determine a opposite-side support model, measure the distance from the tip of the first slot or hole. If the distance is greater than 1-in. (25.4 mm), it is the opposite-side model.) To drill the second hole, follow these steps:
   a. Measure the pipe circumference with a pipe tape, soft wire, or string (for the most accurate measurement the pipe tape needs to be perpendicular to the axis of flow).
   b. Divide the measured circumference by two to determine the location of the second hole.
   c. Rewrap the pipe tape, soft wire, or string from the center of the first hole. Then, using the number calculated in the preceding step, mark the center of what will become the second hole.
   d. Using the diameter determined from Table 2-5, drill the hole into the pipe with a hole saw or drill. Do not torch cut the hole.
5. Deburr the drilled hole or holes on the inside of the pipe.

Step 4: Weld the Mounting Hardware

1. Center the Flange-Lok body over the mounting hole, gap 1/16-in. (2 mm) and measure the distance from the OD of the pipe to the face of the flange. Compare this to the table below and adjust the gap as necessary.
2. Place four 1/4-in. (6-mm) tack welds at 90° increments. Check alignment of the mounting both parallel and perpendicular to the axis of flow (see Figure 2-18). If alignment of the mounting is within tolerances, finish weld per local codes. If outside of specified tolerance, make adjustments prior to making the finish weld.

Figure 2-18. Alignment



Size	ODF (in.)	Size	ODF (mm)
1.0-in. 150#	3.38-in. (85.8 mm)	DN25 PN16	2.68-in. (68.2 mm)
1.0-in. 300#	3.63-in. (92.2 mm)	DN25 PN40	2.76-in. (70.2 mm)
1.0-in. 600#	3.88-in. (98.5 mm)	DN25 PN100	3.47-in. (88.2 mm)
2.0-in. 150#	4.13-in. (104.8 mm)	DN50 PN16	3.40-in. (86.3 mm)
2.0-in. 300#	4.38-in. (111.2 mm)	DN50 PN40	3.51-in. (89.3 mm)
2.0-in. 600#	4.76-in. (120.8 mm)	DN50 PN100	4.30-in. (109.3 mm)
3.0-in. 150#	4.63-in. (117.5 mm)	DN80 PN16	3.84-in. (97.6 mm)
3.0-in. 300#	5.00-in. (126.9 mm)	DN80 PN40	4.16-in. (105.6 mm)
3.0-in. 600#	5.38 (136.6 mm)	DN80 PN100	4.95-in. (125.6 mm)

3. If opposite side support in being used, center the fitting for the opposite side support over the opposite side hole, gap 1/16-in. (1.5 mm) and place four 1/4-in. (6-mm) tack welds at 90° increments. Insert the sensor into the mounting hardware. Verify that the tip of the bar is centered in the opposite side fitting and that the plug will fit around bar. If the bar is centered in the fitting and plug fits around the bar, finish weld per local codes. If alignment of the bar does not allow enough clearance to insert the opposite side plug, make the necessary adjustments prior to making the finish weld.

NOTE:
To avoid serious burns, allow the mounting hardware to cool before continuing.

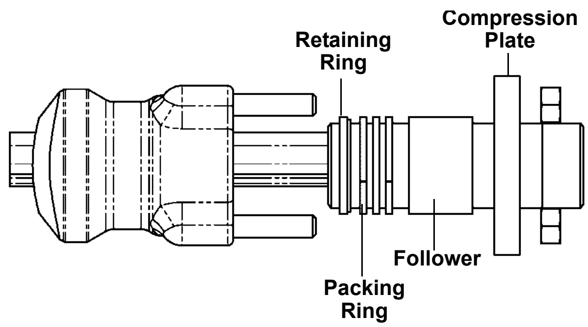
Step 5: Insert into Pipe

After the mounting hardware has cooled, use the following steps for installation.

1. Assemble the sensor flange to the mounting flange using gasket, studs, and nuts.
2. Tighten the nuts in a cross pattern to allow even compression of the gasket.
3. Thread studs into Flange-Lok body.
4. To ensure that the flowmeter contacts the opposite side wall, mark the
   tip of the sensor with a marker. (Do not mark if the sensor was ordered with special-cleaned option code P2.)
5. Rotating the flowmeter back and forth, insert the flowmeter into the Pak-Lok body until the sensor tip contacts the pipe wall (or support plug).
6. Remove the flowmeter.

7. Verify that the sensor tip made contact with the pipe wall by removing the pipe and ensuring that some of the marker has been rubbed off. For special-cleaned bars, look for wear marks on the tip. If the tip did not touch the wall, verify pipe dimensions and the height of the mounting body from the OD of the pipe and re-insert.
8. Re-insert the flowmeter into the Flange-Lok body and install the first packing ring on the sensor between the lock ring and the packing follower. Do not damage the split packing rings.
9. Push the packing ring into the Flange-Lok 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°.

Figure 2-19. Packing Ring Detail

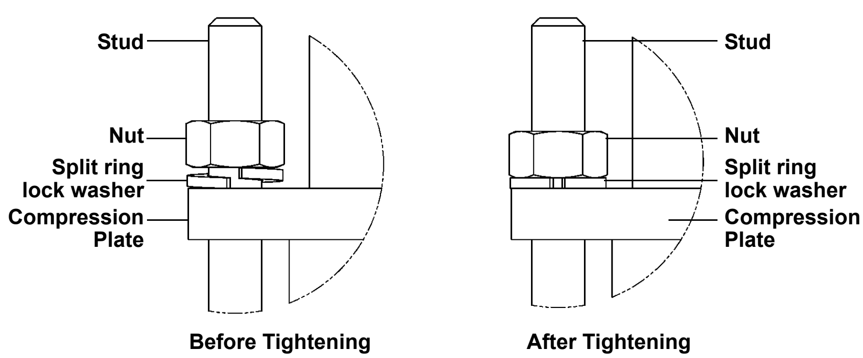


10. Tighten the nuts onto the studs:

- Place the included split-ring lock washer between each of the nuts and the compression plate. Give each nut one half ($^1/_2$) turn in succession until the split-ring lock washer is flat between the nut and the compression plate. Inspect the unit for leakage; if any exists, tighten the nuts in one-quarter ($^1/_4$) turn increments until there is no leakage.

NOTE
On sensor size (1), failure to use the split-ring Lock washers, improper washer orientation, or over-tightening the nuts may result in damage to the flowmeter.

Figure 2-20. Split-Ring Lock Washer Orientation



NOTE
Flange-Lok sealing mechanisms generate significant force at the point where the sensor contacts the opposite pipe wall. Caution needs to be exercised on thin-walled piping (ANSI Schedule 10 and below) to avoid damage to the pipe.

Step 6: Mount the Transmitter

Direct Mount Head

With Valves

1. Place Teflon (PTFE) O-rings into grooves on the face of head.
2. Align the high side of the transmitter to the high side of the probe ("Hi" is stamped on the side of the head) and install.
3. Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Without Valves

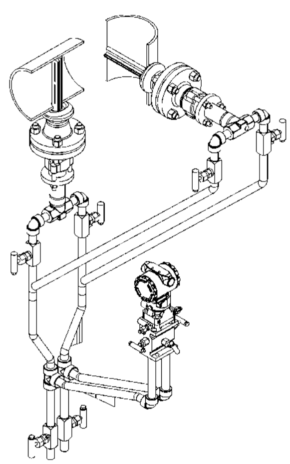
1. Place Teflon (PTFE) O-rings into grooves on the face of head.
2. Orient the equalizer valve or valves so they are easily accessible. Install manifold with the smooth face mating to the face of the head. Tighten in cross pattern to a torque of 400 in•lb (45 N•m).
3. Place Teflon (PTFE) O-rings into grooves on the face of the manifold.
4. Align the high side of the transmitter to the high side of the probe ("Hi" is stamped on the side of the head) and install.
5. Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

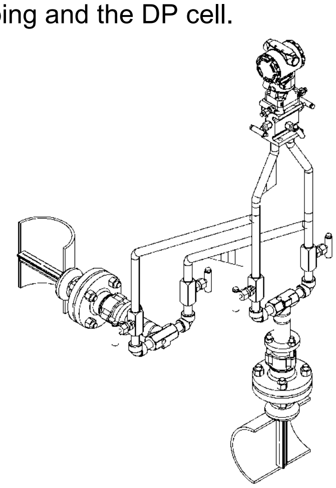
Remote Mount Head – temperature below 250 °F (121 °C)

See "Remote Mount" on page 2-9 for more information

Liquid Applications
Secure the electronics below the sensor to ensure that air will not be introduced into the impulse piping or the electronics.

Gas Applications
Secure the electronics above the sensor to prevent condensable liquids from collecting in the impulse piping and the DP cell.





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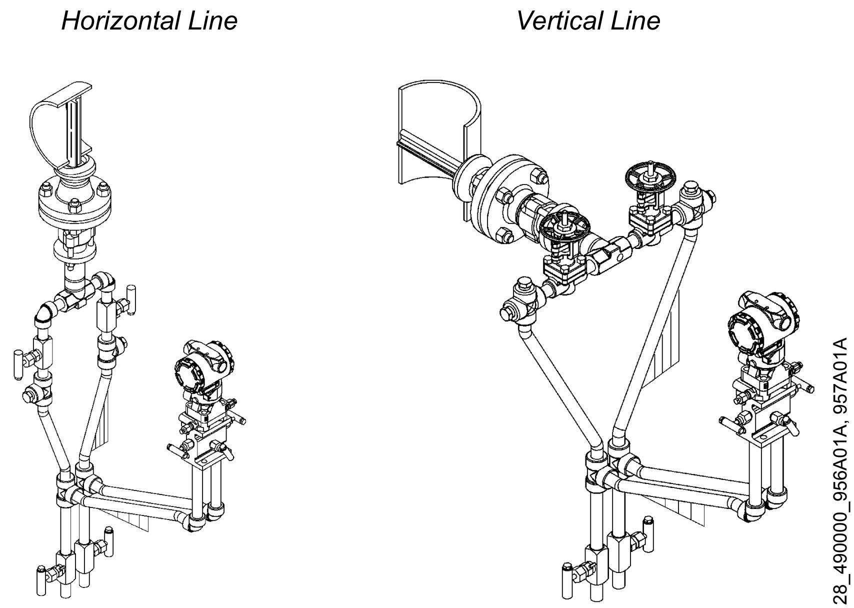
Remote Mount Head – temperature above 250 °F (121 °C)

Liquid or Steam Applications

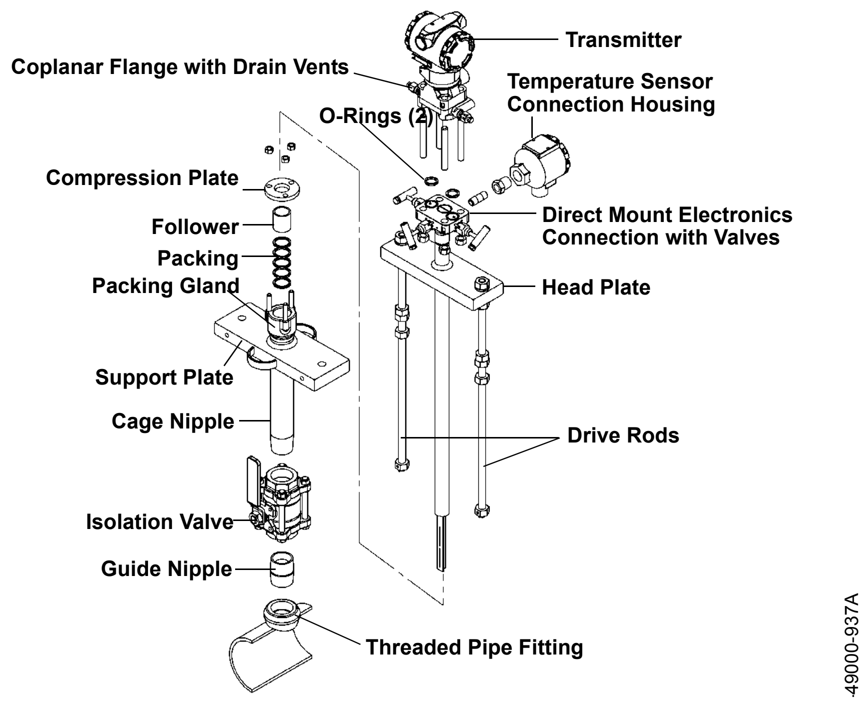
The electronics must be mounted below the process piping. Route the impulse piping down to the electronics and fill the system with cool water through the two tee fittings.



Threaded Flo-Tap Model

Figure 2-21 identifies the components of the Threaded Flo-Tap assembly.

Figure 2-21. Components



Step 1: Set the Switches

Refer to “Mounting” on page 2-4 for more information

Step 2: Determine the Proper Orientation

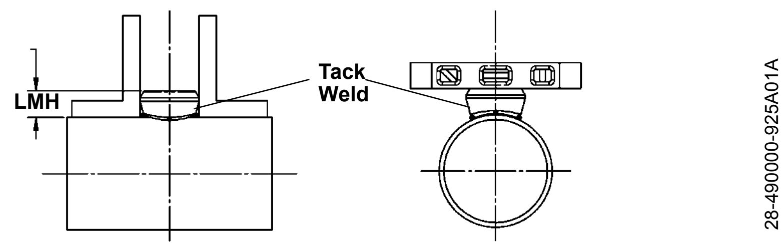
Please refer to “Mounting” on page 2-4 for straight run requirements and orientation information.

Step 3: Weld the Mounting Hardware

NOTE
Rosemount-supplied mounting includes critical alignment hardware that assists in the correct drilling of the mounting hole. This significantly reduces problems encountered during insertion.

1. At the pre-determined position, place the threadolet on the pipe, gap 1/16 in. (1.5 mm) and place four 1/4-in. (6-mm) tack welds at 90° increments.
2. Check alignment of the mounting both parallel and perpendicular to the axis of flow.
3. If the mounting alignment is within tolerances, finish weld per local codes. If outside of tolerances, make adjustments prior to making the finish weld.

Figure 2-22. Alignment



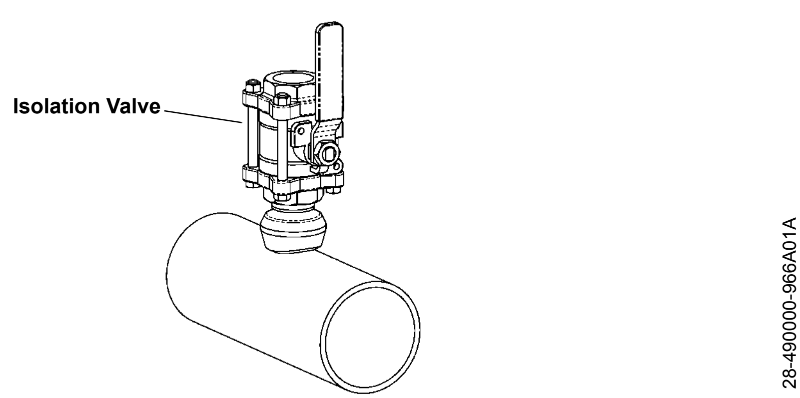
NOTE:
To avoid serious burns, allow the mounting hardware to cool before continuing.

Step 4: Install the Isolation Valve

After the mounting hardware has cooled, use the following steps for installation.

1. Thread the guide nipple into the mounting.
2. Thread the isolation valve into the guide nipple, ensuring that the valve stem is positioned so that when the Flo-Tap is installed, the insertion rods will straddle the pipe and the valve handle will be centered between the rods (see Figure 2-23). **Caution, if valve is located in line with the rods, interference will occur**.

Figure 2-23. Install the Isolation Valve



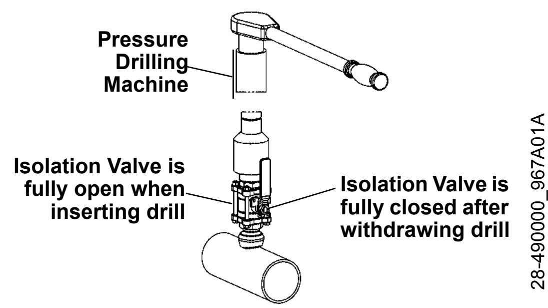
Step 5: Mount the Drilling Machine / Drill Hole

Use Table 2-6 to select the proper drill bit for the sensor that is being used.

1. Mount the drilling machine to the isolation valve.
2. Fully open the valve.
3. Drill the hole into the pipe wall in accordance with the instructions provided by the drilling machine manufacturer.
4. Fully retract the drill beyond the valve

Table 2-6. Drill Hole into Pipe

Sensor Size / Hole Diameter Chart		
Sensor	Diameter	
T1	3/4-in. (19 mm)	+ 1/32-in (1 mm) – 0.00
T2	1 5/16-in. (34 mm)	+ 1/16-in. (1 mm) – 0.00
T3	2 1/2-in. (64 mm)	+ 1/16-in. (1 mm) – 0.00



Step 6: Remove the Drilling Machine

Follow these steps to remove the drilling machine:

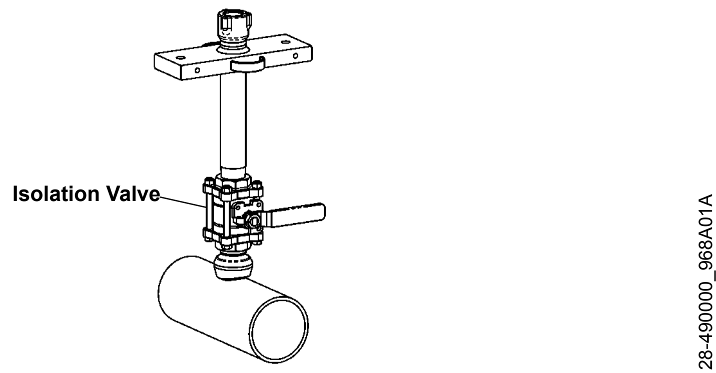
1. Verify that the drill has been fully retracted past the valve.
2. Close the unit isolation valve to isolate the process.
3. Bleed drilling machine pressure and remove.
4. Check isolation valve and mounting for leakage.

Step 7: Mount the Annubar

1. Install the complete Flo-Tap assembly (fully retracted) onto the unit isolation valve by threading the close nipple into the valve using the proper thread sealant compound.
2. Rotate the Flo-Tap assembly until the flow arrow on the head aligns with the direction of flow in the pipe.
3. Ensure that the vent valves are closed before proceeding to the next step.
4. Quickly open and close the isolation valve to pressurize the Annubar.
5. Check the entire installation for leakage. Tighten as required to stop any connection from leaking. Repeat steps 4 and 5 until there is no leakage.

NOTE
Flo-Tap Annubars have the potential to carry a large amount of weight at a great distance from the piping, necessitating external support. The support plate has threaded holes to assist in supporting the Annubar.

Figure 2-24. Flo-Tap Installation



Step 8: Insert the Annubar

Insert the sensor with one of the two drive options available – standard drive (M) or gear drive (G).

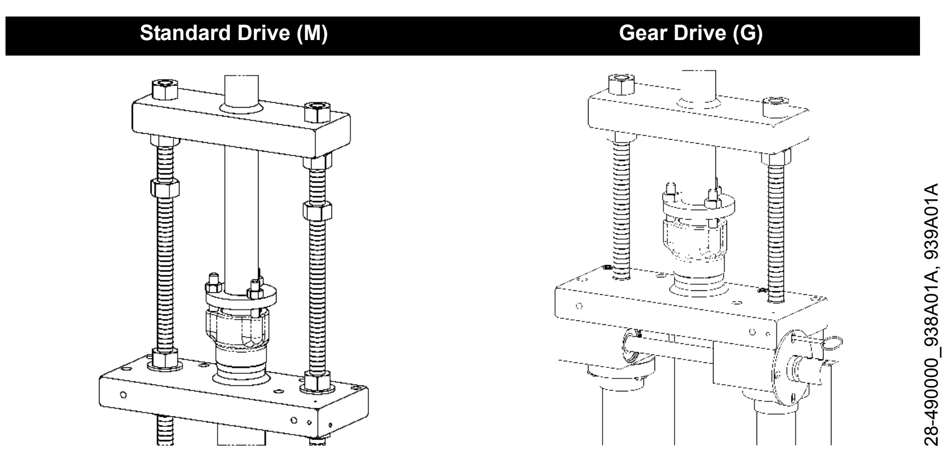
Standard Drive (M)

1. Fully open the isolation valve.
2. Insert the sensor by rotating 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 tip of the probe firmly contacts the opposite side of the pipe. The orange stripe on the insertion rods are used as a guide for full insertion.

Gear Drive (G)

1. Fully open the isolation valve.
2. Insert the sensor by rotating the crank clockwise. If a power drill with an adapter is used, do not exceed 200 rpm.
3. Continue rotating the crank until the sensor firmly contacts the opposite side of the pipe. The orange stripe on the insertion rods are used as a guide for full insertion.
4. Secure the drive by inserting the drive lock pin as shown in Figure 2-25.

Figure 2-25. Insert Annubar



Step 9: Retract the Annubar

Standard Drive (M)

1. Retract by rotating the drive nuts counter-clockwise. 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.

Gear Drive (G)

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

Step 10: Mount the Transmitter

Direct Mount Head

With Valves

1. Place Teflon (PTFE) O-rings into grooves on the face of head.
2. Align the high side of the transmitter to the high side of the probe (“Hi” is stamped on the side of the head) and install.
3. Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Without Valves

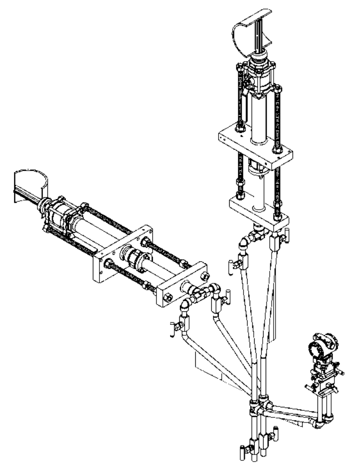
1. Place Teflon (PTFE) O-rings into grooves on the face of head.
2. Orient the equalizer valve or valves so they are easily accessible. Install manifold with the smooth face mating to the face of the head. Tighten in cross pattern to a torque of 400 in•lb (45 N•m).
3. Place Teflon (PTFE) O-rings into grooves on the face of the manifold.
4. Align the high side of the transmitter to the high side of the probe (“Hi” is stamped on the side of the head) and install.
5. Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Remote Mount Head – temperature below 250 °F (121 °C)

See “Remote Mount” on page 2-9 for more information

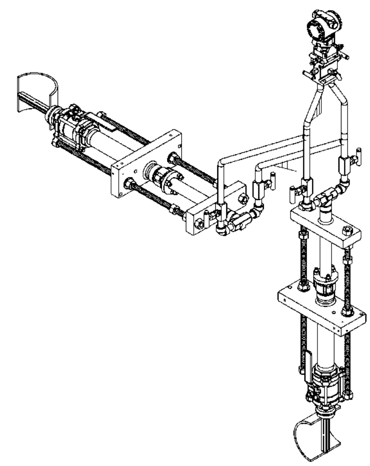
Liquid Applications

Secure the electronics below the sensor to ensure that air will not be introduced into the impulse piping or the electronics.



Gas Applications

Secure the electronics above the sensor to prevent condensable liquids from collecting in the impulse piping and the DP cell.



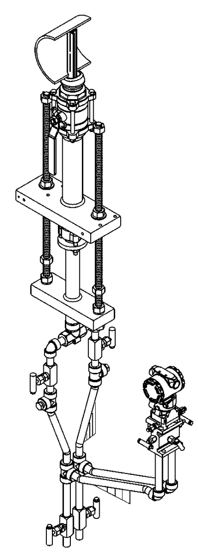
28_490000_962A01A, 963A01A

Remote Mount Head – temperature above 250 °F (121 °C)

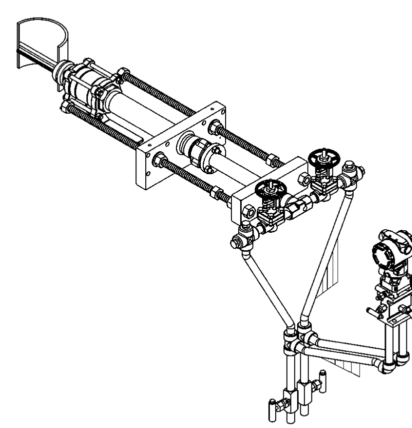
Liquid or Steam Applications

The electronics must be mounted below the process piping. Route the impulse piping down to the electronics and fill the system with cool water through the two tee fittings.

Horizontal Line



Vertical Line



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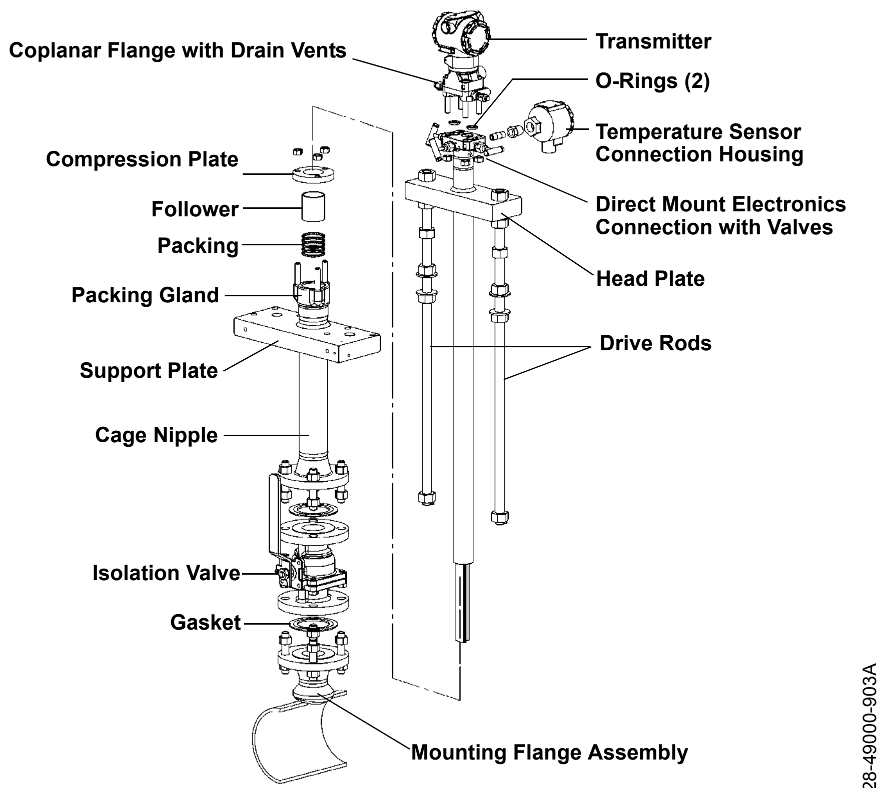
Flanged Flo-Tap Model

Figure 2-26 identifies the components of the Flanged Flo-Tap assembly.

Figure 2-26. Components



Step 1: Set the Switches

Refer to “Mounting” on page 2-4 for more information

Step 2: Determine the Proper Orientation

Please refer to “Mounting” on page 2-4 for straight run requirements and orientation information.

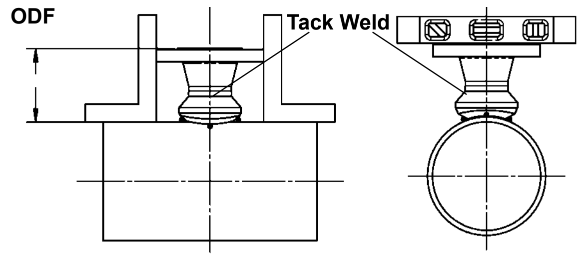
Step 3: Weld the Mounting Hardware

NOTE
Rosemount-supplied mounting includes critical alignment hardware that assists in the correct drilling of the mounting hole. This significantly reduces problems encountered during insertion.

---

1. At the pre-determined position, place the flanged assembly on the pipe, gap 1/16 in (1.5 mm). and measure the distance from the OD of the pipe to the face of the flange. Compare this to the chart below and adjust the gap as necessary.
2. Place four 1/4-in. (6-mm) tack welds at 90° increments. Check alignment of the mounting both parallel and perpendicular to the axis of flow.
3. If the mounting alignment is within tolerances, finish weld per local codes. If outside of tolerances, make adjustments prior to making the finish weld.

Figure 2-27. Alignment



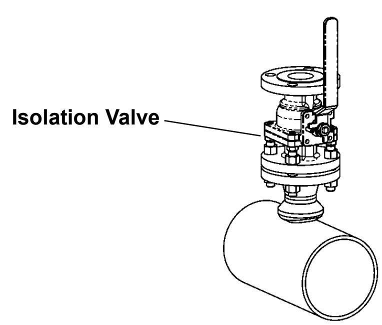
NOTE:
To avoid serious burns, allow the mounting hardware to cool before continuing.

Size	ODF (in.)	Size	ODF (mm)
1-in. 150#	3.38-in. (85.8 mm)	DN25 PN16	2.68-in. (68.2 mm)
1-in. 300#	3.63-in. (92.2 mm)	DN25 PN40	2.76-in. (70.2 mm)
1-in. 600#	3.88-in. (98.5 mm)	DN25 PN100	3.47-in. (88.2 mm)
2-in. 150#	4.13-in. (104.8 mm)	DN50 PN16	3.40-in. (86.3 mm)
2-in. 300#	4.38-in. (111.2 mm)	DN50 PN40	3.51-in. (89.3 mm)
2-in. 600#	4.76-in. (120.8 mm)	DN50 PN100	4.30-in. (109.3 mm)
3-in. 150#	4.63-in. (117.5 mm)	DN80 PN16	3.84-in. (97.6 mm)
3-in. 300#	5.00-in. (126.9 mm)	DN80 PN40	4.16-in. (105.6 mm)
3-in. 600#	5.38-in. (136.6 mm)	DN80 PN100	4.95-in. (125.6 mm)

Step 4: Install the Isolation Valve

1. Position the isolation valve onto the mounting flange ensuring that the valve stem is positioned such that when the Flo-Tap is installed, the insertion rods will straddle the pipe and the valve handle will be centered between the rods (see Figure 2-28). **Caution, if valve is located in line with the rods, interference will occur**.
2. Fasten the isolation valve to the mounting with gasket, bolts, and nuts.

Figure 2-28. Install Isolation Valve



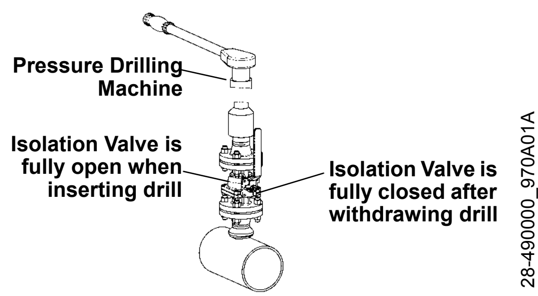
Step 5: Mount the Drilling Machine / Drill Hole

Use Table 2-6 to select the proper drill bit for the sensor that is being used.

1. Mount the drilling machine to the isolation valve.
2. Fully open the valve.
3. Drill the hole into the pipe wall in accordance with the instructions provided by the drilling machine manufacturer.
4. Fully retract the drill beyond the valve

Table 2-7. Drill Hole into Pipe

Sensor Size / Hole Diameter Chart		
Sensor	**Diameter**	
T1	3/4-in. (19 mm)	+ 1/32-in (1 mm) – 0.00
T2	1 5/16-in. (34 mm)	+ 1/16-in. (1 mm) – 0.00
T3	2 1/2-in. (64 mm)	+ 1/16-in. (1 mm) – 0.00



Step 6: Remove the Drilling Machine

Follow these steps to remove the drilling machine:

1. Verify that the drill has been fully retracted past the valve.
2. Close the unit isolation valve to isolate the process.
3. Bleed drilling machine pressure and remove.
4. Check isolation valve and mounting for leakage.

Step 7: Mount the Annubar

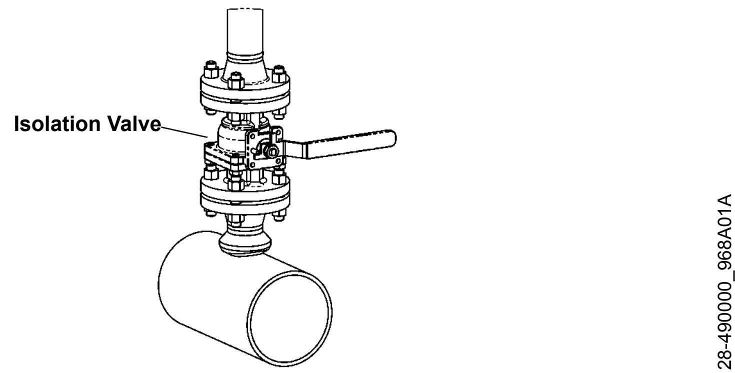
Install the complete Flo-Tap assembly as shown in Figure 2-29.

1. Align the flow arrow on the head with the direction of flow.

1. Use the gaskets and flange bolts supplied to fasten the Flo-Tap assembly to the isolation valve.
2. Tighten the nuts in a cross pattern to compress the gasket evenly.
3. Ensure that the vent valves are closed before proceeding to the next step.
4. Quickly open and close the isolation valve to pressurize the Annubar.
5. Check the entire installation for leakage. Tighten as required to stop any connection from leaking. Repeat steps 4 and 5 until there is no leakage.

NOTE
Flo-Tap Annubars have the potential to carry a large amount of weight at a great distance from the piping, necessitating external support. The support plate has threaded holes to assist in supporting the Annubar.

Figure 2-29. Flo-Tap Installation



Step 8: Insert the Annubar

Insert the sensor with one of the two drive options available – standard drive (M) or gear drive (G).

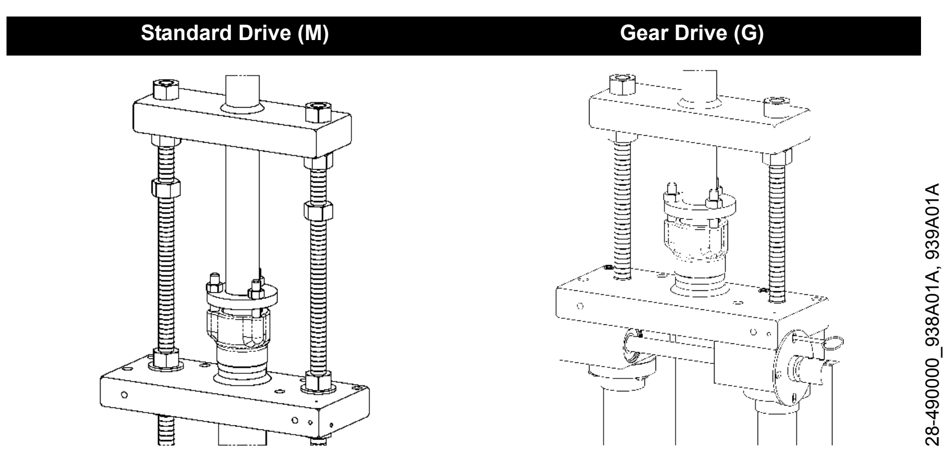
Standard Drive (M)

1. Fully open the isolation valve.
2. Insert the sensor by rotating 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 tip of the probe firmly contacts the opposite side of the pipe. The orange stripe on the insertion rods are used as a guide for full insertion.

Gear Drive (G)

1. Fully open the isolation valve.
2. Insert the sensor by rotating the crank clockwise. If a power drill with an adapter is used, do not exceed 200 rpm.
3. Continue rotating the crank until the sensor firmly contacts the opposite side of the pipe. The orange stripe on the insertion rods are used as a guide for full insertion.
4. Secure the drive by inserting the drive lock pin as shown in Figure 2-30.

Figure 2-30. Insert Annubar



Step 9: Retract the Annubar

Standard Drive (M)

1. Retract by rotating the drive nuts counter-clockwise. 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.

Gear Drive (G)

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

Step 10: Mount the Transmitter

Direct Mount Head

With Valves

1. Place Teflon (PTFE) O-rings into grooves on the face of head.
2. Align the high side of the transmitter to the high side of the probe (“Hi” is stamped on the side of the head) and install.
3. Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Without Valves

1. Place Teflon (PTFE) O-rings into grooves on the face of head.
2. Orient the equalizer valve or valves so they are easily accessible. Install manifold with the smooth face mating to the face of the head. Tighten in cross pattern to a torque of 400 in•lb (45 N•m).
3. Place Teflon (PTFE) O-rings into grooves on the face of the manifold.
4. Align the high side of the transmitter to the high side of the probe (“Hi” is stamped on the side of the head) and install.
5. Tighten the nuts in a cross pattern to 400 in•lb (45 N•m).

Remote Mount Head – temperature below 250 °F (121 °C)

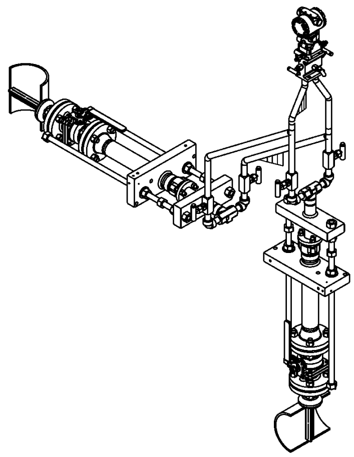
See “Remote Mount” on page 2-9 for more information

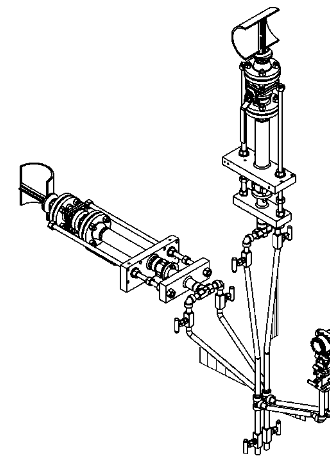
Liquid Applications

Secure the electronics below the sensor to ensure that air will not be introduced into the impulse piping or the electronics.

Gas Applications

Secure the electronics above the sensor to prevent condensable liquids from collecting in the impulse piping and the DP cell.





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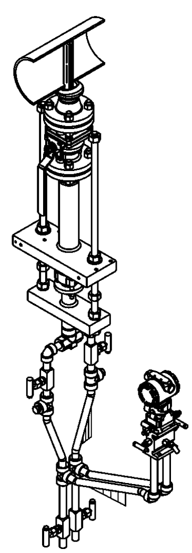
Remote Mount Head – temperature above 250 °F (121 °C)

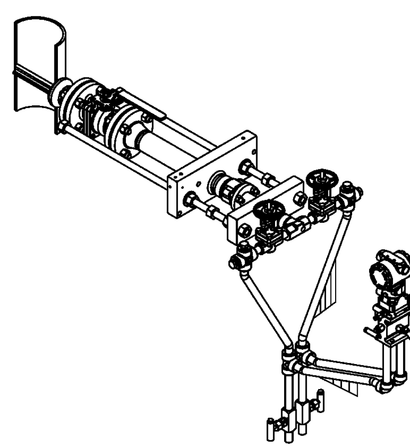
Liquid or Steam Applications

The electronics must be mounted below the process piping. Route the impulse piping down to the electronics and fill the system with cool water through the two tee fittings.

Horizontal Line



Vertical Line



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CONNECT THE WIRING

The dc power supply should provide power with less than 2 percent ripple. The total resistance load is the sum of the resistance of the signal leads and the load resistance of the controller, indicator, and related pieces. Note that the resistance of intrinsic safety barriers, if used, must be included.

NOTE
A minimum loop resistance of 250 ohms is required to communicate with a Model 275 HART Communicator. With 250 ohms of loop resistance, the electronics will require a minimum of 15.5 volts to output 20 mA. If a single power supply is used to power more than one flowmeter, the power supply used, and circuitry common to the electronics, should not have more than 20 ohms of impedance at 1200Hz.

The flowmeter has an explosion-proof housing and circuitry suitable for intrinsically safe and non-incendive operation. Individual Annubar models are clearly marked with a tag indicating the certifications they carry. See Appendix A: Specifications and Reference Data for specific approval categories.

NOTE
Signal wiring does not require shielding; however, twisted pairs provide the best results. In order to ensure communication, wiring should be 24 AWG or larger and shorter than 5,000 feet (1500 meters) in length.

Do not connect the powered signal wiring to the test terminals. Power may damage the test diode in the test connection.

Plug and seal unused conduit connections on the electronics housing to avoid moisture accumulation in the terminal side of the housing. Excess moisture accumulation may damage the electronics. If the connections are not sealed, the electronics should be remote mounted with the electrical housing positioned downward for drainage. Wiring should be installed with a drip loop and the bottom of the drip loop should be lower then the conduit connections and the housing.

⚠ Inductive-based transient protectors, including the Rosemount Model 470 transient protector, can adversely affect the output of the Annubar. If transient protection is desired, install the Transient Protection Terminal Block. Consult the factory for instructions.

Wiring Diagrams

⚠

1. Remove the housing cover on the side marked FIELD TERMINALS. Do not remove the instrument covers in explosive atmospheres when the circuit is live.
2. Connect the lead that originates at the positive side of the power supply to the terminal marked “+” and the lead that originates at the negative side of the power supply to the terminal marked “–.” Avoid contact with the leads and terminals.

Figure 2-31. Bench Hook-up (4–20 mA Flowmeters).

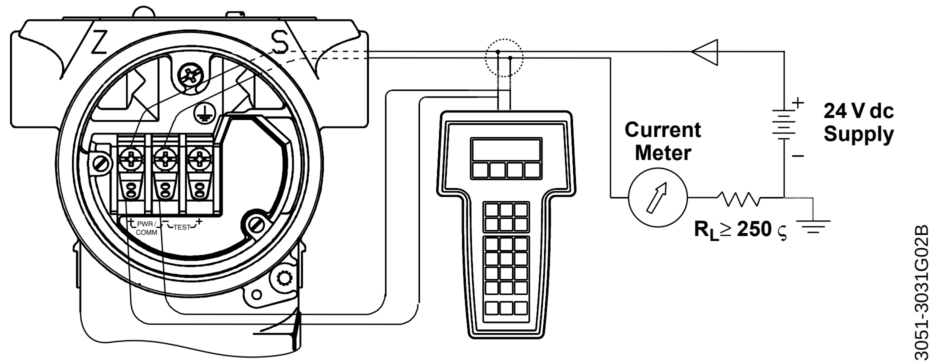
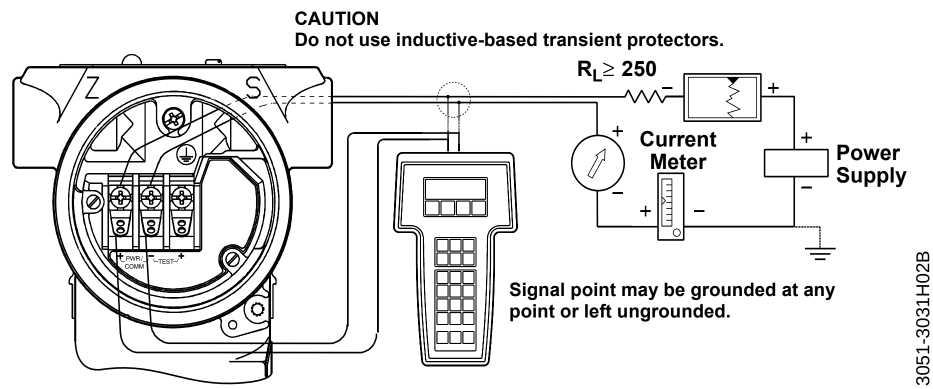


Figure 2-32. Field Hook-up (4-20 mA Flowmeters)



Equipment

The following equipment and tools are not provided with the Annubar. Be sure to review this list before field wiring the Annubar.

- Installation tools
- Field wire between the power supply and the Annubar
- Barriers or seals required for hazardous locations
- Power supply
- Tie wraps

Field Wiring (Power and Signal)

Make field wiring connections (see Figure 2-31 and Figure 2-32). These connections provide both power and signal wiring.

NOTES

- Do not run field wiring in conduit or open trays with other power wiring or near heavy electrical equipment.
- Field wiring need not be shielded, but twisted pairs provide the best results.
- To ensure communication, wiring should be 24 AWG or larger and less than 5,000 feet (1,500 meters) in length.
- For connections in ambient temperatures above 140 °F (60 °C), use wiring rated for at least 194 °F (90 °C).
- Incorrect field wiring connections may damage the Mass ProBar electronics. Do not connect field wiring to the “TEST +” terminals.

1. Remove the cover on the side marked FIELD TERMINALS on the electronics housing.
2. Connect the lead that originates at the positive side of the power supply to the terminal marked “+ SIG.” Be sure to include loop resistance.
3. Connect the lead that originates at the negative side of the power supply to the terminal marked “-.”
4. Plug and seal unused conduit connections on the electronics housing to avoid moisture accumulation in the terminal side of the housing.

NOTE
If the conduit connections are not sealed, mount the electronics with the electrical housing positioned downward for drainage. Conduit should be installed with a drip loop and the bottom of the drip loop should be lower than the conduit connections or the electronics housing.

Grounding

Grounding the Signal Wiring

Do not run signal wiring in conduit or open trays with power wiring, or near heavy electrical equipment. Signal wiring may be grounded at any one point on the signal loop, or it may be left ungrounded. The negative terminal of the power supply is a recommended grounding point.

Ground the Electronics Case

The electronics case should always be grounded in accordance with national and local electrical codes. The most effective electronics case grounding method is a direct connection to the earth ground with minimal impedance. Methods for grounding the electronics case include:

Internal Ground Connection

Inside the FIELD TERMINALS side of the electronics housing is the Internal Ground Connection screw. This screw is identified by a ground symbol: ⏚.

NOTE
The transient protection terminal block does not provide transient protection unless the electronics case is properly grounded. Do not run the transient protection ground wire with field wiring because the transient protector ground wire may carry excessive current if a lightening strike occurs. Grounding the electronics case using a threaded conduit connection may not provide sufficient ground.

Field Wiring Ground (Optional)

Field wiring may be grounded at any one point on the signal loop, or it may be left ungrounded. The negative terminal of the power supply is a recommended grounding point.

Section 3 Commissioning

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 live.
- Before connecting a Model 275 HART 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.

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

- Make sure only qualified personnel perform the installation.
- If the line is pressurized, serious injury or death could occur by opening valves.

COMMISSIONING ON THE BENCH (MODEL 3051SFA ONLY)

Commissioning consists of testing the flowmeter, testing the loop, and verifying the flowmeter configuration data. The flowmeter can be commissioned either before (on the bench) or after (in the field) installation. Commissioning on the bench ensures that all flowmeter components are in good working order and acquaints the user with the operation of the device.

To avoid exposing the flowmeter electronics to the environment after installation, set the failure mode and flowmeter security switches while commissioning the flowmeter on the bench.

Figure 2-3 on page 2-6 identifies the valves on a 5-valve and a 3-valve manifold. Table 2-1 on page 2-6 explains the purpose of these valves.

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.

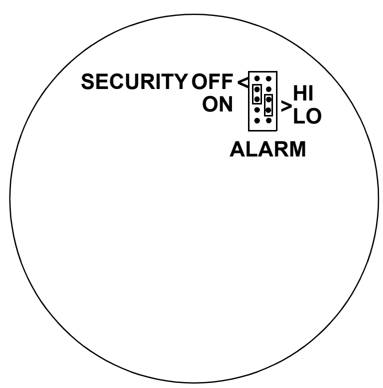
Close all valves before commissioning the system.

Set the Switches

Both the write protect and alarm switches are located on the electronics board inside the electronics housing cover. (See Figure 3-1) To avoid exposing the flowmeter electronics to the plant environment after installation, set these switches during the commissioning stage on the bench.

The flowmeters are delivered with the write-protect switch set to “OFF,” and the alarm switch set to “High.”

Figure 3-1. Write Protect and Alarm Switches



NOTE
Security switch not installed = Not Write Protected. Alarm switch not installed = High Alarm.

OUTPUT ELECTRONICS BOARD

Failure Mode Alarm Switches

As part of normal operation, the flowmeter continuously monitors its own operation. This automatic diagnostic routine is a timed series of checks repeated continuously. If the diagnostic routine detects a failure, the flowmeter drives its output either below or above specific values depending on the position of the failure mode switch.

- For 4–20 mA flowmeters factory-configured for standard operation, the flowmeter drives its output either below 3.75 mA or above 21.75 mA.
- For 4–20 mA flowmeters factory-configured for NAMUR-compliant operation, the flowmeter drives its output either below 3.6 mA or above 22.5 mA.

The failure mode alarm switch is located on the front of the electronics board inside of the electronics housing cover. The position of this switch determines whether the output is driven high or low when a failure is detected. If the alarm switch is not installed the flowmeter will operate normally, and the default alarm condition will be high.

NOTE
The failure mode alarm switch pins occupy one row of a ten-pin socket that is also used to attach the optional LCD meter. To function appropriately, the switch must be positioned correctly.

Use the following steps to change the switch settings:

1. If the transmitter is installed, secure the loop and remove power.
2. Remove the housing cover opposite the field terminal side.
3. Locate the switch on the output electronics board and move the switch to the desired setting (see Figure 3-1).
4. Reattach the transmitter cover. To avoid condensation, metal to metal contact is preferred. Flowmeter covers must be fully engaged to meet explosion-proof requirements.
5. If the transmitter is installed, reapply power.

Failure Mode Alarm vs. Saturation Output Values

The failure mode alarm output levels differ from the output values that occur when applied pressure is outside the range points. When pressure is outside the range points, the analog output continues to track the input pressure until reaching the saturation value listed below; the output does not exceed the listed saturation value regardless of the applied pressure. For example, with standard alarm and saturation levels and pressures outside the 4–20 range points, the output saturates at 3.9 mA or 20.8 mA. When the flowmeter diagnostics detect a failure, the analog output is set to a specific alarm value that differs from the saturation value to allow for proper troubleshooting.

Table 3-1. Analog Output: Standard Alarm Values vs. Saturation Values.

Level	4–20 mA Saturation Value	4–20 mA Alarm Value
Fail Low	3.9 mA	≤3.75 mA
Fail High	20.8 mA	≥ 21.75 mA

Table 3-2. Analog Output: NAMUR-Compliant Alarm Values vs. Saturation Values.

Level	4–20 mA Saturation Value	4–20 mA Alarm Value
Fail Low	3.8 mA	≤3.6 mA
Fail High	20.5 mA	≥ 22.5 mA

NOTE
You can alter the actual flowmeter mA output values from the values listed above by performing an analog output trim (see “Analog Output Trim” on page 3-28).

When a flowmeter is in an alarm condition, the hand-held HART communicator indicates the analog output the flowmeter would drive if the alarm condition did not exist.

The preceding output values can be altered by an analog output trim procedure.

Alarm and Saturation Values for Flowmeters Set to Burst Mode

Saturation and alarm conditions operate differently when a flowmeter is set to burst mode operation:

Alarm Condition (Hi or Lo):

- Analog output switches to alarm level (see Table 3-1).

Saturation:

- Analog output switches to saturation level (see Table 3-1).

Alarm Level Verification

Flowmeters with electronics board revision 5.3 or later (shrouded design) have increased functionality that allows verification testing of alarm current levels. When the electronics board, sensor module, or LCD meter is repair or replace, verify the alarm level before returning the flowmeter to service. This feature is also useful in testing the reaction of the control system to a flowmeter in an alarm state. To verify the flowmeter alarm levels, perform a loop test (see "Loop Test" on page 3-21).

Write Protect Switch

Changes to the flowmeter configuration data can be prevented by using the write protection switch. Position the switch in the “ON” position to prevent accidental or deliberate change of configuration data. Figure 3-1 shows the switch positions for 4–20 mA flowmeters.

If the flowmeter write protection switch is in the “ON” position, the flowmeter will not accept any “writes” to its memory. Configuration changes (such as digital trim and reranging) cannot take place when the flowmeter security is on. To reposition the switch, perform the following procedure.

1. If the flowmeter is installed, secure the loop and remove power.
2. Remove the housing cover opposite the field terminal side. Do not remove the flowmeter covers in explosive atmospheres when the circuit is live.
3. Reposition the switch (see Figure 3-1 for the ON and OFF switch positions). To activate security using a two-pin assembly, install the switch. To activate security with the three-pin assembly, move the switch to the ON pin position.
4. Reattach the flowmeter cover. To avoid condensation, metal-to-metal contact is preferred. Flowmeter covers must be fully engaged to meet explosion-proof requirements.
5. If the flowmeter is installed, reapply power.

NOTE
If the security switch is not installed, the flowmeter will continue to operate in the security OFF configuration.

COMMISSIONING THE ANNUBAR

Direct Mount

Liquid Service

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 electronics DVL and DVH; 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 electronics zero by noting the 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.

Liquid Service 3-Valve Manifold

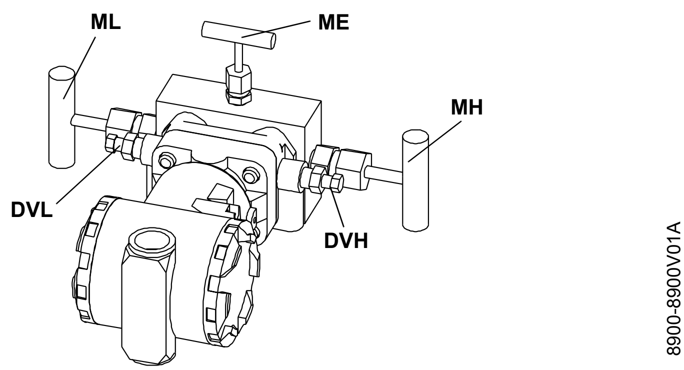
Dry Zero

1. Prior to commissioning the flowmeter a dry zero should be performed to eliminate any positional effects to the transmitter.
2. Keeping both the high and low main valves closed MH and ML open the equalizer valve ME.
3. Perform a zero trim (“Trim the Transmitter” on page 3-26)
4. Check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA then repeat step 3 and 4.

Wet Zero

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 electronics DVH and DVL; bleed until no air is apparent in the liquid.
4. Close both drain/vent valve DVH and DVL.
5. Close the High side valve MH.
6. Check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA then perform a zero trim.
7. Check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA then repeat steps 1 - 6.
8. Close the Equalizer valve ME.
9. Open the High side valve MH and ensure that the Low side valve ML is open.
10. The system is now operational.

Figure 3-2. Valve Identification for Direct Mounted Annubar Models in Liquid Service



Gas Service

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

Gas Service 3-Valve Manifold

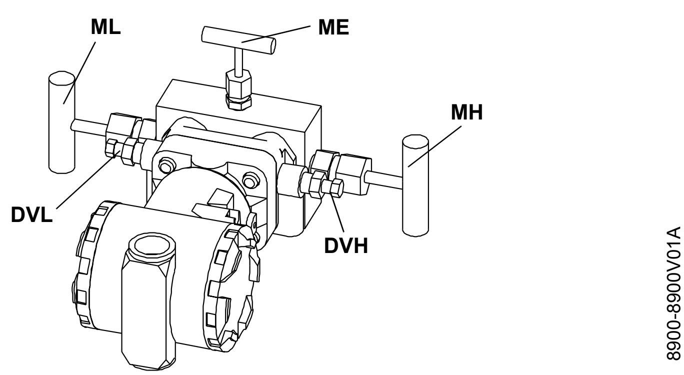
Dry Zero

1. Prior to commissioning the flowmeter a dry zero should be performed to eliminate any positional effects to the transmitter.
2. Keeping both the high and low main valves closed MH and ML open the equalizer valve ME.
3. Perform a zero trim (see “Trim the Transmitter” on page 3-26).
4. Check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA then repeat step 3.

Wet Zero

1. 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 electronics DVH and DVL; bleed to ensure that no liquid is present.
4. Close both drain/vent valve DVH and DVL.
5. Close the High side valve MH.
6. Check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA then perform a zero trim.
7. Check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA then repeat steps 1 - 6.
8. Close the Equalizer valve ME.
9. Open the High side valve MH, ensure that the Low side valve ML is open. The system is now operational.

Figure 3-3. Valve Identification for Direct Mounted Models in Gas Service



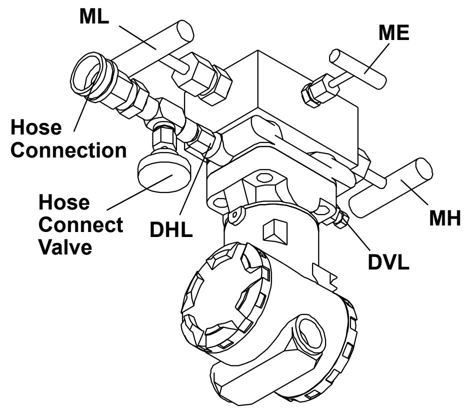
Steam Service (see Figure 3-4 on page 3-10

1. Ensure that the steam line is depressurized with no steam.
2. Check the electronics 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 electronics.
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 electronics until no air is observed.
10. Close the vent.
11. Close the hose connect valve.
12. Close both MH and ML.
13. Check the instrument zero by noting the electronics 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.

3-Valve Steam No Flow

1. Prior to commissioning the flowmeter a dry zero should be performed to eliminate any positional effects to the transmitter.
2. Keeping both the high and low main valves closed MH and ML open the equalizer valve ME.
3. Perform a zero trim (see “Trim the Transmitter” on page 3-26).
4. Check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA then repeat step 3.
5. Verify that the line is depressurized with no steam.
6. Attach a water supply to the hose connection. The water supply should have a maximum of 100 psi.
7. Open the High and Low main valves as well as the equalizer valve MH, ML and ME.
8. Close low side vent DVL on the electronics.
9. 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.
10. Close the high valve MH for 30 seconds to force water to the Low side.
11. Re-open the main High valve MH.
12. Open the low side vent DVL on the electronics until no air is observed.
13. Close the low side vent DVL.
14. Close the hose connect valve, and remove the hose.
15. Open both the high and low main valves MH and ML and close the equalizer valve ME.
16. The sensor is ready for flow.
17. After flow has been started and allowed to reach operating conditions a wet zero needs to be performed.
18. Using the drain/vent valves on the electronics DVH and DVL; burp (carefully crack vents open and closed to ensure that no air is present, this may need to be done more than one time.)
19. Close the High side main valve MH.
20. Open the Equalizer valve ME.
21. Check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA then perform a zero trim.
22. After zero trim is done check the electronics zero by noting the output. If the signal reads outside of the range 3.98 mA to 4.02 mA. Set sensor back to flow by closing the Equalizer valve ME and opening the High side valve MH. Repeat steps 14 - 17.
23. Close the Equalizer valve ME.
24. Open the High side valve MH, ensure that the Low side valve ML is open. The system is now operational

Figure 3-4. Valve Identification for Direct Mounted Annubar Models in Steam Service



Remote Mount

Zero the Electronics

Before the electronics 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, zero trim as described in "Zero Trim" on page 3-27.

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 procedure 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

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

The flowmeter'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 electronics 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:

- The electronics should be located where the ambient temperature does not change rapidly or vary by more than 10 to 15 °F (26 to 29 °C).
- When commissioning the electronics, 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 communicator, as described in "Zero or Wet Calibration" .

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.

Liquid Service below 250 °F (121 °C)

1. Ensure that primary instrument valves PH and PL are *closed*.
2. Open valves ME, ML, and MH.
   a.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 electronics location, 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 electronics 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 electronics output — this is called a *wet zero*. The electronics 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).
    a.For 3-valve manifolds, close valve ME.
    b.For 5-valve manifolds, close valves MEH and MEL.
13. Slowly open valve PH. The system is now operational.

a. For 5-valve manifolds only: 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

1. For an impulse piping arrangement as shown in Figure 8-11 (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.
   a. For 5-valve manifolds, open valves MEH and MEL.
6. Slowly open valve PL, the primary high pressure instrument valve.
7. Check electronics zero by noting the electronics reading. The electronics 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 electronics 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 system.
8. Close equalizer valve(s).
   a. For 3-valve manifolds, close valve ME.
   b. For 5-valve manifolds, close valves MEH and MEL.
9. Slowly open valve PH. The system is now operational.
   a. For 5-valve manifolds only: 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)

1. Ensure that primary instrument valves PH and PL *closed*; ME, ML and MH are *closed*; and DVL and DVH are *closed*.
   a. 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.

a.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 electronics body, valve manifold, and impulse piping with a small wrench to dislodge any remaining entrapped air.
9. Check Annubar zero by noting the electronics output — this is called a *wet zero*. The electronics 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.

    a.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.

    a.For 5-valve manifolds only: 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.

Setting the Loop to Manual

When preparing to send or request data that would disrupt the loop or change the output of the flowmeter, set the process application loop to manual. The HART Communicator Model 275 will prompt the user to set the loop to manual when necessary. Keep in mind that acknowledging this prompt does not set the loop to manual. The prompt is only a reminder, set the loop to manual as a separate operation.

MODEL 275 HART COMMUNICATOR

⚠ The HART Communicator exchanges information with the transmitter from the control room, the instrument site, or any wiring termination point in the loop. The flowmeter must be configured for certain basic variables to operate. In many cases, all of these variables are pre-configured at the factory. Configuration may be required if the transmitter is not configured or if the configuration variables need revision.

Connections and Hardware

To facilitate communication, connect the HART Communicator in parallel with the flowmeter (see Figure 2-10 on page 2-13) using the non-polarized loop connection ports that are located on the rear panel of the HART Communicator.

NOTE
Do not make connections to the serial port or the NiCad recharger jack in explosive atmospheres. Before connecting the HART 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.

MODEL 3051SFA PROBAR

The ProBar can be configured either online or off-line. During online configuration (when the transmitter is connected to a HART communicator) data is entered in the working register of the communicator and sent directly to the transmitter.

Off-line configuration consists of storing configuration data in a HART Communicator while it is not connected to a transmitter. Data is stored in nonvolatile memory and can be downloaded to the transmitter at a later time.

This section contains a brief summary of the HART communicator, but is not meant to replace the Model 275 HART Communicator Reference Manual (document number 00809-0100-4275).

Updating the Model 275 HART Communication Software

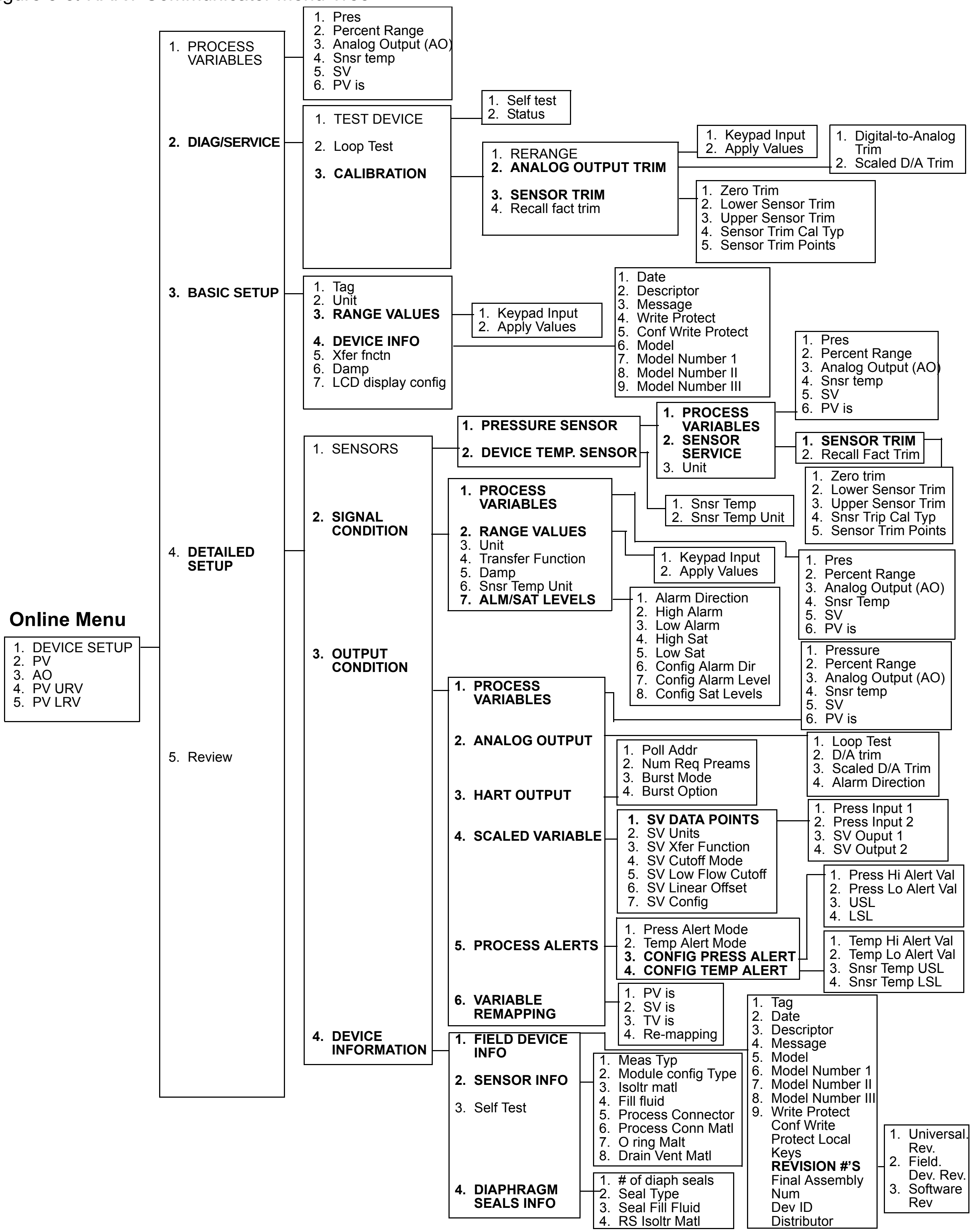
The Model 275 HART Communicator software may need to be upgraded to take advantage of the additional features available in the Annubar (field device revision 3). Perform the following steps to determine if an upgrade is required.

1. Turn on the HART communicator and select *4 Utility*, then *5 Simulation*.
2. Choose “Rosemount” from the list of manufacturers and “3051” from the list of models.
3. If the **Fld Dev Rev** choices include “Dev v3, DD v2,” an upgrade is not required. If the only choice is “Dev v1” or “Dev v2” (with any DD version), than the communicator should be upgraded.

HART Menu Tree

Figure 3-5 displays a complete Annubar menu tree for use with the Model 275 HART Communicator. Options listed in bold type indicate that a selection provides other options.

Figure 3-5. HART Communicator Menu Tree



Fast Key Sequences

Fast key sequences are listed below for common transmitter functions.

NOTE:
The fast key sequences assume that Device Descriptor Dev v3, DD v2 is being used. Table 3-3 provides alphabetical function lists for all Model 275 HART Communicator tasks as well as their corresponding fast key sequences.

Table 3-3. Model 3051SFA Fast Key Sequence

The following menu indicates fast key sequences for common functions.

Function	HART Fast Key Sequence
Alarm Level Config.	1, 4, 2, 7, 7
Alarm and Saturation Levels	1, 4, 2, 7
Analog Output Alarm Direction	1, 4, 2, 7, 6
Analog Output Trim	1, 2, 3, 2
Burst Mode On/Off	1, 4, 3, 3, 3
Burst Options	1, 4, 3, 3, 4
Damping	1, 3, 6
Date	1, 3, 4, 1
Descriptor	1, 3, 4, 2
Digital To Analog Trim (4-20 mA Output)	1, 2, 3, 2, 1
Field Device Information	1, 4, 4, 1
Loop Test	1, 2, 2
Lower Sensor Trim	1, 2, 3, 3, 2
Message	1, 3, 4, 3
Meter Configuration	1, 3, 7
Number of Requested Preambles	1, 4, 3, 3, 2
Pressure Alert Config.	1, 4, 3, 5, 3
Poll Address	1, 4, 3, 3, 1
Poll a Multidropped Transmitter	Left Arrow, 4, 1, 1
Re-mapping	1, 4, 3, 6, 4
Rerange- Keypad Input	1, 2, 3, 1, 1
Saturation Level Config.	1, 4, 2, 7, 8
Scaled D/A Trim (4–20 mA Output)	1, 2, 3, 2, 2
Scaled Variable Config.	1, 4, 3, 4, 7
Self Test (Transmitter)	1, 2, 1, 1
Sensor Information	1, 4, 4, 2
Sensor Temperature	1, 1, 4
Sensor Trim	1, 2, 3, 3
Sensor Trim Points	1, 2, 3, 3, 5
Status	1, 2, 1, 2
Tag	1, 3, 1
Temperature Alert Config.	1, 4, 3, 5, 4
Transfer Function (Setting Output Type)	1, 3, 5
Transmitter Security (Write Protect)	1, 3, 4, 5
Units (Process Variable)	1, 3, 2
Upper Sensor Trim	1, 2, 3, 3, 3
Zero Trim	1, 2, 3, 3, 1

Review Configuration Data

Before operating the Annubar in the actual installation, review all of the factory-set configuration data to ensure that it reflects the current application.

Review

HART Comm.	1, 5

After activating the *Review* function, scroll through the data list to check each variable. If changes to the transmitter configuration data are necessary, refer to the functions below.

Check Output

Before performing other flowmeter on-line operations, review the configuration of the flowmeter digital output parameters to ensure that the flowmeter is operating properly.

Process Variables

HART Comm.	1, 2

The *Process Variables* for the ProBar provide the flowmeter output and are continuously updated. The process variable menu displays the following process variables:

- Flow Pressure
- Percent of Range
- Analog Output
- DP Pressure
- Sensor Temperature

The flow pressure reading in both Engineering Units and Percent of Range will continue to track with pressures outside of the defined range from the lower to the upper range limit of the sensor module.

Sensor Temperature

HART Comm.	1, 1, 5

The ProBar contains a temperature sensor that is located above the pressure sensor in the sensor module. When reading this temperature, keep in mind that this is not a process temperature reading.

Basic Setup

Set Process Variable Units

HART Comm.	1, 3

The *PV Unit* command sets the process variable so the process can be monitored using the appropriate units of measure. Select from the following engineering units:

- in H_2O
- in H_2O at 39.2 °F (4 °C)
- in Hg
- ft H_2O
- mm H_2O
- mm H_2O at 39.2 °F (4 °C)
- mm Hg
- psi
- bar
- mbar
- g/cm^2
- kg/cm^2
- Pa
- kPa
- torr
- atm

Set Output

HART Comm.	1, 3, 5

Activate the flowmeter square root output option to make the analog output proportional to flow. To avoid the extremely high gain that results as the input approaches zero, the ProBar automatically switches to a linear output in order to ensure a more stable output near zero. The transition from linear to square root output is smooth, with no step change or discontinuity in output.

The transition from linear to square root is not adjustable. It occurs at 0.8% of ranged pressure input. In earlier software, the transition point occurred at 4% of ranged pressure input, or 20% of full scale flow output.

From 0 percent to 0.6 percent of the ranged pressure input, the slope of the curve is unity (y = x). This allows accurate calibration near zero. Greater slopes would cause large changes in output for small changes at input. From 0.6 percent to 0.8 percent, the slope of the curve equals 42 (y = 42x) to achieve continuous transition from linear to square root at the transition point.

NOTE
The transmitter accuracy declines after a 10:1 turndown.

$$\text{Accuracy} = \left[0.025 + 0.005\left(\frac{\text{URL}}{\text{Span}}\right)\right]\% \text{ of Span}$$

$$\text{Accuracy} = \left[0.005 + 0.0035\left(\frac{\text{URL}}{\text{Span}}\right)\right]\% \text{ of Span}$$

Figure 3-6. Square Root Output Transition Point

Damping

HART Comm.	1, 3, 6

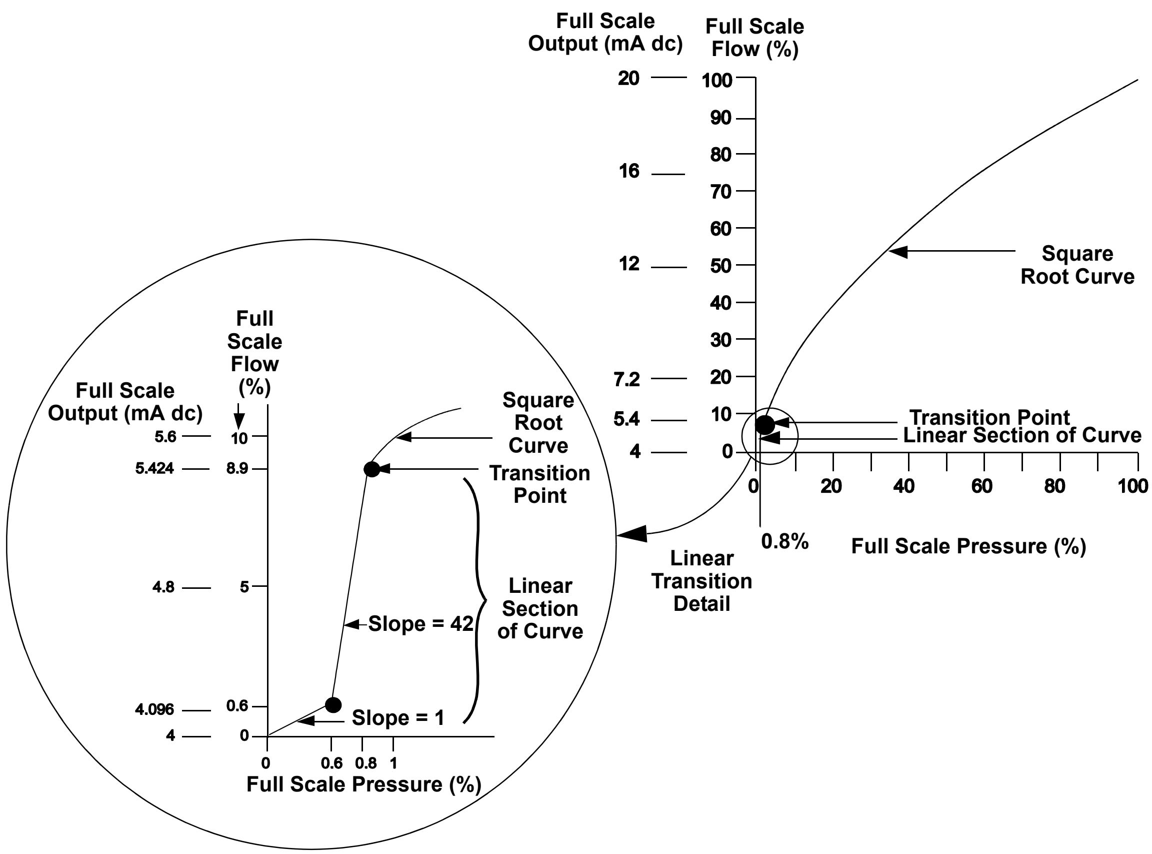
The *PV Damp* command changes the response time of the flowmeter to smooth variations in output readings caused by rapid changes in input. Determine the appropriate damping setting based on the necessary response time, signal stability, and other requirements of the of loop dynamics of the system. The default damping value is 1.6 seconds, and can be reset to any value between 0 and 25.6 seconds.

LCD Meter Options

HART Comm.	1, 4, 3, 4

The *Meter Options* command customizes the LCD meter for use in the application. The meter can be configured to display the following information:

- Engineering Units
- Percent of Range
- User-Configurable LCD Scale
- Alternating between any two of the above



Detailed Setup

Local Span and Zero Control

HART Comm.	1, 4, 4, 1, 7

The *Local Keys* command allows software control over the use of the local span and zero adjustments. To enable or disable the span and zero adjustment buttons on the flowmeter, perform the following fast key sequence: *1 Device Setup*, *4 Detailed Setup*, *4 Device Information*, *1 Field Device Information*, *7 Local Keys Enable*.

NOTE
Disabling the local keys does not disable all flowmeter configuration changes. With the local keys disabled, changes can still be made to the flowmeter configuration using a HART Communicator.

Diagnostics and Service

Transmitter Test

HART Comm.	1, 2, 1, 1

The *Transmitter Test* command initiates a more extensive diagnostics routine than that performed continuously by the flowmeter. The flowmeter test routine can quickly identify potential electronics problems. If the transmitter test detects a problem, messages to indicate the source of the problem are displayed on the communicator screen. This test can be performed either on the bench or in the field.

Loop Test

HART Comm.	1, 2, 2

The *Loop Test* command verifies the output of the flowmeter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. This test should only be performed after the flowmeter is installed. To initiate a loop test, perform the following procedure:

1. Connect a reference meter to the flowmeter. To do so, either connect the meter to the test terminals on the flowmeter terminal block, or shunt the power to the flowmeter through the meter at some point in the loop.
2. From the HOME screen, Select *1 Device Setup*, *2 Diagnostics and Service*, *2 Loop Test*, to prepare to perform a loop test.
3. Select "OK" after you set the control loop to manual. The communicator displays the loop test menu.
4. Select a discrete milliampere level for the flowmeter to output. At the "Choose analog output" prompt, select *1 4mA*, *2 20mA*, or select *3 Other* to manually input a value. If a loop test is being performed to verify the output of a flowmeter, enter a value between 4 and 20 mA. If a loop test is being performed to verify the flowmeter alarm levels, enter the milliampere value at which the flowmeter should enter an alarm state.
5. Check the electrical current meter installed in the test loop to verify that the flowmeter reads the appropriate value it was commanded to output. If the readings match, the flowmeter and the loop are configured and functioning properly. If the readings do not match there may be a fault in the wiring, the flowmeter may require an output trim, or the electrical current meter may be malfunctioning.

After completing the test procedure, the display returns to the loop test screen.

Calibration

A smart flowmeter uses a microprocessor that contains information about the sensor's specific characteristics in response to pressure and temperature inputs; each sensor varies slightly. A smart flowmeter compensates for these sensor variations. The process of generating the sensor performance profile is called factory characterization and it enables a smart flowmeter to maintain higher performance specifications than analog flowmeters.

Calibrating a smart flowmeter is different from calibrating an analog flowmeter. The one-step calibration process of an analog flowmeter is done in three steps with a smart flowmeter:

- Rerange – sets the 4 and 20 mA points at the desired pressures
- Sensor Trim – Adjusts the position of the factory characterization curve to optimize the flowmeter performance over a specified pressure range or to adjust for mounting effects
- Analog Output Trim – Adjusts the analog output to match the plant standard or the control loop

It is important to understand the difference between the trim and the rerange functions of smart flowmeters. Reranging sets the flowmeter analog output to the selected upper and lower range points, and can be done with or without an applied pressure. Reranging does not change the factory characterization curve stored in the microprocessor. In contrast, sensor trimming requires an accurate pressure input, and adds additional compensation that adjusts the position of the factory characterization curve.

NOTE
Sensor trimming adjusts the position of the factory characterization curve. It is possible to degrade the performance of the flowmeter if the sensor trim is done improperly or with equipment that does not meet the accuracy requirements. Contact a Rosemount representative for more information.

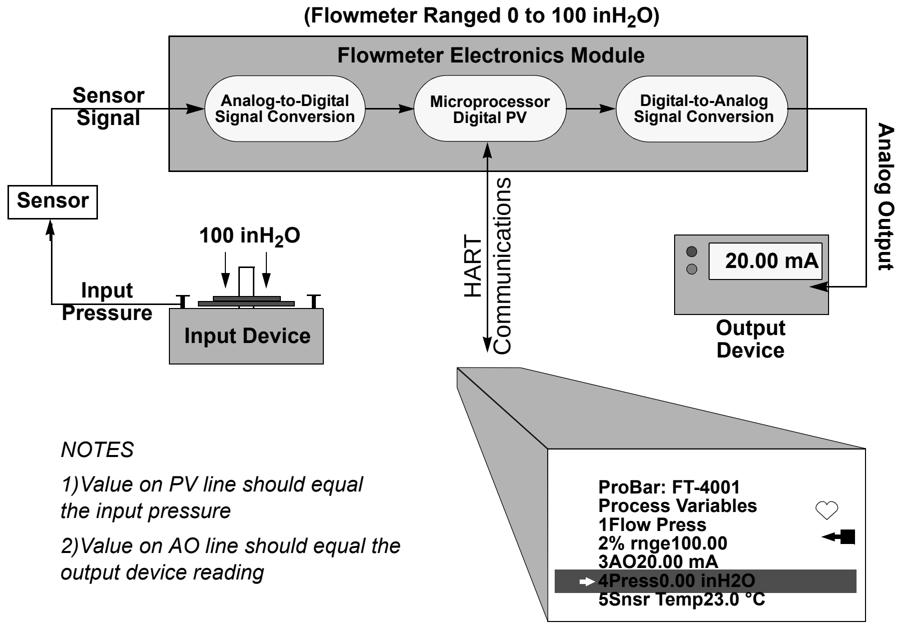
Table 3-7 on page 3-23 illustrates the flowmeter data flow. This data flow can be summarized in four major steps:

1. A change in pressure is measured by a change in the sensor output (Sensor Signal)
2. The sensor signal is converted to a digital format that can be understood by the microprocessor (Analog-to-Digital Signal Converter)
3. Corrects are performed in the microprocessor to obtain a digital representation of the process input (Digital PV)
4. The Digital PV is converted to an analog value (Digital- to-Analog Signal Conversion)

Figure 3-7 also identifies the approximate flowmeter location for each calibration task. Note that the data flows from left to right and a parameter change affects all values to the right of the changed parameter.

Not all calibration procedures should be performed for each flowmeter. Some procedure are appropriate for bench calibration but should not be performed during field calibration. Figure 3-7 identifies the recommended calibration procedure for each type of flowmeter for both bench and field calibration.

Figure 3-7. Flowmeter Data Flow with Calibration Options



Rerange

The *Range Values* command sets the 4 and 20 mA points (lower and upper range values). Setting the range values to the limits of expected readings maximizes flowmeter performance; the flowmeter is most accurate when operated within the expected pressure ranges for your application. In practice, reset the flowmeter range values as often as necessary to reflect changing process conditions.

NOTE
Regardless of the range points, the will measure and report all readings within the digital limits of the sensor. For example, if the 4 and 20 mA points are set to 0 and 10 inH_20, and the flowmeter detects a pressure of 25 inH_20, it digitally outputs the 25 in H_20 reading and a 250% percent of span reading. However, there may be up to ±5.0% error associated with output outside of the range points.

When reranging a calibrated, the new DP must be calculated at the factory during calibration. The is a flowmeter calibrated at reference conditions and has been ranged according to the conditions given at the time of order placement. If the density, pressure, temperature, fluid, or pipe ID has changed, use *Flow Handbook (*document number DS-4012) for equations prior to reranging the flowmeter.

Specific information can be found on the flow calibration report (as shown below) or on the ProBar flowmeter tag.

To rerange the output, use the following equation:

$$\text{New DP Range} = \left(\frac{\text{newQmax}}{\text{oldQmax}}\right)^2 \times \text{Old DP Range}$$

Example:

Current Information

Model: Flanged

Serial#: 222222.2

Max Flow @ 20 mA: 1600 GPM

Max DP @ 20 mA: 153 inH_2O

To rerange 20 mA to 2000 gpm, the calculation is as follows:

$$\text{New DP Range} = \left(\frac{2000}{1600}\right)^2 \times 153\ \text{inH}_2\text{O} = 239\ \text{inH}_2\text{O}$$

The flowmeter can now be reranged to the following new settings:

4 mA = 0 in H_2O

20 mA = 239 inH_20

Use one of the following three methods to rerange the flowmeter. Each method is unique; examine all three closely before deciding which method to use.

Method 1: Rerange with a Communicator Only

HART Comm.	1, 2, 3, 1, 1

Reranging using only the communicator is the easiest and most popular way to rerange the flowmeter. This method changes the values of the analog 4 and 20 mA points independently without a pressure input. Changing the lower or upper range point results in similar changes to the span.

NOTE
If the flowmeter security switch is in the “ON” position, adjustments cannot be made to the zero and span. Refer to Figure 3-1 on page 3-2 for the appropriate placement of the flowmeter security switch.

1. Enter the values directly from the HOME screen

or

2. Enter the fast-key sequence *1*, *2*, *3*, *1*, *1*.
3. Select *1 Keypad input* and follow the on-line instructions.

Method 2: Rerange with a Pressure Input Source and a Communicator

HART Comm.	1, 2, 3, 1, 2

Reranging using the communicator and a pressure source or process pressure is a way of reranging the flowmeter when specific 4 and 20 mA points are not known. This method changes the values of the analog 4 and 20 mA points. When the 4 mA point is set, the span is maintained. When the 20 mA point is set, the span changes. If the lower range point is set to a value that causes the upper range point to exceed the sensor limit, the upper range point is automatically set to the sensor limit and the span is adjusted accordingly.

NOTE
If the flowmeter security switch is in the “ON” position, adjustments cannot be made to the zero and span. Refer to Figure 3-1 on page 3-2 for the appropriate placement of the flowmeter security switch.

1. Enter the fast-key sequence *1*, *2*, *3*, *1*, *2*.
2. Select *2 Apply values* and follow the on-line instructions.

Method 3: Rerange with a Pressure Input Source and the Local Zero and Span Buttons
Reranging using the local zero and span adjustments (see "Local Span and Zero Control" on page 3-20) and a pressure source is a way of reranging the flowmeter when specific 4 and 20 mA points are not known and a communicator is not available. When the 4 mA point is set, the span is maintained. When the 20 mA point is set, the span changes. If the lower range point is set to a value that causes the upper range point to exceed the sensor limit, the upper range point is automatically set to the sensor limit and the span is adjusted accordingly.

To rerange the flowmeter using the span and zero buttons, perform the following procedure.

1. Loosen the screw holding the certifications label on top of the flowmeter housing. Rotate the label to expose the zero and span buttons.
2. Using a pressure source with an accuracy three to ten times the desired calibrated accuracy, apply a pressure equivalent to the lower range value to the high side of the flowmeter.
3. To set the 4 mA point, press and hold the zero button for at least two seconds. Verify that the output is 4 mA. If a meter is installed, it will display ZERO PASS.

NOTE
The zero and span adjustments on previous versions of the flowmeter are screws instead of buttons. To activate the zero or span adjustment, loosen the screw until it pops up.

4. Apply a pressure equivalent to the upper range value to the high side of the flowmeter.
5. To set the 20 mA point, press and hold the span button for at least two seconds. Verify that the output is 20 mA. If a meter is installed, it will display SPAN PASS.

NOTE
If the flowmeter security switch is in the “ON” position or if the local zero and span adjustments are disabled through the software, adjustments cannot be made to the zero and span using the local buttons. Refer to Figure 3-1 on page 3-2 for the proper placement of the flowmeter security switch. Or refer to "Local Span and Zero Control" on page 3-20 for instructions on how to enable the span and zero buttons.

After you rerange the flowmeter using the span and zero adjustments, it is possible to disable the adjustments to prevent further reranging. Refer to "Local Span and Zero Control" on page 3-20 for more information.

Calibration Test

Bench

1. Set output configuration parameters
   a.Set the transmitter range points
   b.Set the Output Units
   c.Set the Output Type
2. Set the Damping Values
3. Perform a full sensor trim (optional) – an accurate pressure source is required.

NOTE
Do not perform a full trim for ProBar flowmeters with a device-type ProBar and a field revision earlier than revision 3.

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4. Perform an analog output trim (optional) – an accurate multimeter is required.

Field

1. Reconfigure parameters if necessary
2. Zero Trim the transmitter to compensate for mounting position effects or static pressure effects.

Trim the Transmitter

To decide which trim procedure to use, first determine whether the analog-to-digital section or the digital-to-analog section of the flowmeter electronics need calibration. To do so, perform the following procedure:

1. Connect a pressure source, a HART communicator, and a digital readout device to the flowmeter.
2. Establish communication between the flowmeter and the communicator.
3. Apply pressure equal to the upper range point pressure (100 in H_20, for example).
4. Compare the applied pressure to the Secondary Variable (Press) line on the Communicator Process Variables Menu. If the Press reading on the communicator does not match the applied pressure, but the test equipment is accurate, perform a sensor trim.
5. Compare the Analog Output (AO) line on the communicator on-line menu to the digital readout device. If the AO reading on the communicator does not match the digital readout device, but the test equipment is accurate, perform an output trim.

Sensor Trim

Trim the sensor using either the zero trim or the full trim function. The trim functions vary in complexity and their use is application-dependent. Both trim functions alter the interpretation of the input signal.

Zero Trim

HART Comm.	1, 2, 3, 3, 1

A *zero trim* is a single-point adjustment. It is useful when compensating for the mounting position effects and is most effective when performed with the flowmeter installed in its final mounting position. Since this correction maintains the slope of the characterization curve, it should not be used in place of a full trim over the full sensor range.

When performing a zero trim, ensure that the equalizing valve is open and all wet legs are filled to the correct levels.

Perform the following procedure to calibrate the sensor with a HART Communicator using the zero trim function.

1. Vent the flowmeter and attach a communicator to the loop.
2. From the communicator main menu select *1 Device setup*, *2 Diagnostics and service*, *3 Calibration*, *3 Sensor trim*, *1 Zero trim* to prepare to adjust the zero trim.

NOTE
The flowmeter must be within 3% of true zero (zero based) in order to calibrate using the zero trim function.

3. Follow the commands provided by the communicator to complete the adjustment of the zero trim.

Full Trim

HART Comm.	1, 2, 3, 3

A **full trim** is a two-point sensor calibration where two end-point pressures are applied and all output is linearized between them. Always adjust the low trim value first to establish the correct offset. Adjustment of the high trim value provides a slope correction to the characterization curve based on the low trim value. The factory-established characterization curve is not changed by this procedure. The trim values optimize performance over the specified measuring range at the calibration temperature.

NOTE
Do not perform a full trim for flowmeters with a device-type and a field revision earlier than field revision 3.

Perform the following procedure to calibrate the sensor with a HART communicator.

1. Assemble and power the entire calibration system including the flowmeter, HART communicator, power supply, pressure input source, and readout device (see Figure 3-8).

NOTE
Use a pressure input source that is at least three times more accurate than the flowmeter. Allow the input pressure to stabilize for 10 seconds before entering any values.

2. From the communicator main menu select *1 Device setup*, *2 Diagnostics and service*, *3 Calibration*, *3 Sensor trim*, *2 Lower sensor trim* to prepare to adjust the lower trim point.

NOTE
Select pressure input values so the low and high values are equal to or outside the 4 and 20 mA points. Do not attempt to obtain reverse output by reversing the high and low points. The flowmeter allows approximately a 5% URL deviation from the characterized curve established at the factory.

3. Follow the commands provided by the communicator to complete the adjustment of the lower value.
4. Repeat the procedure for the upper value, replacing *2 Lower sensor* trim with *3 Upper sensor trim* in Step 2.

Analog Output Trim

The Analog Output Trim commands adjust the current output at the 4 and 20 mA points to match plant standards. This command adjusts the digital to analog signal conversion.

Digital to Analog Trim

HART Comm.	1, 2, 3, 2, 1

Use the following procedure to perform a digital-to-analog trim with a HART communicator.

1. From the HOME screen, select *1 Device setup*, *2 Diag/Service*, *3 Calibration*, *4 D/A trim*. Set the control loop to manual (see "Setting the Loop to Manual" on page 3-14) and select OK.
2. Connect an accurate reference meter to the flowmeter at the “Connect reference meter” prompt. To do so, connect the positive lead to the positive terminal and the negative lead to the test terminal in the flowmeter terminal compartment, or shunt the flowmeter power through the reference meter at some point.
3. Select “OK” after connecting the reference meter.
4. Select “OK” at the “Setting fld dev output to 4 mA” prompt.
   The flowmeter outputs 4.00 mA.
5. Record the actual value from the reference meter, and enter it at the “Enter meter value” prompt. Verify that the output value equals the value on the reference meter when the prompt appears.
6. Select *1 Yes* if the reference meter value equals the flowmeter output value or *2 No* if it does not.
   If you select *1 Yes*, proceed to Step 7.
   If you select *2 No*, repeat Step 5.
7. Select “OK” at the “Setting fld dev output to 20 mA” prompt, and repeat Steps 5 and 6 until the reference meter value equals the flowmeter output value.
8. Select “OK” after you return the control loop to automatic control.

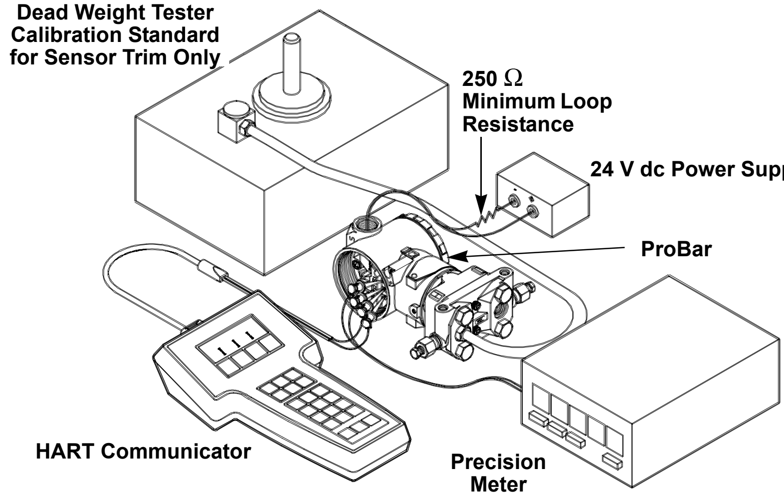
Digital to Analog Trim Using Other Scale

HART Comm.	1, 2, 3, 2, 2

The *Scaled D/A Trim* command matches the 4 and 20 mA points to a user-selectable reference scale other than 4 and 20 mA (1 to 5 volts if measuring across a 250 ohm load, or 0 to 100 percent if measuring from a DCS, for example). To perform a scaled D/A trim, connect an accurate reference meter to the flowmeter and trim the output signal to scale as outlined in the Output Trim procedure.

NOTE
Use a precision resistor for optimum accuracy. When adding a resistor to the loop, ensure that the power supply is sufficient to power the flowmeter to a 20 mA output with the additional loop resistance.

Figure 3-8.
Digital Trim Connection.
Drawing (4–20 mA Flowmeters)



Advanced Functions

For complete instructions, refer to the Model 3051S Series Pressure Transmitter Family Reference Manual (document number 00809-0100-4801).

MODEL 3095MFA MASS PROBAR

EA Software/ HART Communicator Comparison

Table A-1 identifies the functionality of the Model 3095 MV Engineering Assistant and the Model 275 HART Communicator.

Any changes that are associated with flow parameters (pipe, fluid, primary element) require EA software.

Function	EA	HART
Compensated Flow Setup		
Liquid, Gas, Steam, or Natural Gas	YES	NO
Differential Producer Type	YES	NO
Primary Element Diameter	YES	NO
Pipe internal Diameter	YES	NO
Operating Static Pressure Range	YES	NO
Operating Temperature Range	YES	NO
Pressure Standard Reference Condition	YES	NO
Temperature Standard Reference Condition	YES	NO
12 or 63 Point Density Data	YES	NO
4 Point Viscosity Data	YES	NO
Density at Standard Condition	YES	NO
Molecular Weight	YES	NO
Isentropic Exponent	YES	NO
RTD Fixed Mode	YES	YES
Transmitter Setup		
Range Values (Flow, DP, AP, GP, T)	YES	YES
Units (Flow, DP, AP, GP, T)	YES	YES
Damping (DP, AP, GP, T)	YES	YES
Primary Variable	YES	YES
Device Information (tag, date, desc., etc.)	YES	YES

LCD Settings	YES	YES
Totalizer Settings	YES	YES
Special Units	YES	YES
DP Low Flow Cutoff	YES	YES
Burst Mode	YES	YES
Address	YES	YES
Maintenance		
Change Password	YES	NO
Read Output	YES	YES
Module Info (range limits, matl, flange, etc.)	YES	YES
Identification Info (serial no., revisions)	YES	YES
Sensor Trim (DP, AP, GP, T)	YES	YES
Process Temperature Mode	YES	YES
Output Trim	YES	YES
Loop Test	YES	YES
Test Flow Calculation	YES	NO
Diagnostic Messages	YES	YES

Engineering Assistant (EA) Software

Please see the Model 3095MV Pressure Transmitter MultiVariable Multilingual Field Manual (MFM) (document number 00810-0100-4716) for instruction on how to commissioning the Model 3095MFA Mass ProBar.

Model 275 HART Communicator

See “Model 3095MV HART Menu Tree” on page 3-32 and “Model 3095MFA Fast Key Sequence” on page 3-33.

Figure 3-9. Model 3095MV HART Menu Tree

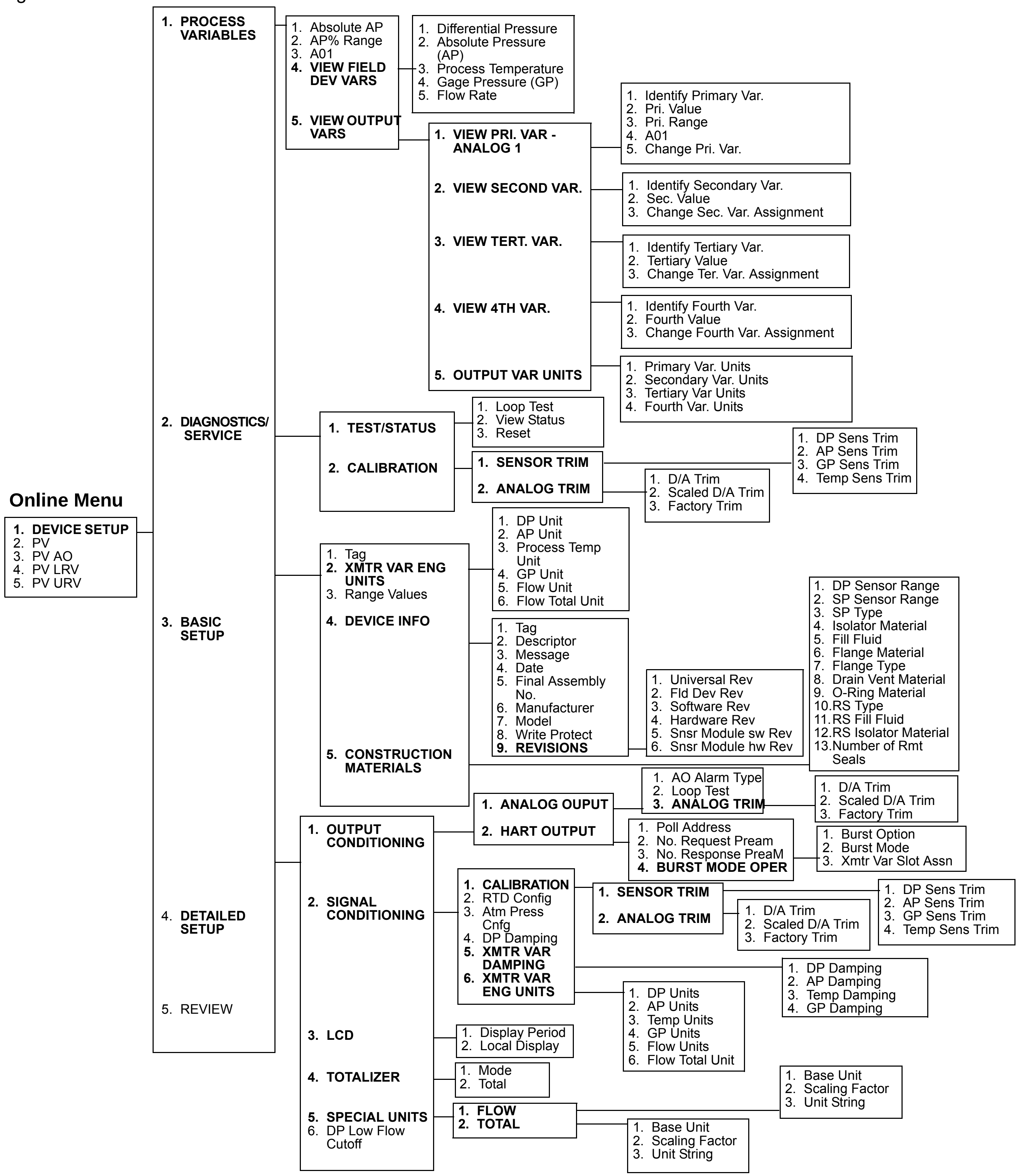


Table 3-4. Model 3095MFA Fast Key Sequence

The following menu indicates fast key sequences for common functions.

Function	HART Fast Key Sequences
% rnge	1, 1, 2
% rnge	1, 1, 5, 1, 3
4V is	1, 1, 5, 4, 1
AO Alrm typ	1, 4, 1, 1, 1
AO1	1, 1, 3
AO1	3
AP Damping	1, 4, 2, 5, 2
AP Sens Trim	1, 2, 2, 1, 2
AP Units	1, 3, 2, 2
Absolute (AP)	1, 1, 4, 2
Atm Press Cnfg	1, 4, 2, 3
Burst mode	1, 4, 1, 2, 4, 2
Burst option	1, 4, 1, 2, 4, 1
Change PV Assgn	1, 1, 5, 1, 5
Change SV Assgn	1, 1, 5, 2, 3
Change TV Assgn	1, 1, 5, 3, 3
Change 4V Assgn	1, 1, 5, 4, 3
D/A trim	1, 2, 2, 2, 1
DP Low Flow Cutoff	1, 4, 6
DP LRV	4
DP Sens Trim	1, 2, 2, 1, 1
DP Snsr Range	1, 3, 5, 1
DP URV	5
DP unit	1, 3, 2, 1
Date	1, 3, 4, 4
Descriptor	1, 3, 4, 2
Diff pres damp	1, 4, 2, 4
Diff pres	1, 1, 1
Diff pres	2
Drain vent matl	1, 3, 5, 8
Factory Trim	1, 2, 2, 2, 3
Fill fluid	1, 3, 5, 5
Final asmbly num	1, 3, 4, 5
Flange type	1, 3, 5, 7
Fld dev rev	1, 3, 4, 9, 2
Flnge matl	1, 3, 5, 6
Flo rate	1, 1, 4, 5
Flow Rate Special Units	1, 4, 5, 1
Flow Units	1, 3, 2, 5
GP Damping	1, 4, 2, 5, 4
GP Sens Trim	1, 2, 2, 1, 3
GP Units	1, 3, 2, 4
Gage (GP)	1, 1, 4, 4
Hardware rev	1, 3, 4, 9, 4
Isoltr matl	1, 3, 5, 4
LCD Settings	1, 4, 3
Loop test	1, 2, 1, 1
Manufacturer	1, 3, 4, 6
Message	1, 3, 4, 3
Model	1, 3, 4, 7
Num remote seal	1, 3, 5, 13
Num req preams	1, 4, 1, 2, 2

Num resp preams	1, 4, 1, 2, 3
O ring matl	1, 3, 5, 9
PV is	1, 1, 5, 1, 1
Poll addr	1, 4, 1, 2, 1
Process temp unit	1, 3, 2, 3
Process temp	1, 1, 4, 3
RS fill fluid	1, 3, 5, 11
RS isoltr matl	1, 3, 5, 12
RS type	1, 3, 5, 10
RTD Config	1, 4, 2, 2
Range values	1, 3, 3
Reset	1, 2, 1, 3
SP Snsr Range	1, 3, 5, 2
SP Type	1, 3, 5, 3
SV is	1, 1, 5, 2, 1
Scaled D/A trim	1, 2, 2, 2, 2
Snsr module hw rev	1, 3, 4, 9, 6
Snsr module sw rev	1, 3, 4, 9, 5
Software rev	1, 3, 4, 9, 3
Status group 1	1, 6
Totalizer	1, 4, 4
Totalizer Special Units	1, 4, 5, 2
TV is	1, 1, 5, 3, 1
Tag	1, 3, 1
Temp Sens Trim	1, 2, 2, 1, 4
Temp damp	1, 4, 2, 5, 3
Universal rev	1, 3, 4, 9, 1
View status	1, 2, 1, 2
Write protect	1, 3, 4, 8
Xmtr Var Slot Assn	1, 4, 1, 2, 4, 3

Section 4 Operation and Maintenance

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 live.
- 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.

Electrical shock can result in death or serious injury.

- Avoid contact with the leads and the terminals.

MODEL 3095MFA MASS PROBAR

Troubleshooting

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

Symptom	Possible Cause	Corrective Action
Questionable accuracy or erroneous flow signal	Improper installation	• Is the r flow arrow pointed in the direction of the flow? • Verify that the cross reservoirs are perfectly level with one another. • Is there sufficient straight run upstream and downstream of the flowmeter?
	System leaks	Check for leaks in instrument piping. Repair and seal all leaks.
	Contamination/plugging	Remove the flowmeter and check for contamination.
	Closed valve	Verify that both Mass ProBar (PH & PL) or (MH & ML) valves are open. Verify that vent, equalizer, and line valves are properly positioned per the “start up procedure.”
	Calibration	Is the calibration too high or low for the flow rate?
	Connections (remote mount only)	Verify that the high side of the electronics is connected to the high side of the flowmeter. 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.
	Mass ProBar misalignment	Misalignment of the flowmeter beyond 3 degrees will cause an erroneous signal.
	Opposite-side support Mass ProBar	If the flowmeter 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 calculation and the fluid parameters for accuracy. Double-check pipe inside diameter for proper sizing. Note: For the multipoint flow calibrated flowmeter, refer to the Handbook for corrections.
Spiking flow signal	Two-phase flow	The flowmeter 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		• Check if power polarity is reversed • Verify voltage across terminals (should be 10–55V dc) • Check for bad diode in terminal block • Replace electronics terminal block
Electronics not in communication		• Check power supply voltage at electronics (10.5V minimum) • Check load resistance (250 ohms minimum) • Check if unit is addressed properly • Replace electronics board
Milliamp reading is low or high		• Check pressure variable reading for saturation • Check if output is in alarm condition • Perform 4–20 mA output trim • Replace electronics board

Symptom	Possible Cause	Corrective Action
No response to changes in applied flow		• Check test equipment • Check impulse piping for blockage • Check for disabled span adjustment • Check electronics security switch • Verify calibration settings (4 and 20 mA points) • Contact factory for replacement
Low reading/high reading		• Check impulse piping for blockage • Check test equipment • Perform full sensor trim (if software revision is 35 or higher) • Contact factory for replacement
Erratic reading for pressure variable		• Check impulse piping for blockage • Check damping • Check for EMF interference • Contact factory for replacement

DISASSEMBLY

Remove the Flowmeter from Service

NOTE
Once you have determined a that flowmeter is inoperable, remove it from service.

Be aware of the following:

- Isolate and vent the process from the flowmeter before removing the flowmeter from service.
- Remove all electrical leads and conduit.
- Do not detach the process flange or the electronics without consulting the factory.

Terminal Block

Remove

Electrical connections are located on the terminal block in the compartment labelled “FIELD TERMINALS.”

Loosen the two small screws located at the 9 and 4 o'clock positions. Pull the entire terminal block out.

NOTE
To remove the terminal block from the housing of a previous version of the flowmeter, manually disconnect the power leads from the rear of the terminal block prior to separating it from the housing.

Install

Gently slide the terminal block into place, making sure the posts from the electronics housing properly engage the receptacles on the terminal block. Tighten the captive screws, and replace the electronics housing cover. The flowmeter covers must be fully engaged to meet explosion-proof requirements.

NOTE
When reassembling a previous version of the terminal block, attach the black and red wires to the back side of the block before inserting it into the electronics housing.

Electronics Board

Removal

The flowmeter electronics board is located in the compartment opposite the terminal side. To remove the electronics board perform the following procedure:

1. Remove the housing cover opposite the field terminal side.
2. Loosen the two captive screws that anchor the board to the housing. The electronics board is electrostatically sensitive; observe handling precautions for static-sensitive components.

NOTE
When disassembling a flowmeter with a LCD meter, loosen the two captive screws that are visible on the right and left sides of the meter display. The two screws anchor the LCD meter to the electronics board and the electronics board to the housing.

---

3. Slowly pull the electronics board out of the housing. With the two captive screws free of the flowmeter housing, only the sensor module ribbon cable holds the board to the housing.

NOTE
Previous versions of the electronics board utilize a snap-in power plug and receptacle. Carefully unsnap the power plug from the receptacle to free the board from the power cord.

---

4. Disconnect the sensor module ribbon cable to release the electronics board from the flowmeter.

Attaching

1. Remove the cable connector from its position inside of the internal shroud and attach it to the electronics board.
2. Insert the electronics board into the housing. Make sure the posts from the electronics housing properly engage the receptacles on the electronics board.

NOTE
When reassembling a previous version of the electronics board or placing a new version of the electronics board in a previous version of the housing, attach the snap-in power connection to the receptacle on the board with the black and red wires routed towards the center of the board and below the white reed switch holder.

---

3. Tighten the captive mounting screws.
4. Replace the electronics housing cover. The flowmeter covers must be engaged metal-to-metal to ensure proper seal and to meet explosion-proof requirements.

NOTE
Electronics board revision 5.3.163 or later (all shrouded designs) have increased functionality that allows verification testing of alarm current levels. When repairing or replacing the flowmeter electronics board, sensor module or LCD meter, verify the flowmeter alarm level before you return the flowmeter to service (see "Mounting" on page 2-4).

RTD MAINTENANCE

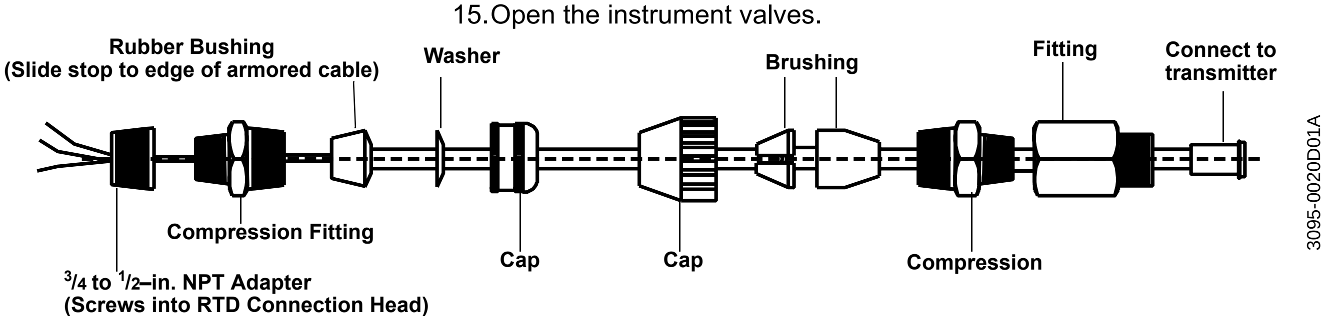
This section covers RTD maintenance procedures.

Replacing a RTD

Direct Mount

If an RTD needs to be replaced on a direct mounted Mass ProBar, 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.
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 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 finger tight plus 1/8 of a turn. Thread the wires through the nipple.
10. For all threaded connections, use appropriate thread lubricant. Reinstall the 1/2-in. NPT plug.
11. Use the same teflon gaskets to reinstall the transmitter to the Mass ProBar 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.



Remote Mount

If an RTD needs to be replaced on a remote mount, 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 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. Using the appropriate thread lubricant or tape, install the terminal housing onto the remote head.
9. Reconnect the RTD wires to the terminal. This diagram is for a typical RTD transmitter wiring connection.
10. Open the instrument valves.

Appendix A Specifications and Reference Data

MODEL 3051SFA PROBAR FLOWMETER

Performance

System Reference Accuracy

- Accuracy is ±0.90% of volumetric flow rate in liquids
- Accuracy is ±1.4% of volumetric flow rate in gas and steam

Repeatability

±0.1%

Turndown

8:1 flow turndown

Line Sizes

Sensor Size 1

- 2-in. to 8-in. (50 to 200 mm)

Sensor Size 2

- 6-in. to 36-in. (150 to 900 mm)

Sensor Size 3

- 12-in. to 72-in. (300 to 1800 mm)

Sensor Size	Minimum Rod Reynolds Number (R_d)	Probe Width ($_d$) (inches)
1	6000	0.590
2	12500	1.060
3	25000	1.935

$$R_d = \frac{d \times v \times p}{\mu}$$

Where
d = Probe width (feet)
v = Velocity of fluid (ft/sec)
p = Density of fluid (lbm/ft^3)
μ = Viscosity of the fluid (lbm/ft-sec)

Annubar Sensor Surface Finish

The front surface of the Annubar primary is textured for high Reynolds number applications. The surface texture creates a more turbulent boundary layer on the front surface of the sensor. The increased turbulence produces a more predictable and repeatable separation of flow at the edge of the sensor.

Performance Statement Assumptions

- Density uncertainty is ±2.2 percent
- Measured pipe I.D
- Electronics are trimmed for optimum flow accuracy

Functional

Service

- Liquid
- Gas
- Steam

Process Temperature Limits

Direct Mount Electronics

- 500 °F (260 °C)

Remote Mount Electronics

- 1250 °F (677 °C) – Hastelloy®
- 850 °F (454 °C) – Stainless Steel

Electronics Temperature Limits

Ambient

- –40 to 185 °F (–40 to 85 °C)
- With Integral Mount LCD Display: –4 to 175 °F (–20 to 80 °C)

Storage

- –50 to 230 °F (–46 to 110 °C)
- With Integral Mount LCD Display: –40 to 185 °F (–40 to 85 °C)

Pressure Limits(1)

Direct Mount Electronics

- Up to 3626 psig (250 bar)

Remote Mount Electronics

- Up to 3626 psig (250 bar)

Power Supply

4–20 mA option

- External power supply required. Standard transmitter (4–20 mA) operates on 10.5 to 42.4 v dc with no load

FOUNDATION™ Fieldbus option

- External power supply required. Transmitters operate on 9.0 to 32.0 V dc transmitter terminal voltage

(1) Static pressure selection may effect pressure limitations.

Range and Sensors Limits

Table A-1. Range and Sensor Limits

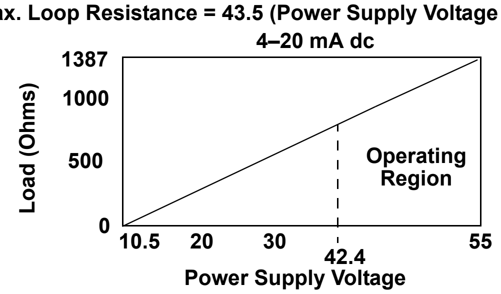
Range	Minimum Span		Range and Sensor Limits	
	Ultra	Classic	Upper (URL)	Lower (LRL)
1A	0.5 inH_2O (1.24 mbar)	0.5 inH_2O (1.24 mbar)	25.0 inH_2O (0.0623 bar)	0 inH_2O (0 mbar)
2A	1.3 inH_2O (3.11 mbar)	2.5 inH_2O (6.23 mbar)	250.0 inH_2O (0.62 bar)	0 inH_2O (0 bar)
3A	5.0 inH_2O (12.4 mbar)	10.0 inH_2O (24.9 mbar)	1000.0 inH_2O (2.49 bar)	0 inH_2O (0 bar)

Turn-On Time
Performance within specifications less than 2.0 seconds after power is applied to the transmitter

Damping
Analog output response to a step input change is user-selectable from 0 to 60 seconds for one time constant. This software damping is in addition to sensor module response time

Load Limitations
Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

Max. Loop Resistance = 43.5 (Power Supply Voltage – 10.5)



HART communication requires a minimum loop resistance of 250 ohms.

Static Pressure Limits
- Range 1A: Operates within specification between static line pressures of 0.5 to 2000 psig (0.03 to 138 bar)
- Ranges 2A– 3A: Operates within specifications between static line pressures of 0.5 and 3626 psig (0.03 to 250 bar)

Humidity Limits
- 0–100% relative humidity

Failure Mode Alarm
HART 4–20mA (output code A)
- If self-diagnostics detect a gross transmitter failure, the analog signal will be driven offscale to alert the user. Rosemount standard, NAMUR, and custom alarm levels are available (see Table A-2 below)
- High or low alarm signal is software-selectable or hardware-selectable via the optional switch (option D1)

Table A-2. Alarm Configuration

	High Alarm	Low Alarm
Rosemount	≥ 21.75 mA	≤3.75 mA
NAMUR compliant(1)	≥ 22.5 mA	≤3.6 mA
Custom levels(2)	20.2 - 23.0 mA	3.6 - 3.8 mA

(1) Analog output levels are compliant with NAMUR recommendation NE 43 (June 27, 1996).
(2) Low alarm must be 0.1 mA less than low saturation and high alarm must be 0.1 mA greater than high saturation.

FOUNDATION Fieldbus (output code F)

- The AI block allows the user to configure HI-HI, HI, LO, or LO-LO, alarms

FOUNDATION Fieldbus (output code F)

Power Supply

- External power supply required; transmitters operate on 9.0 to 32.0 V dc transmitter terminal voltage

Current Draw

- 17.5 mA for all configurations (including LCD display option)

Overpressure Limits

Flowmeters withstand the following limits without damage:

- Range 1A: 2000 psig (138 bar)
- Ranges 2A–3A: 3626 psig (250 bar)

Table A-3. Overpressure Limits(1)

Standard	Type	Carbon Steel Rating	Stainless Steel Rating
ANSI/ASME	Class 150	285 (20)	275 (19)
ANSI/ASME	Class 300	740 (51)	720 (50)
ANSI/ASME	Class 600	1480 (102)	1440 (99)
At 100 °F (38 °C), the rating decreases with increasing temperature.			
DIN	PN 10/40	580 (40)	580 (40)
DIN	PN 10/16	232 (16)	232 (16)
DIN	PN 25/40	580 (40)	580 (40)
At 248 °F (120 °C), the rating decreases with increasing temperature.			

Installation Considerations

Drill Hole Size According to Sensor Size

Sensor Size	Diameter
1	3/4-in. (19 mm)
2	1 5/16-in. (34 mm)
3	2 1/2-in. (64 mm)

Physical

Annubar Type

- See “Dimensional Drawings” on page A-16 for visual representation of the different Annubar types available

Pak-Lok (option P)

- Provided with a threaded connection rated up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C))
- Graphite Packing

Flanged with Opposite Side Support (option F)

- Provided with opposite side support, which requires a second pipe penetration

(1) Carbon Steel and Stainless Steel Ratings are measured in psig (bar).

All Flanged Models

- Sensor flange is the same material as the Annubar sensor and the mounting flange is the same material as the pipe material
- Flanged mounting hardware: nuts, bolts and gaskets (constructed from the same material as the pipe material)

Flange Size According to Sensor Size

Sensor Size	Up to 600#	Up to 1500 #	Up to 2500 #
1	$1^1/_2$-in. (38 mm) schedule 80	$1^1/_2$-in. (38 mm) schedule 80	$1^1/_2$-in. (38 mm) schedule XX heavy
2	2-in. (50 mm) schedule 80	2-in. (50 mm) schedule 80	2-in. (50 mm) schedule XX heavy
3	3-in. (76 mm) schedule 40	3-in. (76 mm) schedule 40	3-in. (76 mm) schedule XX heavy

Annubar Type Specification Chart

Option Code	Description	Pak-Lok(1)	Flange-Lok	Flange	Manual and Gear Drive Flo-Tap
T1(1)	Threaded connection	X			X
A1	150# RF ANSI		X	X	X
A3	300# RF ANSI		X	X	X
A6	600# RF ANSI		X	X	X
A9(2)	900# RF ANSI			X	X
AF(2)	1500# RF ANSI			X	X
AT(2)	2500# RF ANSI			X	X
D1	DN PN 16		X	X	X
D3	DN PN 40		X	X	X
D6	DN PN 100		X	X	X
R9(2)	900# RTJ Flange			X	X
RF(2)	1500# RTJ Flange			X	X
RT(2)	2500# RTJ Flange			X	X

(1) Available up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).
(2) Remote mount only.

Annubar Sensor Material

- 316 Stainless Steel
- Hastelloy 276

Packing Gland

- Only required for the Flo-Tap Annubar types
- The packing gland is a wetted part and matches sensor material

Flo-Tap Packing Gland Material Temperature Limits

- Urethane: –20 to 250 °F (–29 to 121 °C)
- Graphite: –300 to 850 °F (–184 to 454 °C)

Isolation Valve

- Only required for the Flo-Tap Annubar types
- The isolation valve will carry the same pressure rating as the sensor flange and mounting flange specified in the mounting type
- Ball valves have a 300# limitation

Temperature Measurement

Integral RTD

- 100 Ohm platinum RTD
- 4-wire RTD ($\alpha = 0.00385$)

Remote RTD

- 100 Ohm platinum RTD, spring loaded with 1/2-in. NPT nipple and union
- Remote RTD material is the same as the specified pipe material

Thermowell

- 1/2-in. x 1/2-in NPT, 316 Stainless Steel with 1/2-in. Carbon Steel weld couplet

Electronic Connections for Remote Mount

1/2–14 NPT, G1/2, and M20 × 1.5 (CM20) conduit. HART interface connections fixed to terminal block for output code A

Installed in Flanged Pipe Spool Section (option code H2)

- All flanged pipe spool sections are flanged pipe sections
- The flanged pipe spool section is constructed from the same material as the pipe
- The flange rating of the flanged pipe section will be the same as the flange rating selected for the mounting type
- Consult the factory for Pak-Lok and Flo-Tap Annubar Type flanged pipe spool sections, remote temperature measurement, and ANSI ratings above 600#

Table A-4. Flange Pipe Spool Section Schedule

ANSI	Schedule
150# ANSI	40
300# ANSI	40
600# ANSI	80

Table A-5. Flange Pipe Spool Section Length

Nominal Pipe Size	Length
2-in. (50 mm)	10.52-in. (267.2 mm)
3-in. (80 mm)	11.37-in. (288.8 mm)
4-in. (100 mm)	12.74-in. (323.6 mm)
6-in. (150 mm)	14.33-in. (364.0 mm)
8-in. (200 mm)	16.58-in. (421.1 mm)

MODEL 3095MFA MASS PROBAR FLOWMETER

Performance

System Mass Flow Reference Accuracy

Accuracy is ±1.0% of mass flow rate in gas and steam

Repeatability

±0.1%

Turndown

8:1 flow turndown

Line Sizes

Sensor Size 1

- 2-in. to 8-in. (50 to 200 mm)

Sensor Size 2

- 6-in. to 36-in. (150 to 900 mm)

Sensor Size 3

- 12-in. to 72-in. (300 to 1800 mm)

Sensor Size	Minimum Rod Reynolds Number (R_d)	Probe Width ($_d$) (inches)
1	6000	0.590
2	12500	1.060
3	25000	1.935

$$R_d = \frac{d \times v \times p}{\mu}$$

Where
d = Probe width (feet)
v = Velocity of fluid (ft/sec)
p = Density of fluid (lbm/ft^3)
μ = Viscosity of the fluid (lbm/ft-sec)

Annubar Sensor Surface Finish

The front surface of the Annubar primary is textured for high Reynolds number applications. The surface texture creates a more turbulent boundary layer on the front surface of the sensor. The increased turbulence produces a more predictable and repeatable separation of flow at the edge of the sensor.

Performance Statement Assumptions

- Density uncertainty is ±0.1%
- Measured pipe I.D.
- Electronics are trimmed for optimum flow accuracy.

Functional

Service

- Liquid
- Gas
- Steam

Process Temperature Limits

Direct Mount Electronics

- 500 °F (260 °C)

Remote Mount Electronics

- 1250 °F (677 °C) – Hastelloy
- 850 °F (454 °C) – Stainless Steel

Electronics Temperature Limits

Ambient

- –40 to 185 °F (–40 to 85 °C)
- With Integral Mount LCD Display: –4 to 175 °F (–20 to 80 °C)

Storage

- –50 to 230 °F (–46 to 110 °C)
- With Integral Mount LCD Display: –40 to 185 °F (–40 to 85 °C)

Pressure Limits(1)

Direct Mount Electronics

- Up to 3626 psig (250 bar)

Remote Mount Electronics

- Up to 3626 psig (250 bar)

Power Supply

4–20 mA option

- External power supply required. Standard transmitter (4–20 mA) operates on 11 to 55 v dc with no load

Output Protocol

Two-wire 4–20 mA, user-selectable for DP, AP,
GP, PT, mass flow, or totalized flow. Digital HART protocol superimposed on 4–20 mA signal, available to any host that conforms to the HART protocol

Turn-on Time

Digital and analog measured variables will be within specifications 7–10 seconds after power is applied to transmitter

Digital and analog flow output will be within specifications 10–14 seconds after power is applied to transmitter

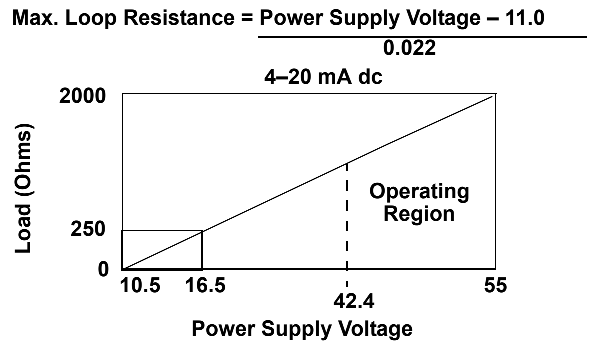
Damping

Analog output response to a step input change is user-selectable from 0 to 29 seconds for one time constant. This software damping is in addition to sensor module response time

Load Limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:

(1) Static pressure selection may effect pressure limitations.



For CSA approval, power supply must not exceed 42.4 V dc. HART communication requires a minimum loop resistance of 250 ohms.

Static Pressure Limits

- Operates within specification between static pressures of 0.5 psia (34 mbar) and the URL of the absolute pressure sensor

Humidity Limits

0–100% relative humidity

Failure Mode Alarm

HART 4–20 mA (output code A)

- If self-diagnostics detect a gross transmitter failure, the analog signal will be driven either below 3.75 mA or above 21.7 mA to alert the user. High or low alarm signal is user-selectable by internal jumper

Overpressure Limits

Zero to two times the absolute pressure range with a maximum of 3626 psia (250 bar).

Installation Considerations

Drill Hole Size According to Sensor Size

Sensor Size	Diameter
1	3/4-in. (19 mm)
2	1 5/16-in. (34 mm)
3	2 1/2-in. (64 mm)

Physical

Annubar Type

- See “Dimensional Drawings” on page A-16 for visual representation of the different Annubar types available

Pak-Lok (option P)

- Provided with a threaded connection rated up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C))
- Graphite Packing

Flanged with Opposite Side Support (option F)

- Provided with opposite side support, which requires a second pipe penetration

All Flanged Models

- Sensor flange is the same material as the Annubar sensor and the mounting flange is the same material as the pipe material
- Flanged mounting hardware: nuts, bolts and gaskets (constructed from the same material as the pipe material)

Flange Size According to Sensor Size

Sensor Size	Up to 600#	Up to 1500 #	Up to 2500 #
1	$1^1/_2$-in. (38 mm) schedule 80	$1^1/_2$-in. (38 mm) schedule 80	$1^1/_2$-in. (38 mm) schedule XX heavy
2	2-in. (50 mm) schedule 80	2-in. (50 mm) schedule 80	2-in. (50 mm) schedule XX heavy
3	3-in. (76 mm) schedule 40	3-in. (76 mm) schedule 40	3-in. (76 mm) schedule XX heavy

Annubar Type Specification Chart

Option Code	Description	Pak-Lok(1)	Flange-Lok	Flange	Manual and Gear Drive Flo-Tap
T1(1)	Threaded connection	X			X
A1	150# RF ANSI		X	X	X
A3	300# RF ANSI		X	X	X
A6	600# RF ANSI		X	X	X
A9(2)	900# RF ANSI			X	X
AF(2)	1500# RF ANSI			X	X
AT(2)	2500# RF ANSI			X	X
D1	DN PN 16		X	X	X
D3	DN PN 40		X	X	X
D6	DN PN 100		X	X	X
R9(2)	900# RTJ Flange			X	X
RF(2)	1500# RTJ Flange			X	X
RT(2)	2500# RTJ Flange			X	X

(1) Available up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).
(2) Remote mount only.

Annubar Sensor Material

- 316 Stainless Steel
- Hastelloy 276

Packing Gland

- Only required for the Flo-Tap Annubar types
- The packing gland is a wetted part and matches sensor material

Flo-Tap Packing Gland Material Temperature Limits

- Urethane: –20 to 250 °F (–29 to 121 °C)
- Graphite: –300 to 850 °F (–184 to 454 °C)

Isolation Valve

- Only required for the Flo-Tap Annubar types
- The isolation valve will carry the same pressure rating as the sensor flange and mounting flange specified in the mounting type
- Ball valves have a 300# limitation

Temperature Measurement

Integral RTD

- 100 Ohm platinum RTD
- 4-wire RTD ($\alpha = 0.00385$)

Remote RTD

- 100 Ohm platinum RTD, spring loaded with 1/2-in. NPT nipple and union
- Remote RTD material is the same as the specified pipe material

Thermowell

- 1/2-in. x 1/2-in NPT, 316 Stainless Steel with 1/2-in. Carbon Steel weld couplet

Electronic Connections for Remote Mount

1/2–14 NPT, G1/2, and M20 × 1.5 (CM20) conduit. HART interface connections fixed to terminal block for output code A

Installed in Flanged Pipe Spool Section (option code H2)

- All flanged pipe spool sections are flanged pipe sections
- The flanged pipe spool section is constructed from the same material as the pipe
- The flange rating of the flanged pipe section will be the same as the flange rating selected for the mounting type
- Consult the factory for Pak-Lok and Flo-Tap Annubar Type flanged pipe spool sections, remote temperature measurement, and ANSI ratings above 600#

Table A-6. Flange Pipe Spool Section Schedule

ANSI	Schedule
150# ANSI	40
300# ANSI	40
600# ANSI	80

Table A-7. Flange Pipe Spool Section Length

Nominal Pipe Size	Length
2-in. (50 mm)	10.52-in. (267.2 mm)
3-in. (80 mm)	11.37-in. (288.8 mm)
4-in. (100 mm)	12.74-in. (323.6 mm)
6-in. (150 mm)	14.33-in. (364.0 mm)
8-in. (200 mm)	16.58-in. (421.1 mm)

MODEL 485 ANNUBAR PRIMARY

Performance

Discharge Coefficient Factor
±0.75% of flow rate

Repeatability
±0.1%

Flow Turndown
10:1

Line Sizes
Sensor Size 1
- 2-in. to 8-in. (50 to 200 mm)

Sensor Size 2
- 6-in. to 36-in. (150 to 900 mm)

Sensor Size 3
- 12-in. to 72-in. (300 to 1800 mm)

Sensor Size	Minimum Rod Reynolds Number (R_d)	Probe Width ($_d$) (inches)
1	6000	0.590
2	12500	1.060
3	25000	1.935

$$R_d = \frac{d \times v \times p}{\mu}$$

Where
d = Probe width (feet)
v = Velocity of fluid (ft/sec)
p = Density of fluid (lbm/ft^3)
μ = Viscosity of the fluid (lbm/ft-sec)

Annubar Sensor Surface Finish
The front surface of the Annubar primary is textured for high Reynolds number applications. The surface texture creates a more turbulent boundary layer on the front surface of the sensor. The increased turbulence produces a more predictable and repeatable separation of flow at the edge of the sensor.

Performance Statement Assumptions
Measured pipe I.D.

Functional

Service
- Liquid
- Gas
- Steam

Temperature Limits
Direct Mount Electronics
- 500°F (260 °C)

Remote Mount Electronics
- 1250 °F (677 °C) – Hastelloy
- 850 °F (454 °C) – Stainless Steel

Pressure Limits[1]

Direct Mount Electronics

- Up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).

Remote Mount Electronics

- Up to 2500# ANSI (6000 psig at 100 °F (413 bar at 38 °C)).

Installation Considerations

Drill Hole Size According to Sensor Size

Sensor Size	Diameter
1	3/4-in. (19 mm)
2	1 5/16-in. (34 mm)
3	2 1/2-in. (64 mm)

Physical

Annubar Type

- See "Model 485 Pak–Lok Annubar" on page A-26 for visual representation of the different Annubar types available

Pak-Lok (option P)

- Provided with a threaded connection rated up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C))
- Graphite Packing

Flanged with Opposite Side Support (option F)

- Provided with opposite side support, which requires a second pipe penetration

All Flanged Models

- Sensor flange is the same material as the Annubar sensor and the mounting flange is the same material as the pipe material
- Flanged mounting hardware: nuts, bolts and gaskets (constructed from the same material as the pipe material)

Flange Size According to Sensor Size

Sensor Size	Up to 600#	Up to 1500 #	Up to 2500 #
1	1 1/2-in. (38 mm) schedule 80	1 1/2-in. (38 mm) schedule 80	1 1/2-in. (38 mm) schedule XX heavy
2	2-in. (50 mm) schedule 80	2-in. (50 mm) schedule 80	2-in. (50 mm) schedule XX heavy
3	3-in. (76 mm) schedule 40	3-in. (76 mm) schedule 40	3-in. (76 mm) schedule XX heavy

(1) *Static pressure selection may effect pressure limitations.*

Annubar Type Specification Chart

Option Code	Description	Pak-Lok[(1)]	Flange-Lok	Flange	Manual and Gear Drive Flo-Tap
T1[(1)]	Threaded connection	X			X
A1	150# RF ANSI		X	X	X
A3	300# RF ANSI		X	X	X
A6	600# RF ANSI		X	X	X
A9[(2)]	900# RF ANSI			X	X
AF[(2)]	1500# RF ANSI			X	X
AT[(2)]	2500# RF ANSI			X	X
D1	DN PN 16		X	X	X
D3	DN PN 40		X	X	X
D6	DN PN 100		X	X	X
R9[(2)]	900# RTJ Flange			X	X
RF[(2)]	1500# RTJ Flange			X	X
RT[(2)]	2500# RTJ Flange			X	X

(1) Available up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).
(2) Remote mount only.

Annubar Sensor Material

- 316 Stainless Steel
- Hastelloy 276

Packing Gland

- Only required for the Flo-Tap Annubar types
- The packing gland is a wetted part and matches sensor material

Flo-Tap Packing Gland Material Temperature Limits

- Urethane: –20 to 250 °F (–29 to 121 °C)
- Graphite: –300 to 850 °F (–184 to 454 °C)

Isolation Valve

- Only required for the Flo-Tap Annubar types
- The isolation valve will carry the same pressure rating as the sensor flange and mounting flange specified in the mounting type
- Ball valves have a 300# limitation

Temperature Measurement

Integral RTD

- 100 Ohm platinum RTD
- 4-wire RTD ($\alpha = 0.00385$)

Remote RTD

- 100 Ohm platinum RTD, spring loaded with 1/2-in. NPT nipple and union
- Remote RTD material is the same as the specified pipe material

Thermowell

- 1/2-in. x 1/2-in NPT, 316 Stainless Steel with 1/2-in. Carbon Steel weld couplet

Electronic Connections for Remote Mount

$^1/_2$–14 NPT, G$^1/_2$, and M20 × 1.5 (CM20) conduit. HART interface connections fixed to terminal block for output code A

Installed in Flanged Pipe Spool Section (option code H2)

- All flanged pipe spool sections are flanged pipe sections
- The flanged pipe spool section is constructed from the same material as the pipe
- The flange rating of the flanged pipe section will be the same as the flange rating selected for the mounting type
- Consult the factory for Pak-Lok and Flo-Tap Annubar Type flanged pipe spool sections, remote temperature measurement, and ANSI ratings above 600#

Table A-8. Flange Pipe Spool Section Schedule

ANSI	Schedule
150# ANSI	40
300# ANSI	40
600# ANSI	80

Table A-9. Flange Pipe Spool Section Length

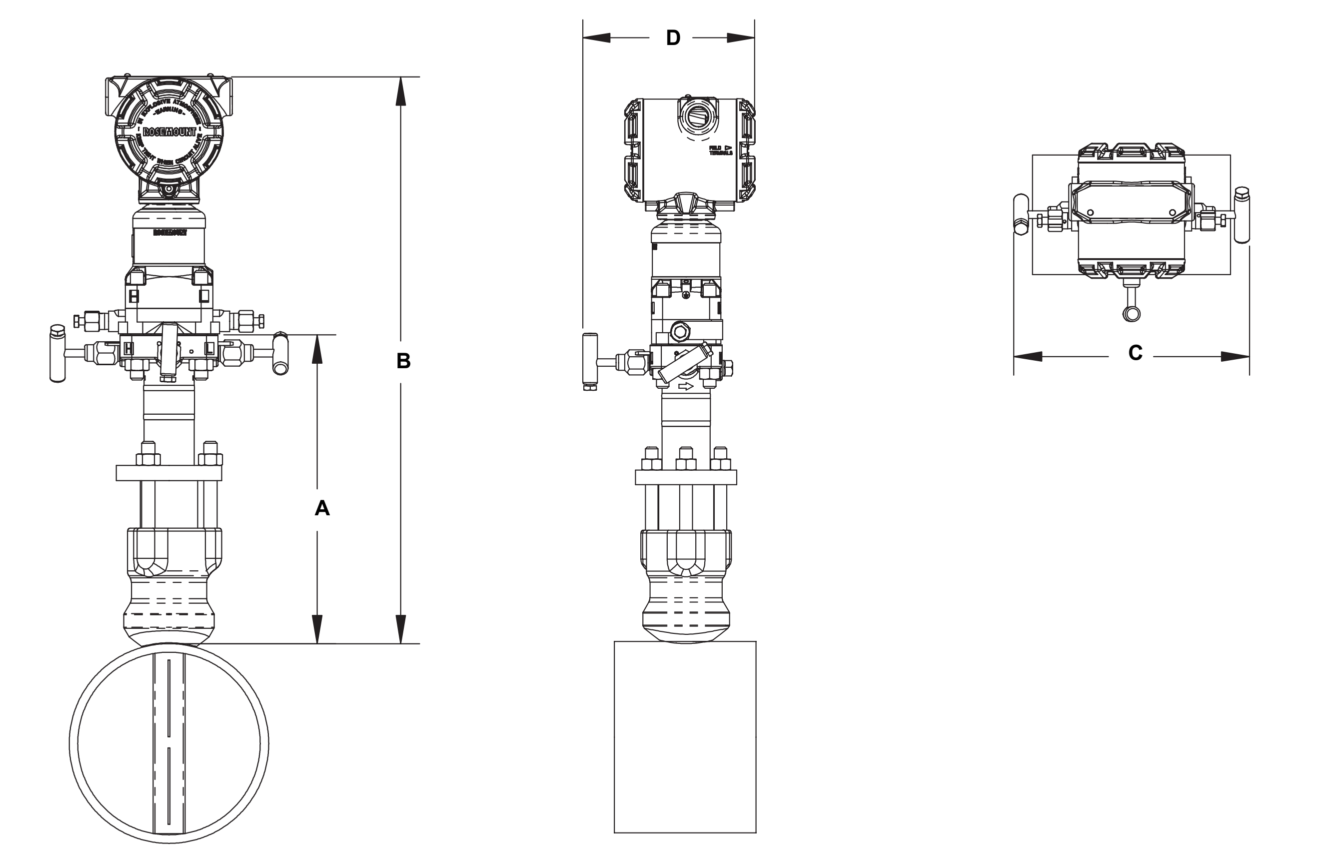
Nominal Pipe Size	Length
2-in. (50 mm)	10.52-in. (267.2 mm)
3-in. (80 mm)	11.37-in. (288.8 mm)
4-in. (100 mm)	12.74-in. (323.6 mm)
6-in. (150 mm)	14.33-in. (364.0 mm)
8-in. (200 mm)	16.58-in. (421.1 mm)

DIMENSIONAL DRAWINGS

Model 3051SFA Pak–Lok Probar

Pak-Lok ProBar Flowmeter[(1)]

Front View | **Side View** | **Top View**



(1) The Pak-Lok Annubar model is available up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).

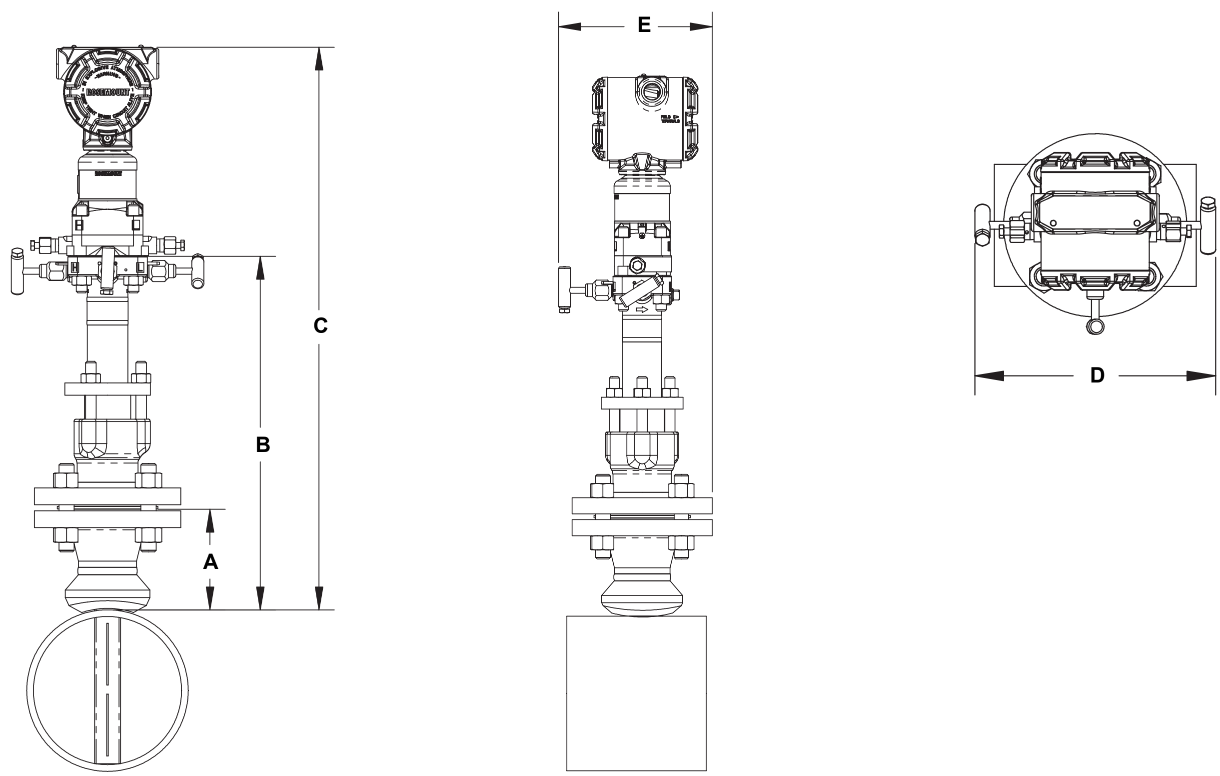
TABLE 1. Pak-Lok ProBar Flowmeter Dimensional Data

Sensor Size	A ± 0.25-in. (6.4 mm)	B (Max)	C (Max)	D (Max)
1	7.50-in. (190.5 mm)	16.03-in. (407.2 mm)	9.00-in. (228.6 mm)	6.90-in. (175.3 mm)
2	9.25-in. (235.0 mm)	17.78-in. (451.7 mm)	9.00-in. (228.6 mm)	6.90-in. (175.3 mm)
3	12.00-in. (304.8 mm)	20.53-in. (521.5 mm)	9.00-in. (228.6 mm)	6.90-in. (175.3 mm)

Model 3051SFA Flange–Lok Probar

Flange-Lok ProBar Flowmeter[(1)]

Front View	Side View	Top View



(1) *The Flange-Lok Annubar model can be direct mounted up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).*

TABLE 2. Flange-Lok ProBar Flowmeter Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B ± 0.25-in. (6.4 mm)	C (Max)	D (Max)	E (Max)
1 – 150#	3.88-in. (98.6 mm)	12.25-in. (311.2 mm)	20.80-in. (528.4 mm)	9.00-in. (228.6 mm)	6.60-in. (167.6 mm)
1 – 300#	4.13-in. (104.9 mm)	12.25-in. (311.2 mm)	20.80-in. (528.4 mm)	9.00-in. (228.6 mm)	7.15-in. (181.6 mm)
1 – 600#	4.44-in. (112.8 mm)	12.25-in. (311.2 mm)	20.80-in. (528.4 mm)	9.00-in. (228.6 mm)	7.15-in. (181.6 mm)
2 – 150#	4.13-in. (104.9 mm)	14.25-in. (362.0 mm)	22.80-in. (579.2 mm)	9.00-in. (228.6 mm)	7.10-in. (180.3 mm)
2 – 300#	4.38-in. (111.3 mm)	14.25-in (362.0 mm)	22.80-in. (579.2 mm)	9.00-in. (228.6 mm)	7.35-in. (186.7 mm)
2 – 600#	4.76-in. (120.9 mm)	14.25-in. (362.0 mm)	22.80-in. (579.2 mm)	9.00-in. (228.6 mm)	7.35-in. (186.7 mm)
3 – 150#	4.63-in. (117.6 mm)	17.50-in. (444.5 mm)	26.05-in. (661.7 mm)	9.00-in. (228.6 mm)	7.85-in. (200.0 mm)
3 – 300#	5.00-in. (127.0 mm)	17.50-in. (444.5 mm)	26.05-in. (661.7 mm)	9.00-in. (228.6 mm)	8.21-in. (208.5 mm)
3 – 600#	5.38-in. (136.7 mm)	17.50-in. (444.5 mm)	26.05-in. (661.7 mm)	9.00-in. (228.6 mm)	8.21-in. (208.5 mm)

Model 3051SFA Flange Probar

Flange ProBar Flowmeter

Front View	Side View	Top View

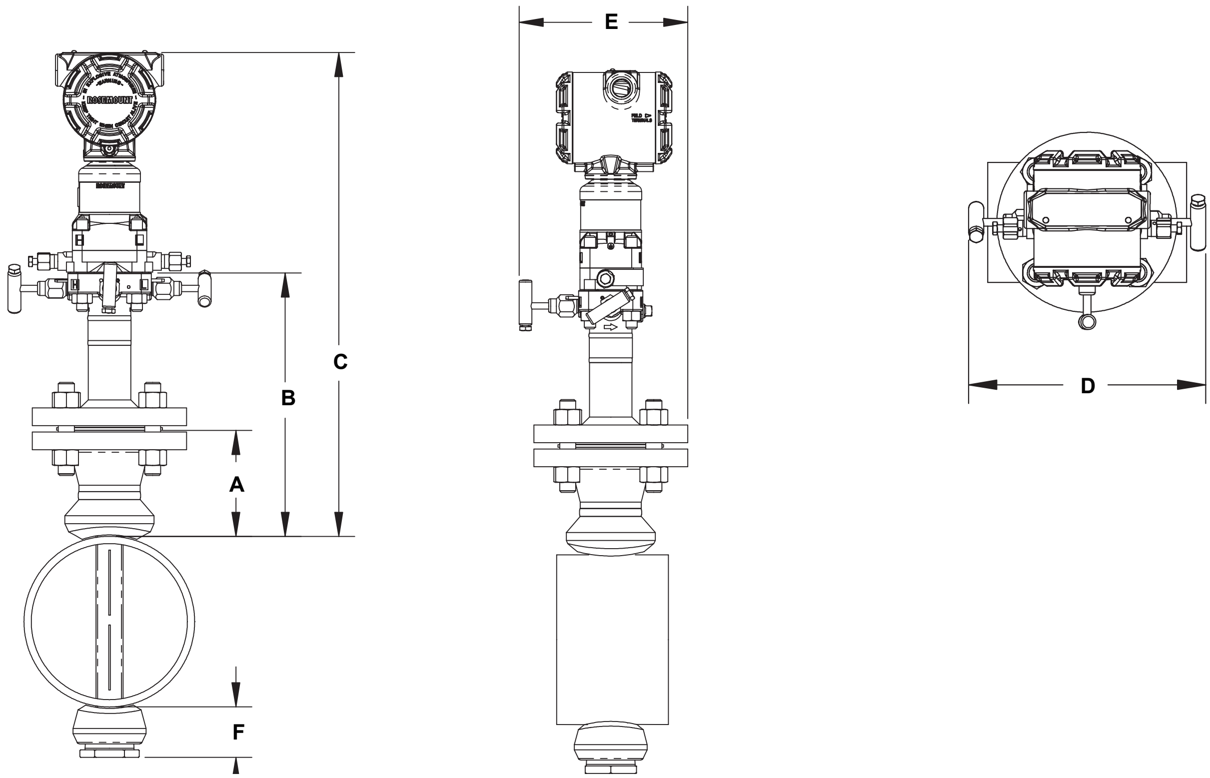


TABLE 3. Flange ProBar Flowmeter Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B (Max)	C (Max)	D (Max)	E ± 0.5-in. (12.7 mm)	F (Max)
1 – 150#	4.13-in. (104.9 mm)	10.5-in. (266.7 mm)	19.05-in. (483.9 mm)	9.00-in. (228.6 mm)	6.60-in. (167.6 mm)	2.46-in. (62.5 mm)
1 – 300#	4.13-in. (104.9 mm)	10.5-in. (266.7 mm)	19.05-in. (483.9 mm)	9.00-in. (228.6 mm)	7.15-in. (181.6 mm)	2.46-in. (62.5 mm)
1 – 600#	4.44-in. (112.8 mm)	10.5-in. (266.7 mm)	19.05-in. (483.9 mm)	9.00-in. (228.6 mm)	7.15-in. (181.6 mm)	2.46-in. (62.5 mm)
2 – 150#	4.13-in. (104.9 mm)	11.00-in. (279.4 mm)	19.55-in. (496.6 mm)	9.00-in. (228.6 mm)	7.10-in. (180.3 mm)	2.76-in. (70.1 mm)
2 – 300#	4.38-in. (111.3 mm)	11.00-in (279.4 mm)	19.55-in. (496.6 mm)	9.00-in. (228.6 mm)	7.35-in. (186.7 mm)	2.76-in. (70.1 mm)
2 – 600#	4.76-in. (120.9 mm)	11.00-in. (279.4 mm)	19.55-in. (496.6 mm)	9.00-in. (228.6 mm)	7.35-in. (186.7 mm)	2.76-in. (70.1 mm)
3 – 150#	4.63-in. (117.6 mm)	13.50-in. (342.9 mm)	22.05-in. (560.1 mm)	9.00-in. (228.6 mm)	7.85-in. (200.0 mm)	3.88-in. (98.6 mm)
3 – 300#	5.00-in. (127.0 mm)	13.50-in. (342.9 mm)	22.05-in. (560.1 mm)	9.00-in. (228.6 mm)	8.21-in. (208.5 mm)	3.88-in. (98.6 mm)
3 – 600#	5.38-in. (136.7 mm)	13.50-in. (342.9 mm)	22.05-in. (560.1 mm)	9.00-in. (228.6 mm)	8.21-in. (208.5 mm)	3.88-in. (98.6 mm)

Model 3051SFA Flange Flo–Tap Probar

Flange Flo-Tap ProBar Flowmeter

Front View | **Side View** | **Top View**

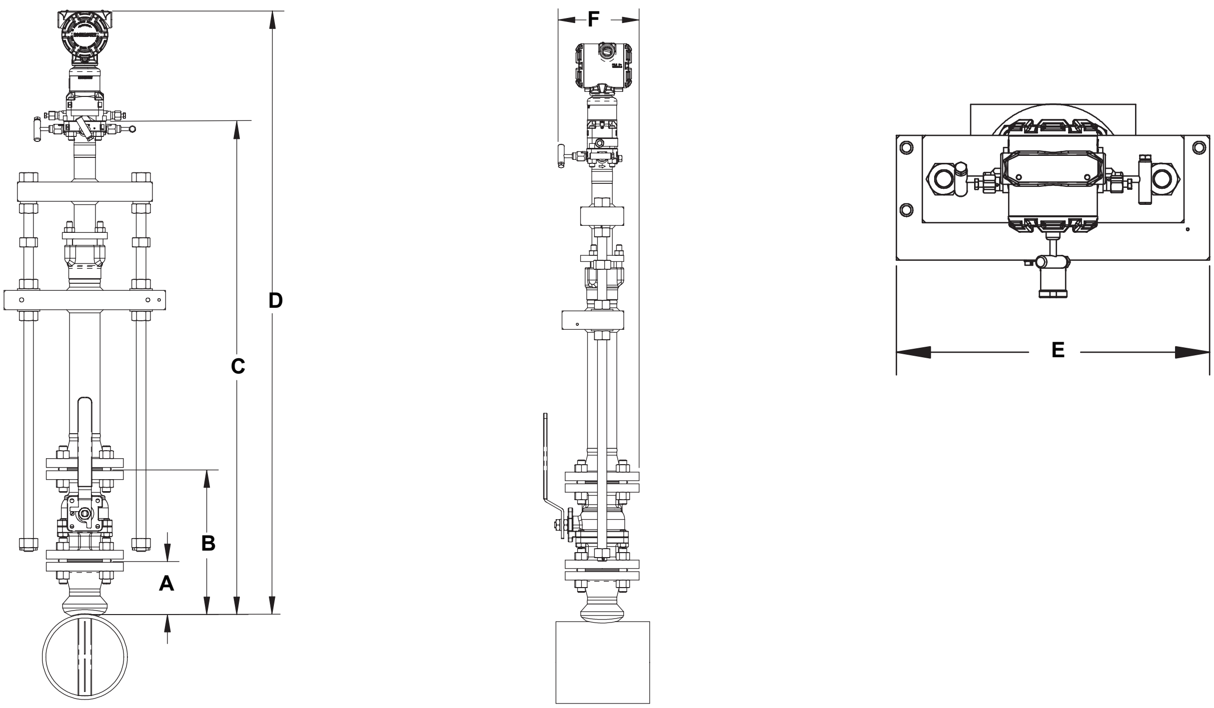


TABLE 4. Flange Flo-Tap ProBar Flowmeter Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B ± 0.25-in. (6.4 mm)	C (Max)		D (Max)	E (Max)	F (Max)
			Use formulas below to determine C value				
1 – 150#	4.13-in. (104.9 mm)	10.50-in. (266.7 mm)				10.00-in. (254.0 mm)	6.60-in. (167.6 mm)
1 – 300#	4.13-in. (104.9 mm)	11.75-in. (298.5 mm)	*Manual Drive (C^1):* 20-in. (508 mm)	*Gear Drive (C^1):* 25.5-in. (648 mm)	D = C + 8.53	10.00-in. (254.0 mm)	7.15-in. (181.6 mm)
1 – 600#	4.44-in. (112.8 mm)	14.06-in. (357.2 mm)				10.00-in. (254.0 mm)	7.15-in. (181.6 mm)
2 – 150#	4.13-in. (104.9 mm)	11.25-in. (285.8 mm)				12.56-in. (319.0 mm)	7.10-in. (180.3 mm)
2 – 300#	4.38-in. (111.3 mm)	13.00-in (330.2 mm)	*Manual Drive (C^1):* 23.0-in. (584 mm)	*Gear Drive (C^1):* 27.5-in. (699 mm)	D = C + 8.53	12.56-in. (319.0 mm)	7.35-in. (186.7 mm)
2 – 600#	4.76-in. (120.904 mm)	16.38-in. (416.0 mm)				12.56-in. (319.0 mm)	7.35-in. (186.7 mm)
3 – 150#	4.63-in. (117.6 mm)	12.75-in. (323.9 mm)				13.63-in. (346.2 mm)	7.85-in. (200.0 mm)
3 – 300#	5.00-in. (127.0 mm)	16.25-in. (412.8 mm)	*Manual Drive (C^1):* 25.5-in. (648 mm)	*Gear Drive (C^1):* 29.5-in. (749 mm)	D = C + 8.53	13.63-in. (346.2 mm)	8.21-in. (208.5 mm)
3 – 600#	5.38-in. (136.7 mm)	19.50-in. (495.4 mm)				13.63-in. (346.2 mm)	8.21-in. (208.5 mm)

Use the appropriate formula to determine C value:
Inserted formula: Pipe I.D. + Wall Thickness + Value B + C^1 (use the Manual Drive or Gear drive values for C^1)
Retracted formula: [2 x (Pipe I.D. + Wall Thickness + Value B)] + C^1 (use the Manual Drive or Gear drive values for C^1)

Model 3051SFA Threaded Flo–Tap Probar

Threaded Flo-Tap ProBar Flowmeter

Front View **Side View** **Top View**

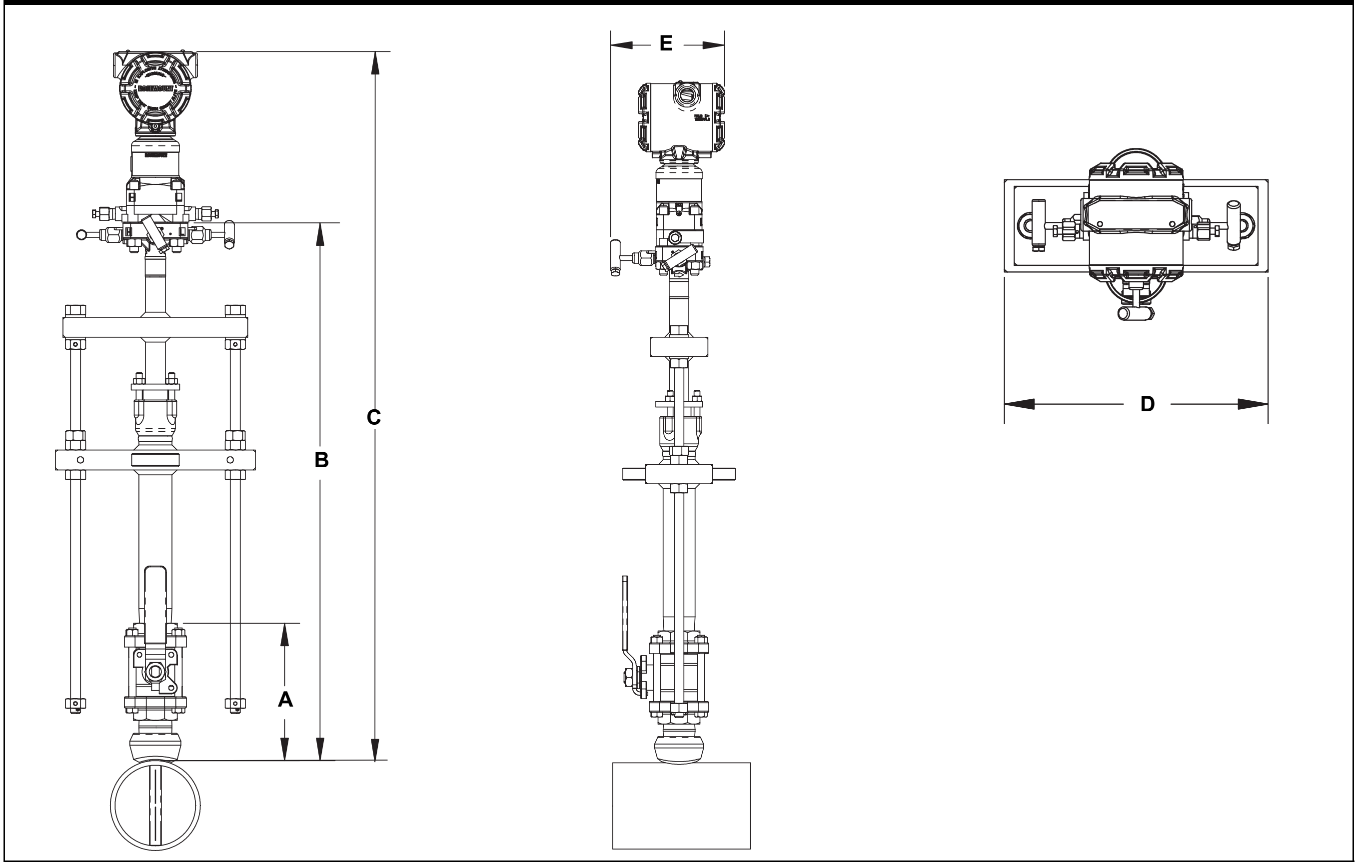


TABLE 5. Threaded Flo-Tap ProBar Flowmeter Dimensional Data

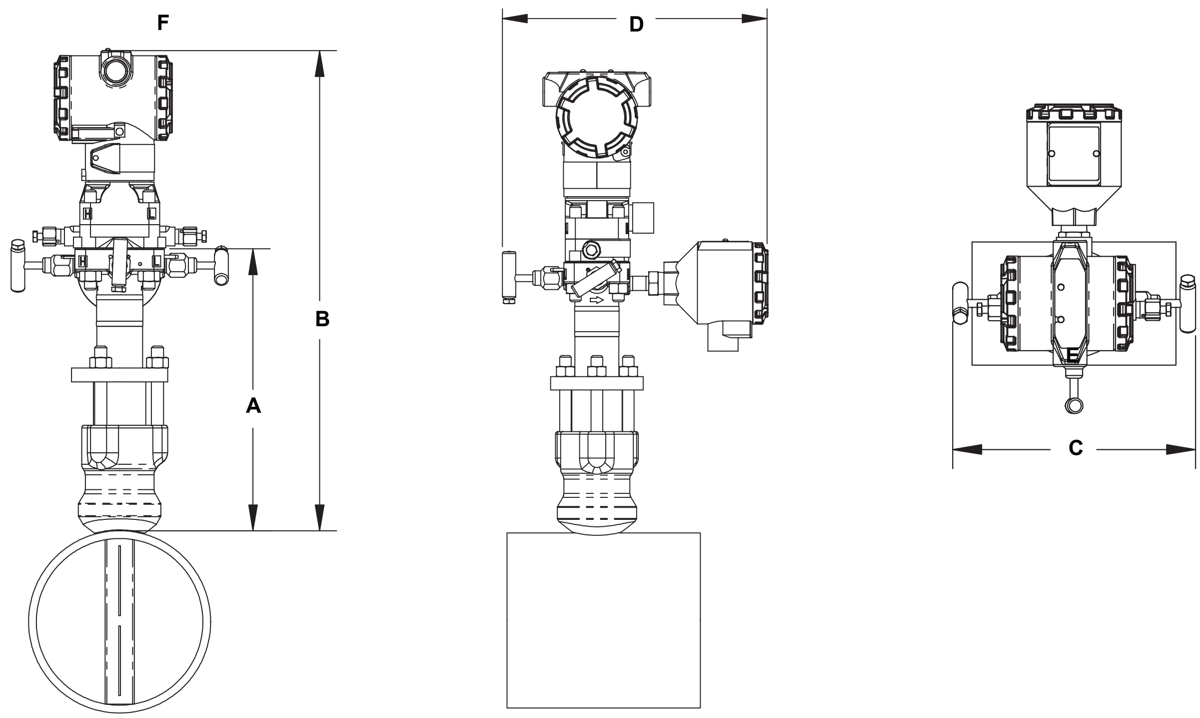
Sensor Size	A ± 0.25-in. (6.4 mm)	B (Max)		C (Max)	D (Max)	E (Max)
		Use formulas below to determine B value				
1	6.71-in. (170.5 mm)	*Manual Drive (B[1]):* 20-in. (508 mm)	*Gear Drive (B[1]):* 25.5-in. (648 mm)	C = B + 8.53	10.00-in. (254.0 mm)	6.90-in. (175.3 mm)
2	8.11-in. (206.0 mm)	*Manual Drive (B[1]):* 23.0-in. (584 mm)	*Gear Drive (B[1]):* 27.5-in. (699 mm)	C = B + 8.53	12.56-in. (319.0 mm)	6.90-in. (175.3 mm)
Sensor Size 3 is not available in a Threaded Flo-Tap.						

Use the appropriate formula to determine C value:
Inserted formula: Pipe I.D. + Wall Thickness + Value A + B[1] (use the Manual Drive or Gear drive values for B[1])
Retracted formula: [2 x (Pipe I.D. + Wall Thickness + Value A)] + B[1] (use the Manual Drive or Gear drive values for B[1])

Model 3095MFA Pak–Lok Mass ProBar

Pak-Lok Mass ProBar Flowmeter(1)

Front View	Side View	Top View



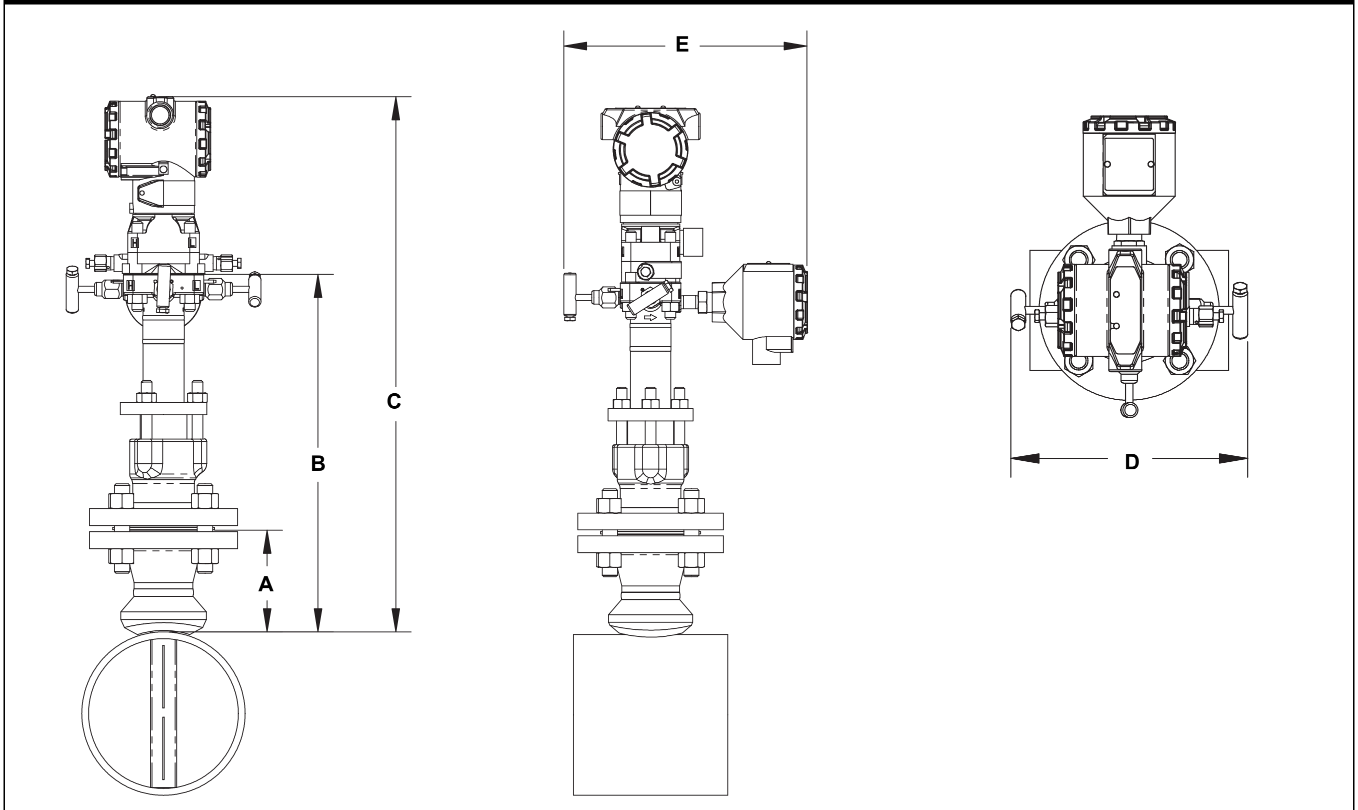
(1) The Pak-Lok Annubar model is available up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).

TABLE 6. Pak-Lok Mass ProBar Flowmeter Dimensional Data

Sensor Size	A ± 0.25-in. (6.4 mm)	B (Max)	C (Max)	D (Max)
1	7.50-in. (190.5 mm)	14.60-in. (370.9 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
2	9.25-in. (235.0 mm)	16.35-in. (415.3 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
3	12.00-in. (304.8 mm)	19.10-in. (485.2 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)

Model 3095MFA Flange–Lok Mass ProBar

Flange-Lok Mass ProBar Flowmeter(1)



(1) The Flange-Lok Annubar model can be direct mounted up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).

TABLE 7. Flange-Lok Mass ProBar Flowmeter Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B ± 0.25-in. (6.4 mm)	C (Max)	D (Max)	E (Max)
1 – 150#	3.88-in. (98.6 mm)	12.25-in. (311.2 mm)	19.35-in. (491.5 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
1 – 300#	4.13-in. (104.9 mm)	12.25-in. (311.2 mm)	19.35-in. (491.5 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
1 – 600#	4.44-in. (112.8 mm)	12.25-in. (311.2 mm)	19.35-in. (491.5 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
2 – 150#	4.13-in. (104.9 mm)	14.25-in. (362.0 mm)	21.35-in. (542.3 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
2 – 300#	4.38-in. (111.3 mm)	14.25-in (362.0 mm)	21.35-in. (542.3 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
2 – 600#	4.76-in. (120.9 mm)	14.25-in. (362.0 mm)	21.35-in. (542.3 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
3 – 150#	4.63-in. (117.6 mm)	17.50-in. (444.5 mm)	24.60-in. (626.4 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
3 – 300#	5.00-in. (127.0 mm)	17.50-in. (444.5 mm)	24.60-in. (626.4 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)
3 – 600#	5.38-in. (136.7 mm)	17.50-in. (444.5 mm)	24.60-in. (624.8 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)

Model 3095MFA Flange Mass ProBar

Flange Mass ProBar Flowmeter

Front View | Side View | Top View

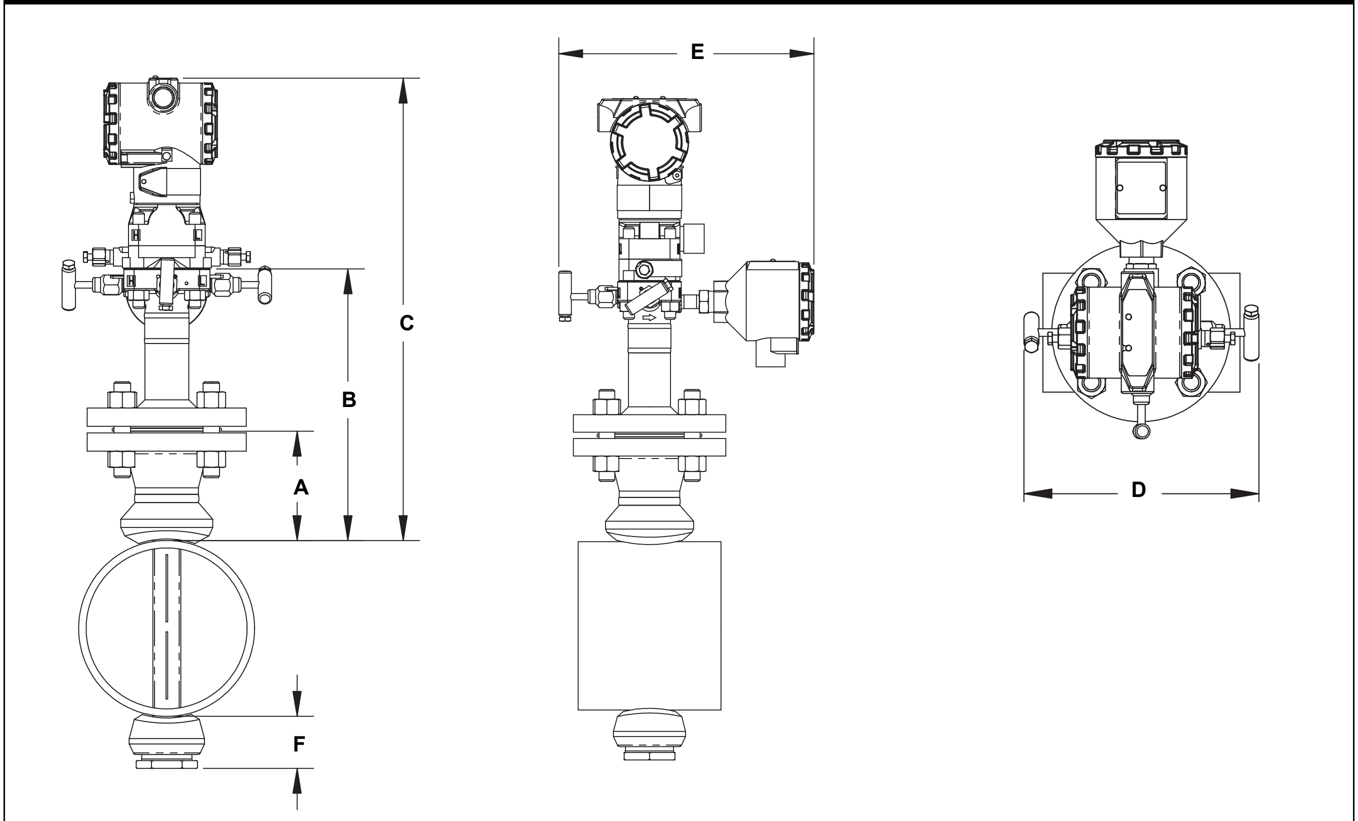


TABLE 8. Flange Mass ProBar Flowmeter Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B (Max)	C (Max)	D (Max)	E (Max)	F (Max)
1 – 150#	4.13-in. (104.9 mm)	10.5-in. (266.7 mm)	17.60-in. (447.1 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	2.46-in. (62.5 mm)
1 – 300#	4.13-in. (104.9 mm)	10.5-in. (266.7 mm)	17.60in. (447.1 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	2.46-in. (62.5 mm)
1 – 600#	4.44-in. (112.8 mm)	10.5-in. (266.7 mm)	17.60-in. (447.1 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	2.46-in. (62.5 mm)
2 – 150#	4.13-in. (104.9 mm)	11.00-in. (279.4 mm)	18.10-in. (459.8 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	2.76-in. (70.1 mm)
2 – 300#	4.38-in. (111.3 mm)	11.00-in (279.4 mm)	18.10-in. (459.8 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	2.76-in. (70.1 mm)
2 – 600#	4.76-in. (120.9 mm)	11.00-in. (279.4 mm)	18.10-in. (459.8 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	2.76-in. (70.1 mm)
3 – 150#	4.63-in. (117.6 mm)	13.50-in. (342.9 mm)	20.60-in. (523.3 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	3.88-in. (98.6 mm)
3 – 300#	5.00-in. (127.0 mm)	13.50-in. (342.9 mm)	20.60-in. 523.3 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	3.88-in. (98.6 mm)
3 – 600#	5.38-in. (136.7 mm)	13.50-in. (342.9 mm)	20.60-in. (523.3 mm)	9.00-in. (228.6 mm)	11.25-in. (285.8 mm)	3.88-in. (98.6 mm)

Model 3095MFA Flange Flo–Tap Mass ProBar

Flange Flo-Tap Mass ProBar Flowmeter

Front View | **Side View** | **Top View**

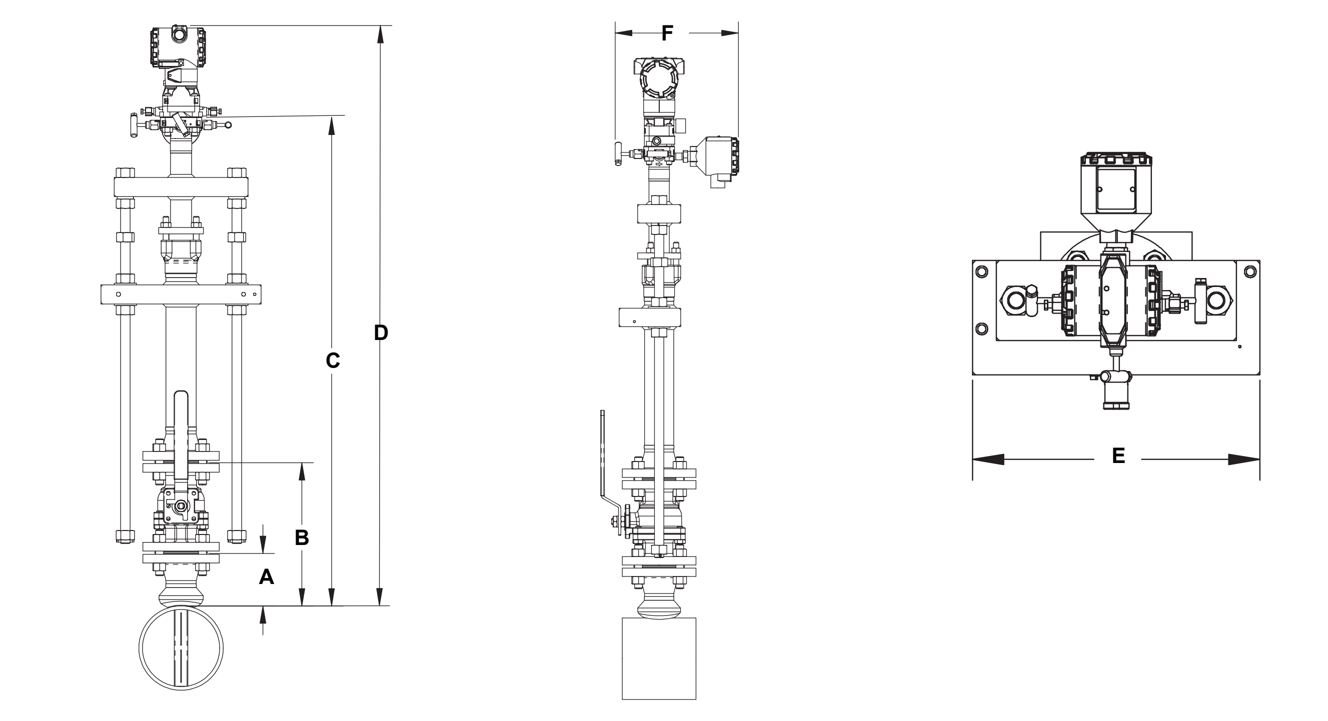


TABLE 9. Flange Flo-Tap Mass ProBar Flowmeter Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B ± 0.25-in. (6.4 mm)	C (Max)		D (Max)	E (Max)	F (Max)
			Use formulas below to determine C value				
1 – 150#	4.13-in. (104.9 mm)	10.50-in. (266.7 mm)				10.00-in. (254.0 mm)	11.25-in. (285.8 mm)
1 – 300#	4.13-in. (104.9 mm)	11.75-in. (298.5 mm)	*Manual Drive (C[1]):* 20-in. (508 mm)	*Gear Drive (C[1]):* 25.5-in. (648 mm)	D = C + 7.1	10.00-in. (254.0 mm)	11.25-in. (285.8 mm)
1 – 600#	4.44-in. (112.8 mm)	14.06-in. (357.2 mm)				10.00-in. (254.0 mm)	11.25-in. (285.8 mm)
2 – 150#	4.13-in. (104.9 mm)	11.25-in. (285.8 mm)				12.56-in. (319.0 mm)	11.25-in. (285.8 mm)
2 – 300#	4.38-in. (111.3 mm)	13.00-in (330.2 mm)	*Manual Drive (C[1]):* 23.0-in. (584 mm)	*Gear Drive (C[1]):* 27.5-in. (699 mm)	D = C + 7.1	12.56-in. (319.0 mm)	11.25-in. (285.8 mm)
2 – 600#	4.76-in. (120.9 mm)	16.38-in. (416.0 mm)				12.56-in. (319.0 mm)	11.25-in. (285.8 mm)
3 – 150#	4.63-in. (117.6 mm)	12.75-in. (323.9 mm)				13.63-in. (346.2 mm)	11.25-in. (285.8 mm)
3 – 300#	5.00-in. (127.0 mm)	16.25-in. (412.8 mm)	*Manual Drive (C[1]):* 25.5-in. (648 mm)	*Gear Drive (C[1]):* 29.5-in. (749 mm)	D = C + 7.1	13.63-in. (346.2 mm)	11.25-in. (285.8 mm)
3 – 600#	5.38-in. (136.7 mm)	19.50-in. (495.4 mm)				13.63-in. (346.2 mm)	11.25-in. (285.8 mm)

Use the appropriate formula to determine C value:
Inserted formula: Pipe I.D. + Wall Thickness + Value B + C^1 (use the Manual Drive or Gear drive values for C^1)
Retracted formula: [2 x (Pipe I.D. + Wall Thickness + Value B)] + C^1 (use the Manual Drive or Gear drive values for C^1)

Model 3095MFA Threaded Flo–Tap Mass ProBar

Threaded Flo-Tap Mass ProBar Flowmeter

Front View	Side View	Top View

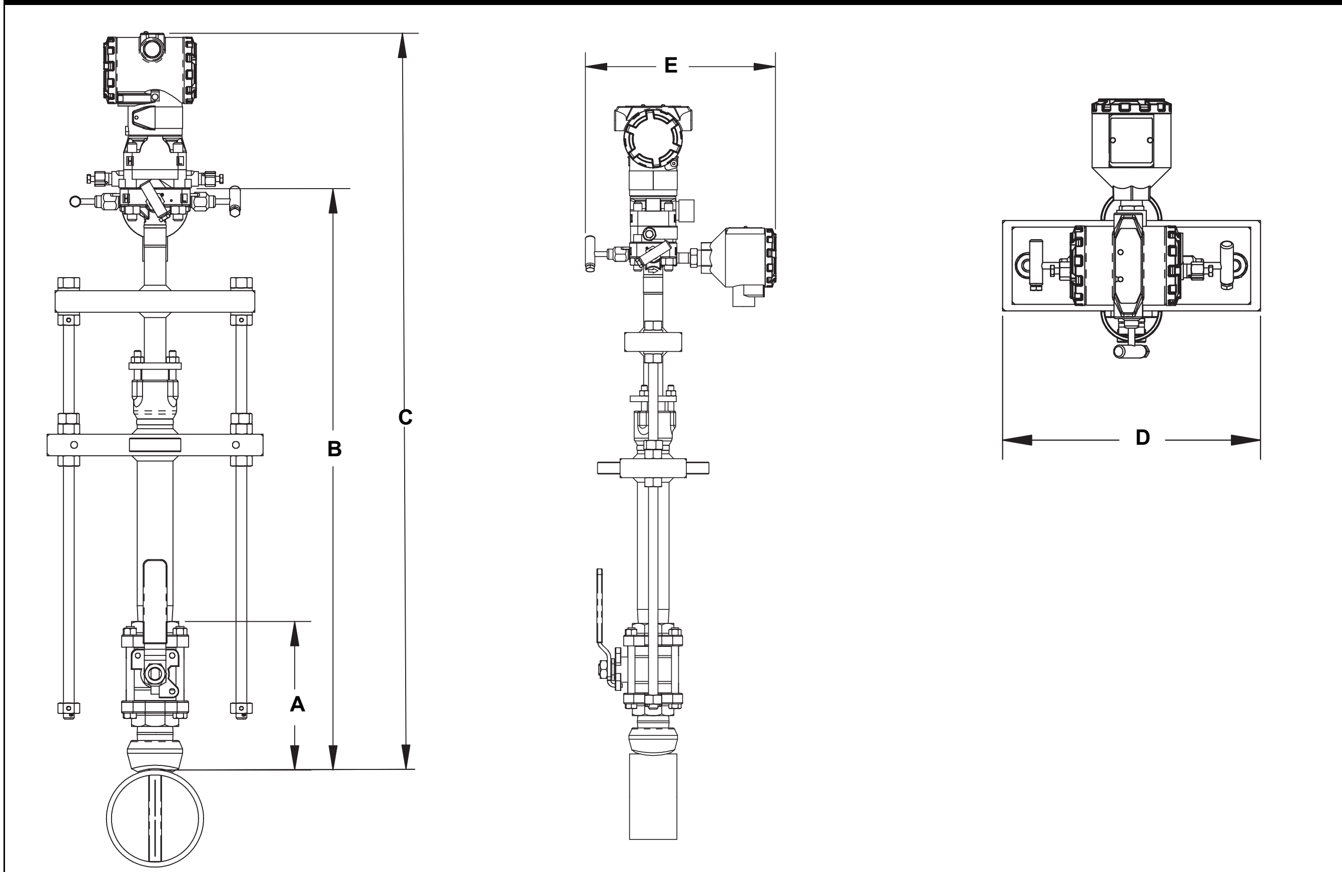


TABLE 10. Threaded Flo-Tap Mass ProBar Flowmeter Dimensional Data

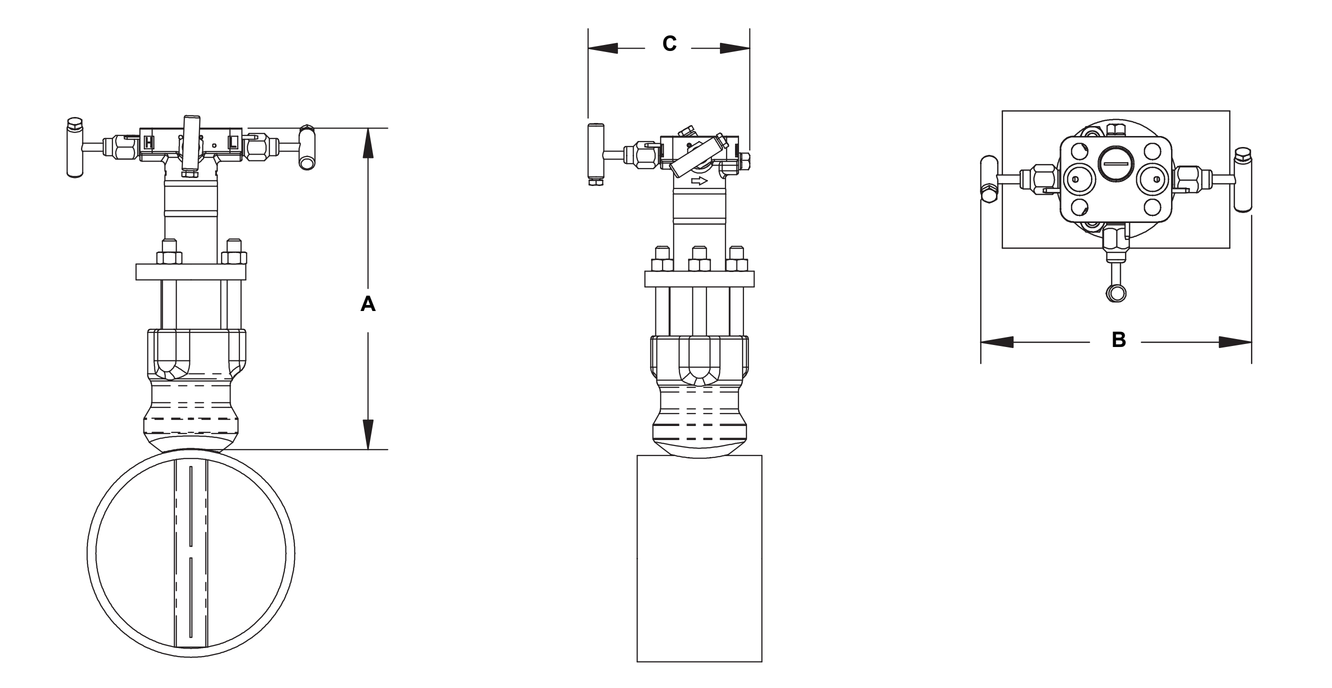
Sensor Size	A ± 0.25 -in. (6.4 mm)	B (Max)		C (Max)	D (Max)	E (Max)
		Use formulas below to determine B value				
1	6.71-in. (170.5 mm)	*Manual Drive (B[1]):* 20-in. (508 mm)	*Gear Drive (B[1]):* 25.5-in. (648 mm)	C = B + 7.1	10.00-in. (254.0 mm)	11.25-in. (285.8 mm)
2	8.11-in. (206.0 mm)	*Manual Drive (B[1]):* 23.0-in. (584 mm)	*Gear Drive (B[1]):* 27.5-in. (699 mm)	C = B + 7.1	12.56-in. (319.0 mm)	11.25-in. (285.8 mm)
Sensor Size 3 is not available in a Threaded Flo-Tap.						

Use the appropriate formula to determine C value:
Inserted formula: Pipe I.D. + Wall Thickness + Value A + B[1] (use the Manual Drive or Gear drive values for B[1])
Retracted formula: [2 x (Pipe I.D. + Wall Thickness + Value A)] + B[1] (use the Manual Drive or Gear drive values for B[1])

Model 485 Pak–Lok Annubar

Pak-Lok Model 485 Annubar Primary(1)

Front View	Side View	Top View



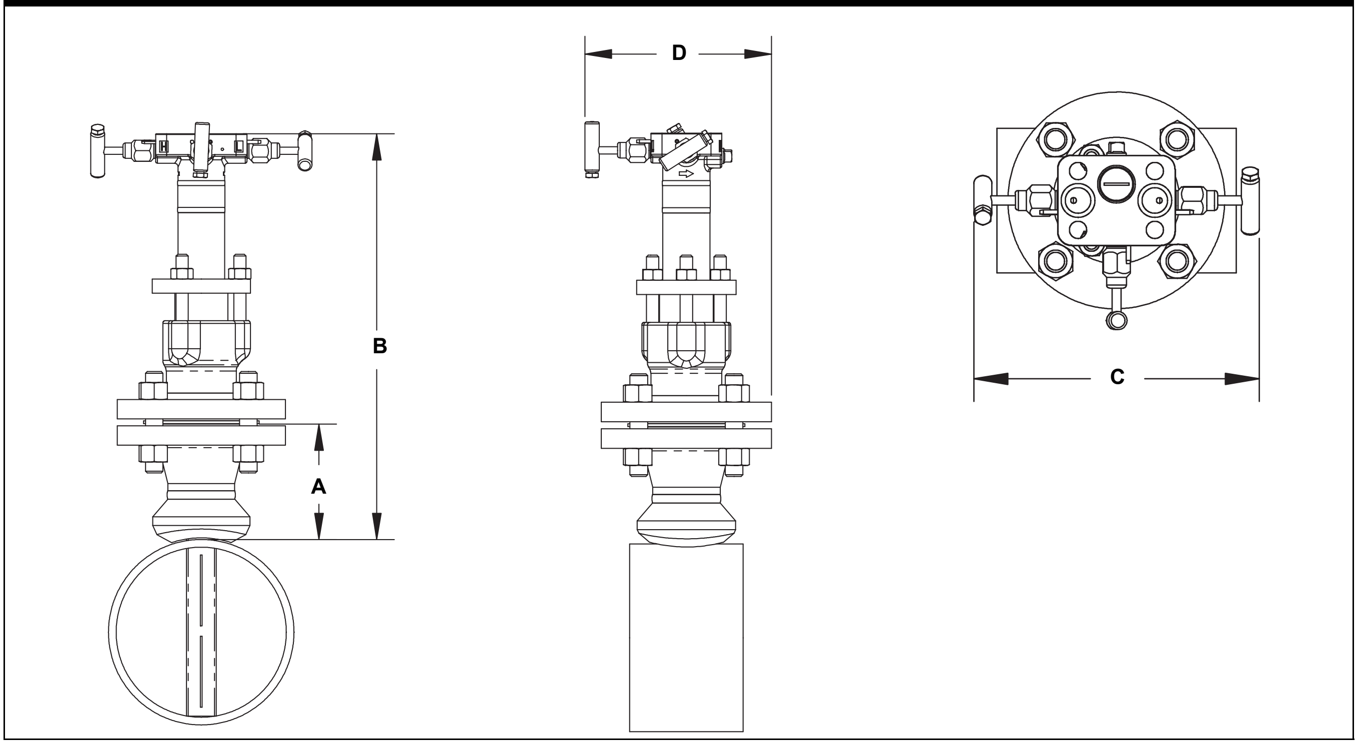
(1) The Pak-Lok Annubar model is available up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).

TABLE 11. Pak-Lok Model 485 Annubar Primary Dimensional Data

Sensor Size	A ± 0.25-in. (6.4 mm)	B (Max)	C (Max)
1	7.50-in. (190.5 mm)	9.00-in. (228.6 mm)	5.70-in. (144.8 mm)
2	9.25-in. (235.0 mm)	9.00-in. (228.6 mm)	5.70-in. (144.8 mm)
3	12.00-in. (304.8 mm)	9.00-in. (228.6 mm)	5.70-in. (144.8 mm)

Model 485 Flange–Lok Annubar

Flange-Lok Model 485 Annubar Primary(1)



(1) The Flange-Lok Annubar model can be direct mounted up to 600# ANSI (1440 psig at 100 °F (99 bar at 38 °C)).

TABLE 12. Flange-Lok Model 485 Annubar Primary Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B ± 0.25-in. (6.4 mm)	C (Max)	D (Max)
1 – 150#	3.88-in. (98.6 mm)	12.25-in. (311.2 mm)	9.00-in. (228.6 mm)	6.60-in. (167.6 mm)
1 – 300#	4.13-in. (104.9 mm)	12.25-in. (311.2 mm)	9.00-in. (228.6 mm)	7.15-in. (181.6 mm)
1 – 600#	4.44-in. (112.8 mm)	12.25-in. (311.2 mm)	9.00-in. (228.6 mm)	7.15-in. (181.6 mm)
2 – 150#	4.13-in. (104.9 mm)	14.25-in. (362.0 mm)	9.00-in. (228.6 mm)	7.10-in. (180.3 mm)
2 – 300#	4.38-in. (111.3 mm)	14.25-in (362.0 mm)	9.00-in. (228.6 mm)	7.35-in. (186.7 mm)
2 – 600#	4.76-in. (120.9 mm)	14.25-in. (362.0 mm)	9.00-in. (228.6 mm)	7.35-in. (186.7 mm)
3 – 150#	4.63-in. (117.6 mm)	17.50-in. (444.5 mm)	9.00-in. (228.6 mm)	7.85-in. (200.0 mm)
3 – 300#	5.00-in. (127.0 mm)	17.50-in. (444.5 mm)	9.00-in. (228.6 mm)	8.21-in. (208.5 mm)
3 – 600#	5.38-in. (136.7 mm)	17.50-in. (444.5 mm)	9.00-in. (228.6 mm)	8.21-in. (208.5 mm)

Model 485 Flange Annubar

Flange Model 485 Annubar Primary

Front View	Side View	Top View

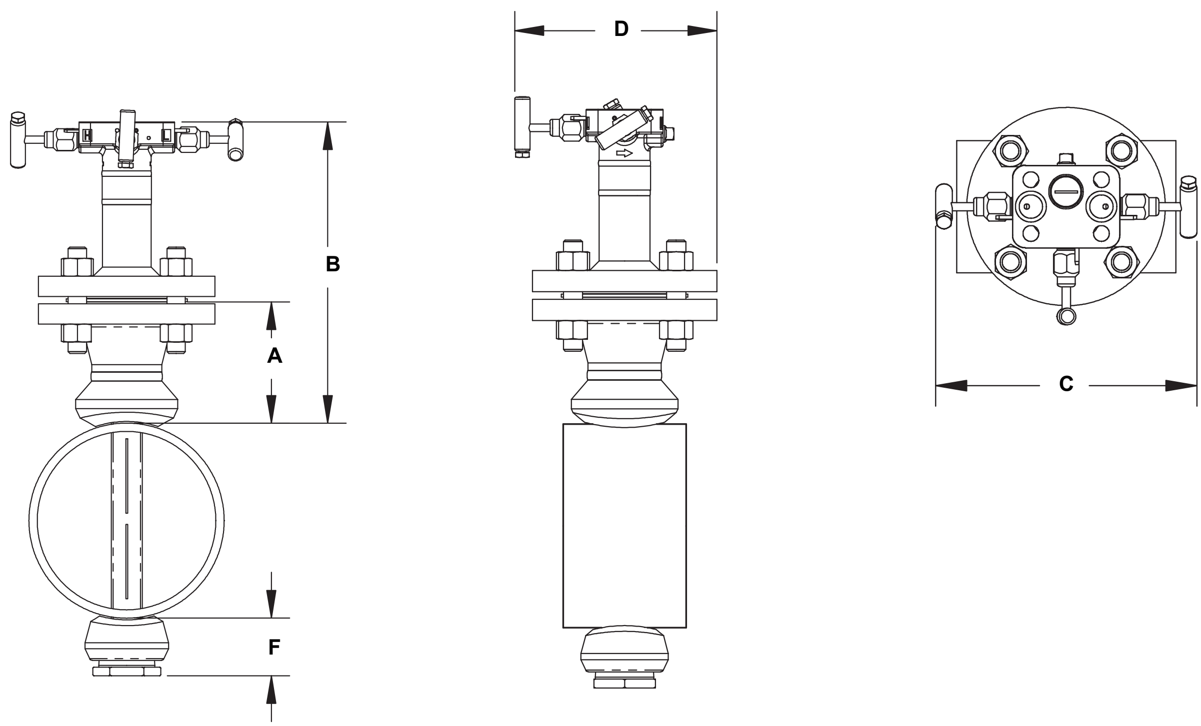


TABLE 13. Flange Model 485 Annubar Primary Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B (Max)	C (Max)	D ± 0.5-in. (12.7 mm)	F (Max)
1 – 150#	4.13-in. (104.9 mm)	10.5-in. (266.7 mm)	9.00-in. (228.6 mm)	6.60-in. (167.6 mm)	2.46-in. (62.5 mm)
1 – 300#	4.13-in. (104.9 mm)	10.5-in. (266.7 mm)	9.00-in. (228.6 mm)	7.15-in. (181.6 mm)	2.46-in. (62.5 mm)
1 – 600#	4.44-in. (112.8 mm)	10.5-in. (266.7 mm)	9.00-in. (228.6 mm)	7.15-in. (181.6 mm)	2.46-in. (62.5 mm)
2 – 150#	4.13-in. (104.9 mm)	11.00-in. (279.4 mm)	9.00-in. (228.6 mm)	7.10-in. (180.3 mm)	2.76-in. (70.1 mm)
2 – 300#	4.38-in. (111.3 mm)	11.00-in (279.4 mm)	9.00-in. (228.6 mm)	7.35-in. (186.7 mm)	2.76-in. (70.1 mm)
2 – 600#	4.76-in. (120.9 mm)	11.00-in. (279.4 mm)	9.00-in. (228.6 mm)	7.35-in. (186.7 mm)	2.76-in. (70.1 mm)
3 – 150#	4.63-in. (117.6 mm)	13.50-in. (342.9 mm)	9.00-in. (228.6 mm)	7.85-in. (200.0 mm)	3.88-in. (98.6 mm)
3 – 300#	5.00-in. (127.0 mm)	13.50-in. (342.9 mm)	9.00-in. (228.6 mm)	8.21-in. (208.5 mm)	3.88-in. (98.6 mm)
3 – 600#	5.38-in. (136.7 mm)	13.50-in. (342.9 mm)	9.00-in. (228.6 mm)	8.21-in. (208.5 mm)	3.88-in. (98.6 mm)

Model 485 Flange Flo–Tap Annubar

Flange Flo-Tap Model 485 Annubar Primary

Front View | **Side View** | **Manifold**

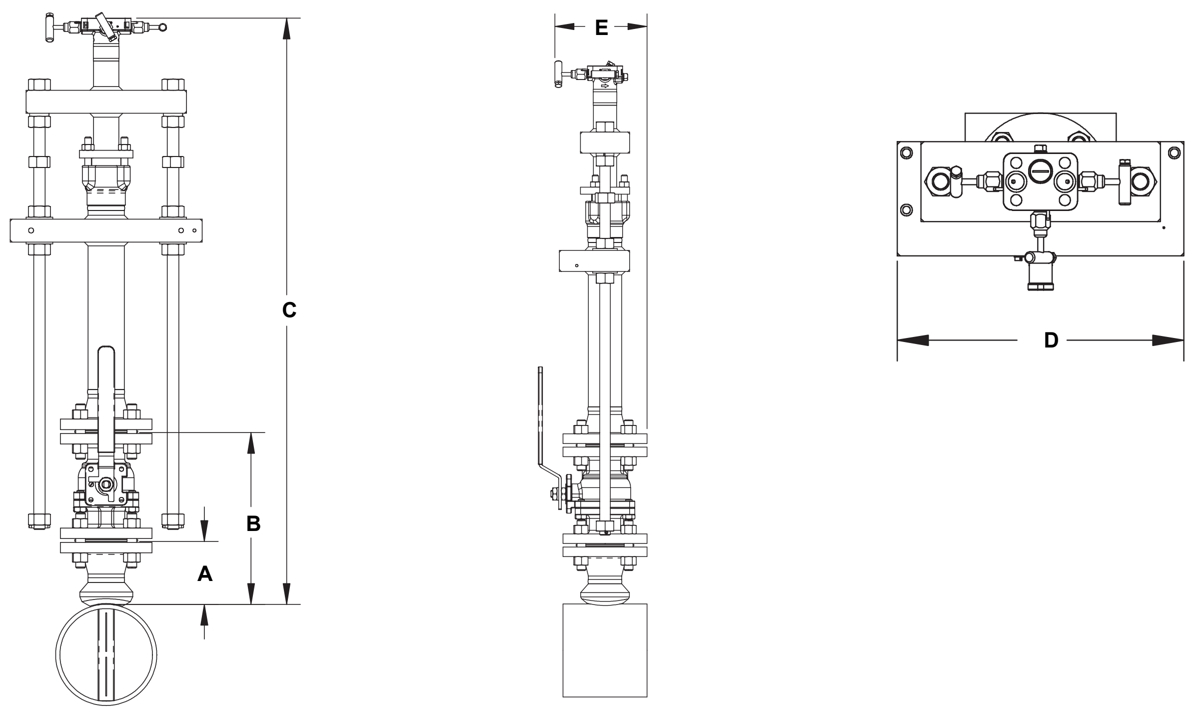


TABLE 14. Flanged Flo-Tap Model 485 Annubar Primary Dimensional Data

Sensor Size – Flange Rating	A ± 0.125-in. (3.2 mm)	B ± 0.25-in. (6.4 mm)	C (Max)		D (Max)	E (Max)
			Use formulas below to determine C value			
1 – 150#	4.13-in. (104.9 mm)	10.50-in. (266.7 mm)			10.00-in. (254.0 mm)	6.60-in. (167.6 mm)
1 – 300#	4.13-in. (104.9 mm)	11.75-in. (298.5 mm)	*Manual Drive (C^1):* 20-in. (508 mm)	*Gear Drive (C^1):* 25.5-in. (648 mm)	10.00-in. (254.0 mm)	7.15-in. (181.6 mm)
1 – 600#	4.44-in. (112.8 mm)	14.06-in. (357.2 mm)			10.00-in. (254.0 mm)	7.15-in. (181.6 mm)
2 – 150#	4.13-in. (104.9 mm)	11.25-in. (285.8 mm)			12.56-in. (319.0 mm)	7.10-in. (180.3 mm)
2 – 300#	4.38-in. (111.3 mm)	13.00-in (330.2 mm)	*Manual Drive (C^1):* 23.0-in. (584 mm)	*Gear Drive (C^1):* 27.5-in. (699 mm)	12.56-in. (319.0 mm)	7.35-in. (186.7 mm)
2 – 600#	4.76-in. (120.9 mm)	16.38-in. (416.0 mm)			12.56-in. (319.0 mm)	7.35-in. (186.7 mm)
3 – 150#	4.63-in. (117.6 mm)	12.75-in. (323.9 mm)			13.63-in.(346.2 mm)	7.85-in. (200.0 mm)
3 – 300#	5.00-in. (127.0 mm)	16.25-in. (412.8 mm)	*Manual Drive (C^1):* 25.5-in. (648 mm)	*Gear Drive (C^1):* 29.5-in. (749 mm)	13.63-in. (346.2 mm)	8.21-in. (208.5 mm)
3 – 600#	5.38-in. (136.7 mm)	19.50-in. (495.4 mm)			13.63-in. (346.2 mm)	8.21-in. (208.5 mm)

Use the appropriate formula to determine C value:
Inserted formula: Pipe I.D. + Wall Thickness + Value B + C^1 (use the Manual Drive or Gear drive values for C^1)
Retracted formula: [2 x (Pipe I.D. + Wall Thickness + Value B)] + C^1 (use the Manual Drive or Gear drive values for C^1)

Model 485 Threaded Flo–Tap Annubar

Threaded Flo-Tap Model 485 Annubar Primary

Front View | **Side View** | **Top View**

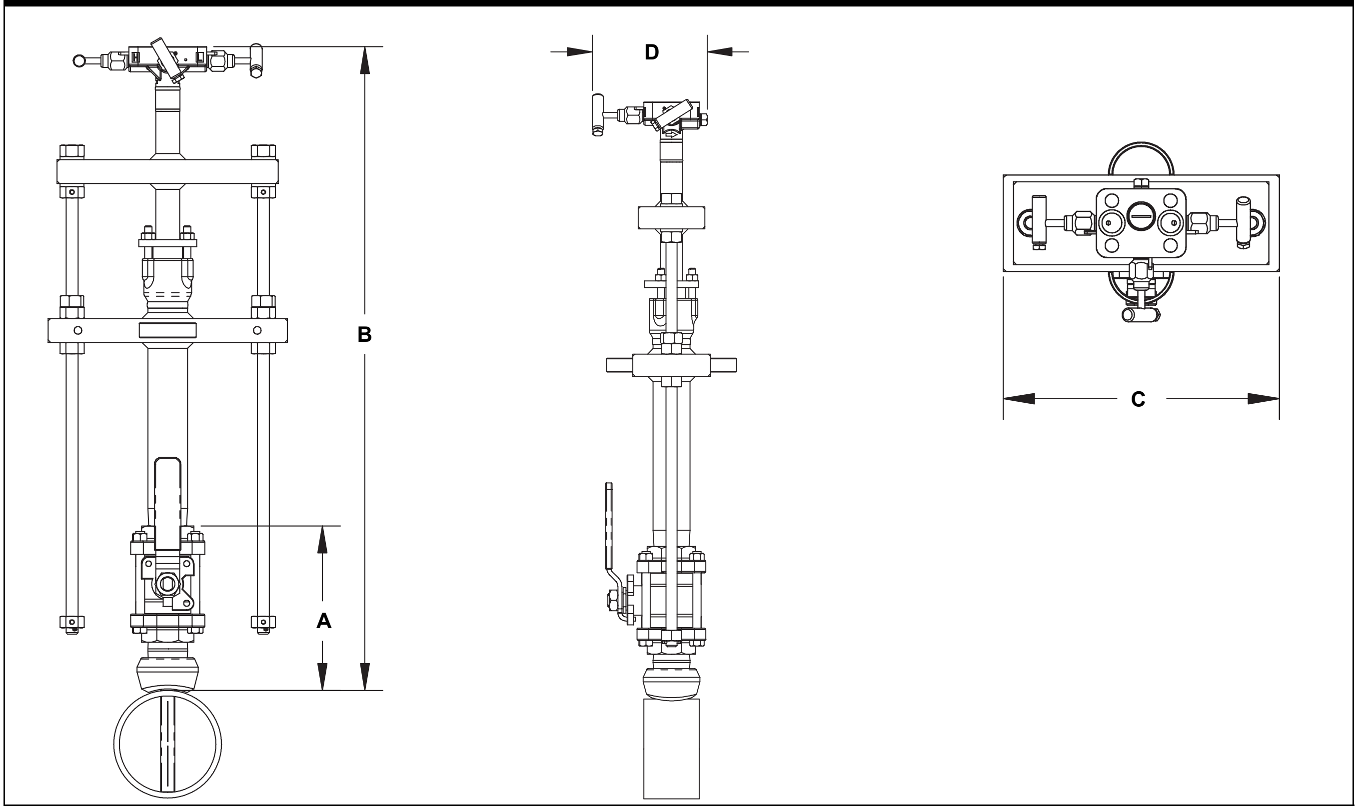


TABLE 15. Threaded Flo-Tap Model 485 Annubar Primary Dimensional Data

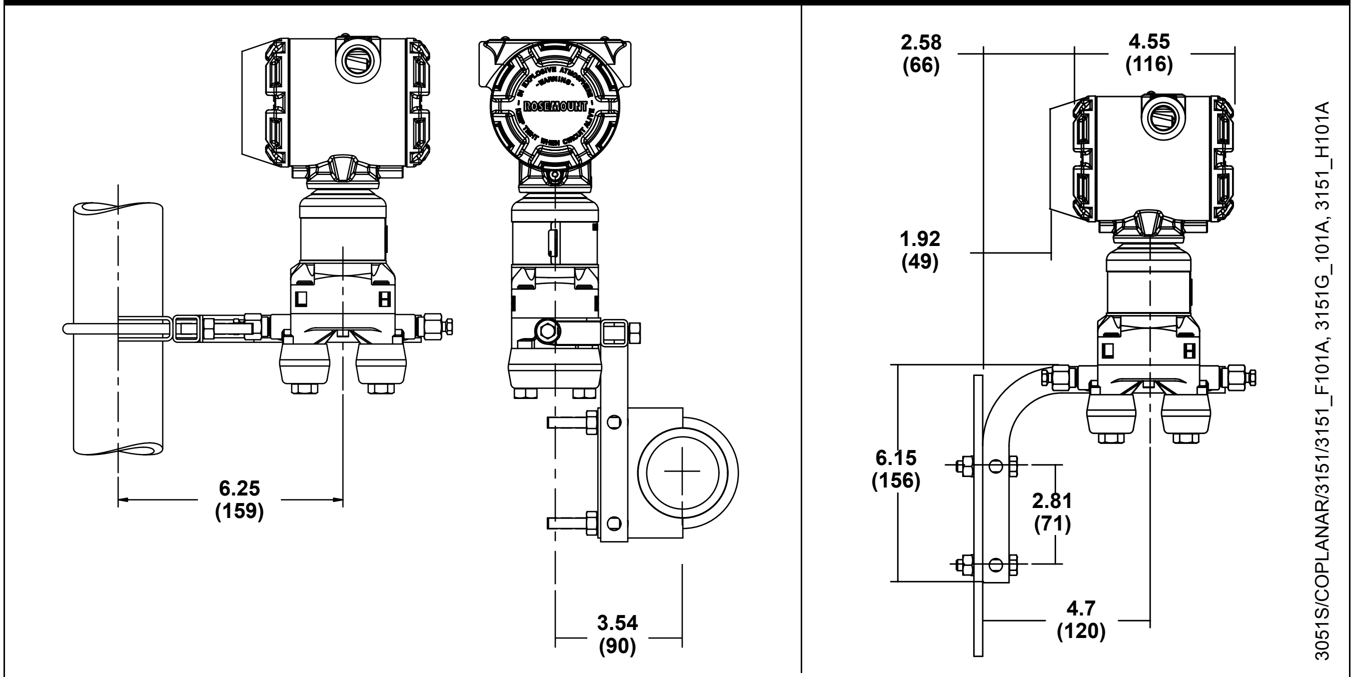
Sensor Size	A ± 0.25-in. (6.4 mm)	B (Max)		C (Max)	D (Max)
		Use formulas below to determine B value			
1	6.71-in. (170.5 mm)	*Manual Drive (B[1]):* 20-in. (508 mm)	*Gear Drive (B[1]):* 25.5-in. (648 mm)	10.00-in. (254.0 mm)	5.70-in (144.8 mm)
2	8.11-in. (206.0 mm)	*Manual Drive (B[1]):* 23.0-in. (584 mm)	*Gear Drive (B[1]):* 27.5-in. (699 mm)	12.56-in. (319.0 mm)	5.70-in (144.8 mm)
Sensor Size 3 is not available in a Threaded Flo-Tap.					

Use the appropriate formula to determine C value:
Inserted formula: Pipe I.D. + Wall Thickness + Value A + B[1] (use the Manual Drive or Gear drive values for B[1])
Retracted formula: [2 x (Pipe I.D. + Wall Thickness + Value A)] + B[1] (use the Manual Drive or Gear drive values for B[1])

Mounting

Integral Mount

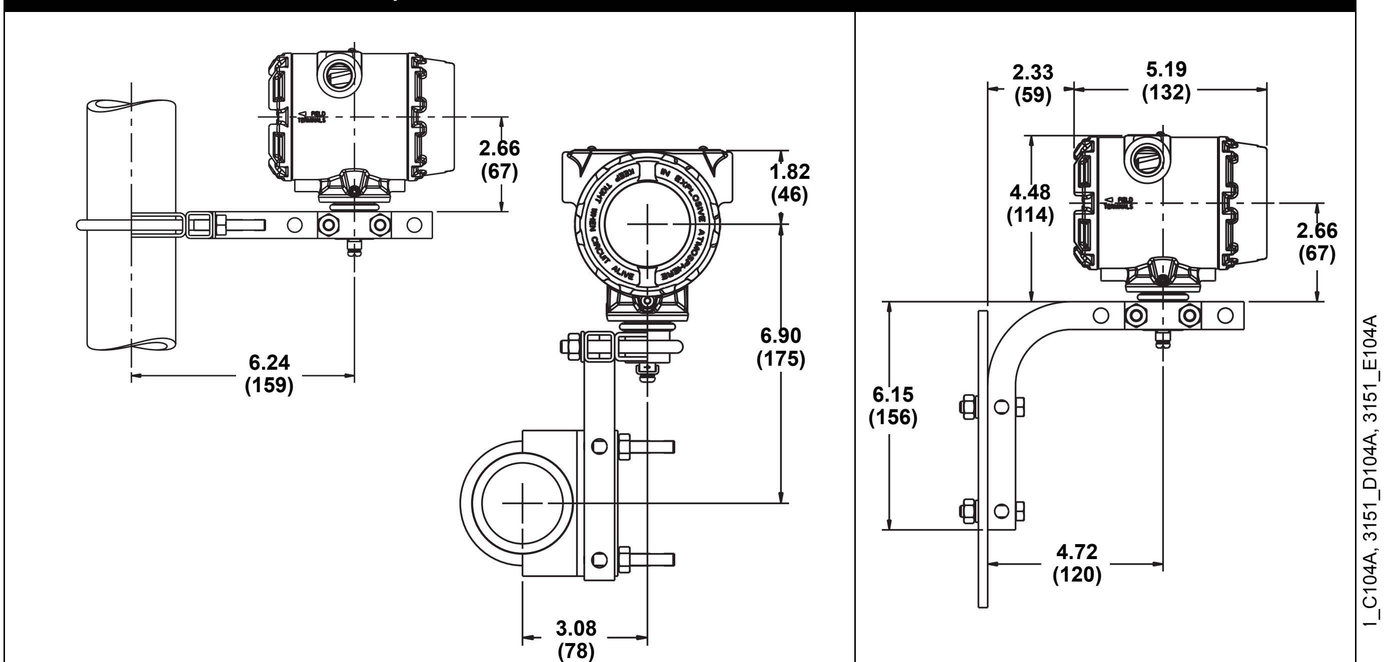
Pipe Mount | **Panel Mount**



Dimensions are in inches (millimeters)

Remote Mount

Pipe Mount | **Panel Mount**



Dimensions are in inches (millimeters)

ORDERING INFORMATION

Please see the Annubar Flowmeter Series Product Data Sheet (document number 00813-0100-4809) for a complete list of the ordering tables.

Appendix B Approvals

HAZARDOUS LOCATIONS INSTALLATIONS

The flowmeter is designed with explosion-proof housings and circuitry suitable for intrinsically safe and non-incendive operation. Each flowmeter is clearly marked with a tag indicating the approvals. To maintain certified ratings for installed transmitters, install in accordance with all applicable installation codes and approval drawings. 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.

HAZARDOUS LOCATIONS CERTIFICATIONS

Models 3051SFA

Factory Mutual (FM) Approvals

1 Explosion Proof for Class 1, Division 1. Groups B, C, and D. Dust-ignition Proof for Class II, Division 1, Groups E,F, and G. Dust ignition Proof for Class III, Division 1. NEMA 4X. Factory Sealed.

2 Combination of Approval Code 5 and the following: Intrinsically Safe for use in Class I, Division 1, Groups B, C, and D; Class II, Division 2, Groups E, F, and G; Intrinsically sage for Class III, Division 1. Nonincendive for Class I, Division 2, Groups A, B, C, and D. Temperature Code T4. Install per Rosemount drawings 03031-1019 and 00268-0031.

Canadian Standards Association (CSA)

3 Explosion Proof for Class I, Division 1, Groups C, and D. Dust-ignition Proof for Class II, Divsion1, Groups E, F, and G. Dust-ignition Proof for Class III, Division 1. Suitable for Class I, Division 2, Groups A, B, C, and D. CSA Enclosure Type 4X. Factory-sealed.

4 Combination of Approval Code K6 and the following:Intrinsically safe for use in Class I, Division1, Groups C and D when connected in accordance with Rosemount drawings 03031-1024. Temperature Code T3C.

KEMA/CENELEC

5 Explosion Proof.
EEx d IIC T5 (T_{amb} = 70 °C)
EEx d IIC T6 (T_{amb} = 40 °C)
Enclosure Type: IP65.

6 Intrinsically Safe
EEx ia IIC T5 (T_{amb} = –45 to 40 °C)
EEx ia IIC T4 (T_{amb} = –45 to 70 °C)
Ui = 30V dc
Ii = 200 mA
Pi = 1.0 W
Ci = 0.012 uF
Li = 0

European Pressure Equipment Directive (PED)

The Model 3051SFA Probar Flowmeter is designed to conform with PED 97/23/EC.

Model 3095MFA Mass ProBar

Factory Mutual (FM) Approvals

1 Explosion Proof for Class 1, Division 1. Groups B, C, and D. Dust-ignition Proof for Class II, Division 1, Groups E,F, and G. Dust ignition Proof for Class III, Division 1. NEMA 4X. Factory Sealed. Install per Rosemount drawing 03095-1025.

2 Combination of Approval Code K5 and the following: Intrinsically Safe for use in Class I, Division 1, Groups B and C; Class II, Division 2, Groups E, F, and G; Intrinsically sage for Class III, Division 1. Nonincendive for Class I, Division 2, Groups A, B, C, and D. Temperature Code T4. Install per Rosemount drawing 03095-1020.

Canadian Standards Association (CSA)

3 Explosion Proof for Class I, Division 1, Groups C, and D. Dust-ignition Proof for Class II, Divsion1, Groups E, F, and G. Dust-ignition Proof for Class III, Division 1. Suitable for Class I, Division 2, Groups A, B, C, and D. CSA Enclosure Type 4X. Factory-sealed.

4 Combination of Approval Code K6 and the following:Intrinsically sage for use in Class I, Divsion1, Groups A, B, C and D when connected in accordance with Rosemount Drawings 03095-1021. Temperature Code T3C.

KEMA/CENELEC

5 Explosion Proof.
EEx d IIC T5 (T_{amb} = 70 °C), EEx d IIC T6 (T_{amb} = 40 °C)
Enclosure Type: IP65.

6 Intrinsically Safe
EEx ia IIC T5 (T_{amb} = –45 to 40 °C), EEx ia IIC T4
(T_{amb} = –45 to 70 °C)
Ui = 30V dc, Ii = 200 mA, Pi = 1.0 W, Ci = 0.012 uF, Li = 0

European Pressure Electronics Directive (PED)

The Model 3095MFA Mass Probar Flowmeter is designed to conform with PED 97/23/EC.

INSTALLATION DRAWINGS

Model 3051SFA ProBar Flowmeter

Rosemount Drawing 03031-1019, 12 Sheets:
Factory Mutual (FM) Installation Drawing.

Rosemount Drawing 00268-0031, 7 Sheet:
Factory Mutual (FM) Installation Drawing.

Rosemount Drawing 03031-1024, 1 Sheet:
Canadian Standards Association (CSA) Installation Drawing.

Model 3095MFA Mass ProBar Flowmeter

Rosemount Drawing 03095-1025, 1 Sheet:
Factory Mutual (FM) Installation Drawing.

Rosemount Drawing 03095-1020, 1 Sheet:
Factory Mutual (FM) Installation Drawing.

Rosemount Drawing 03095-1021, 1 Sheet:
Canadian Standards Association (CSA) Installation Drawing.

IMPORTANT
Once a device labeled with multiple approval types is installed, it should not be reinstalled using any of the other labeled approval types. To ensure this, the approval label should be permanently marked to distinguish the used from the unused approval type(s).

Figure B-1. FM Installation
Drawing 03031-1019, Rev. AC
Page 1 of 12

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS

REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AA	ADD FIELDBUS	RTC1004088	M.L.M.	5/28/98
AB	ADD PROFIBUS, NONINCENDIVE PARAMETERS	RTC1008309	P.C.S.	2/4/00
AC	ADD FISCO DETAILS	RTC1011731	J.P.W.	9/19/01

ENTITY APPROVALS FOR

3051C	3001C
3051L	3001CL
3051P	3001CH
3051H	3001S
3051CA	3001SL
3051T	3001SH

OUTPUT CODE A (4-20 mA HART) I.S. SEE SHEETS 2-4
OUTPUT CODE M (LOW POWER) I.S. SEE SHEETS 5-6
OUTPUT CODE F/W (FIELDBUS) I.S. SEE SHEETS 7-11
ALL OUTPUT CODES NONINCENDIVE SEE SHEETS 12

THE ROSEMOUNT TRANSMITTERS LISTED ABOVE ARE F.M. APPROVED AS INTRINSICALLY SAFE WHEN USED IN CIRCUIT WITH F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED IN THE CLASS I, II, AND III, DIVISION 1 GROUPS INDICATED, TEMP CODE T4. ADDITIONALLY, THE ROSEMOUNT 751 FIELD SIGNAL INDICATOR IS F.M. APPROVED AS INTRINSICALLY SAFE WHEN CONNECTED IN CIRCUIT WITH ROSEMOUNT TRANSMITTERS (FROM ABOVE) AND F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED FOR CLASS I, II, AND III, DIVISION 1, GROUPS INDICATED, TEMP CODE T4.

TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM.

CAD MAINTAINED (MicroStation)

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125

-TOLERANCE-
.X ± .1 [2,5]
.XX ± .02 [0,5]
.XXX ± .010 [0,25]

FRACTIONS	ANGLES
± 1/32	± 2°

DO NOT SCALE PRINT

CONTRACT NO.
DR. MIKE DOBE 03/21/89
CHK'D
APP'D. KELLY ORTH 03/22/89
APP'D. GOVT.

EMERSON. Process Management — ROSEMOUNT®
8200 Market Boulevard • Chanhassen, MN 55317 USA

TITLE: INDEX OF I.S. & NONINCENDIVE F.M. FOR 3051C/L/P/H/T AND 3001C/S

SIZE A | FSCM NO | DWG NO. 03031-1019
SCALE N/A | WT. | SHEET 1 OF 12

03031-1019A01A

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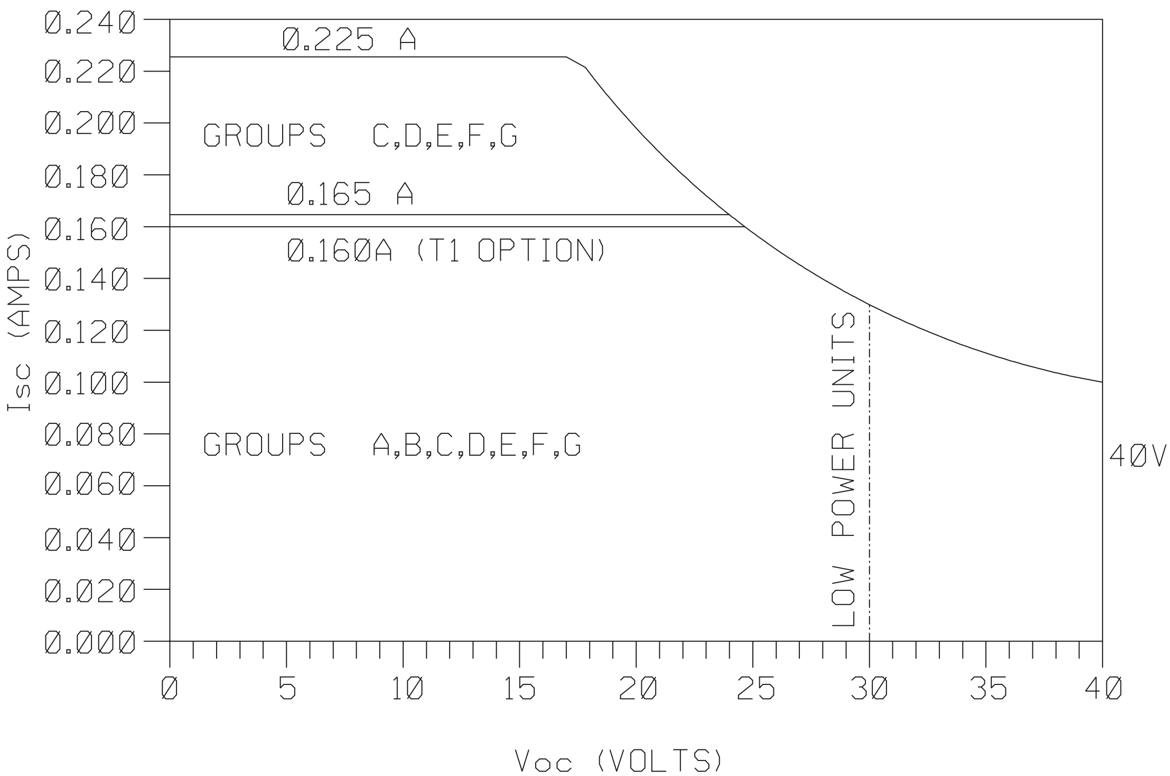
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

BARRIER PARAMETERS (APPLICABLE TO OUTPUT CODES A & M)
Pmax = 1WATT



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8200 Market Boulevard
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DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ————	SHEET 2 OF 12

03031-1019A02A

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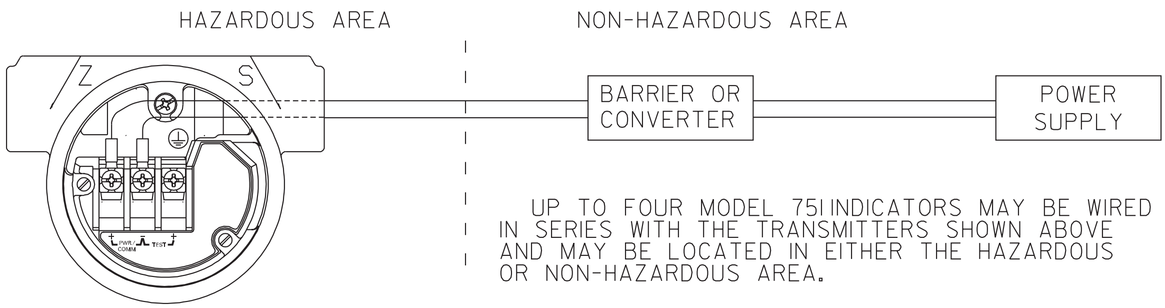
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

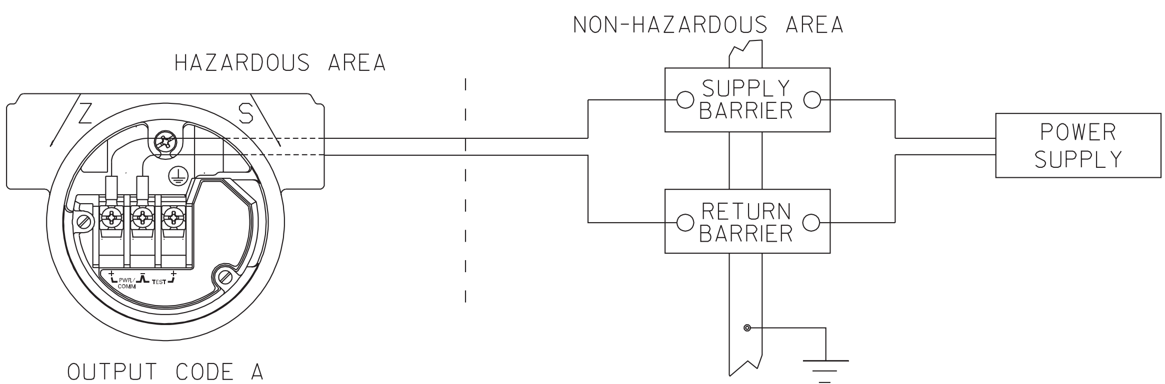
CIRCUIT DIAGRAM 1
ONE BARRIER OR CONVERTER:
SINGLE OR DUAL CHANNEL



UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

OUTPUT CODE A
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH, S, SL, SH

CIRCUIT DIAGRAM 2
SUPPLY AND RETURN BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



OUTPUT CODE A
MODELS INCLUDED
3051C, L, P, H, T, CA
3001C, CL, CH, S, SL, SH

UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

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8200 Market Boulevard
Chanhassen, MN 55317 USA

CAD MAINTAINED (MicroStation)

DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019	
ISSUED	SCALE N/A	WT. ————	SHEET 3 OF 12	

03031-1019A03A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (Voc OR Vt) AND MAX. SHORT CIRCUIT CURRENT (Isc OR It) AND MAX.POWER (Voc X Isc/4) OR (Vt X It/4), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (Vmax), MAXIMUM SAFE INPUT CURRENT (Imax), AND MAXIMUM SAFE INPUT POWER (Pmax) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (Ca) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (Ci) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (La) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (Li) OF THE INTRINSICALLY SAFE APPARATUS.

FOR OUTPUT CODE A

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

CLASS I, DIV. 1, GROUPS A AND B

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
I_{MAX} = 165mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 165mA
P_{MAX} = 1 WATT	$(\frac{V_T X I_T}{4})$ OR $(\frac{Voc \times Isc}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .01µf	C_A IS GREATER THAN .01µf
L_I =10µH	L_A IS GREATER THAN 10µH

* FOR T1 OPTION:

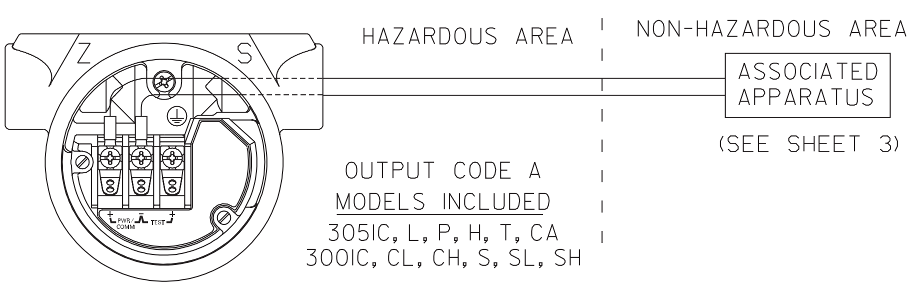
Imax = 160mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 160mA
L_I =1.05mH	L_A IS GREATER THAN 1.05mH

CLASS I, DIV. 1, GROUPS C AND D

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
I_{MAX} = 225mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225mA
P_{MAX} = 1 WATT	$(\frac{V_T X I_T}{4})$ OR $(\frac{Voc \times Isc}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .01µf	C_A IS GREATER THAN .01µf
L_I =10µH	L_A IS GREATER THAN 10µH

* FOR T1 OPTION:

L_I =1.05mH	L_A IS GREATER THAN 1.05mH



Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA

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DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ———	SHEET 4 OF 12

03031-1019A04A

Page 5 of 12

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AC				

FOR OUTPUT CODE M

CLASS I, DIV. 1, GROUPS A AND B

V_{MAX} = 30V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 165mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 165mA
P_{MAX} = 1 WATT	$(\frac{V_T \times I_T}{4})$ OR $(\frac{V_{OC} \times I_{SC}}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .042μf	C_A IS GREATER THAN .042μf
L_I =10μH	L_A IS GREATER THAN 10μH

* FOR T1 OPTION:

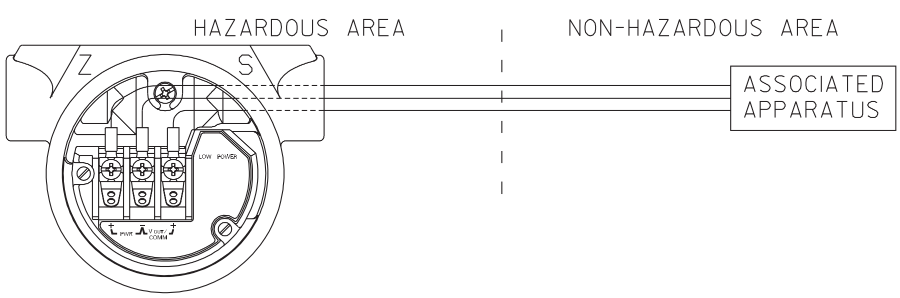
L_I =0.75mH	L_A IS GREATER THAN 0.75mH

CLASS I, DIV. 1, GROUPS C AND D

V_{MAX} = 30V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 225mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225mA
P_{MAX} = 1 WATT	$(\frac{V_T \times I_T}{4})$ OR $(\frac{V_{OC} \times I_{SC}}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .042μf	C_A IS GREATER THAN .042μf
L_I =10μH	L_A IS GREATER THAN 10μH

* FOR T1 OPTION:

L_I =0.75mH	L_A IS GREATER THAN 0.75mH



OUTPUT CODE M
AVAILABLE FOR THE MODELS LISTED

305IC 305IH
305IL 305ICA
305IP 305IT

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DR. MIKE DOBE	SIZE A	FSCM NO	DWG NO. 03031-1019		
ISSUED	SCALE N/A	WT. ————	SHEET 5 OF 12		

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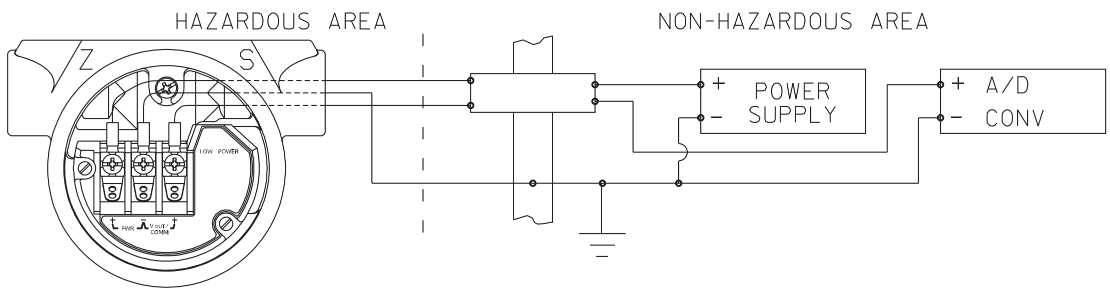
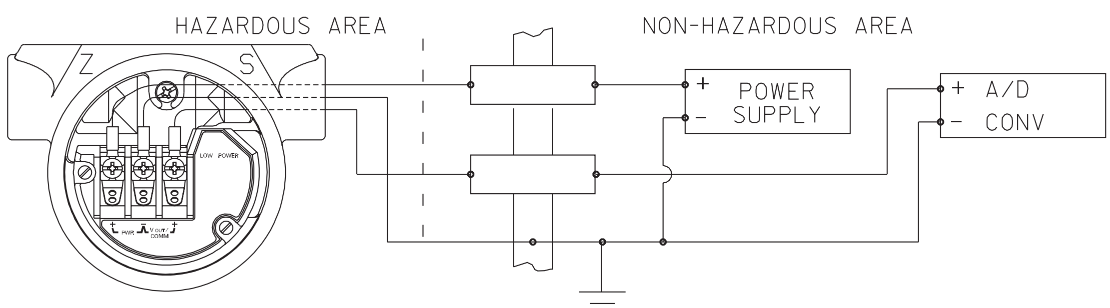
CIRCUIT DIAGRAM 3
ONE DUAL CHANNEL BARRIER



OUTPUT CODE M
AVAILABLE FOR THE MODELS LISTED

305IC	305IH
305IL	305ICA
305IP	305IT

CIRCUIT DIAGRAM 4
TWO SINGLE CHANNEL BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED
IN THIS CONFIGURATION)



OUTPUT CODE M
AVAILABLE FOR THE MODELS LISTED

305IC	305IH
305IL	305ICA
305IP	305IT

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DR. SANDI MANSON	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ————	SHEET 6 OF 12

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REVISIONS				
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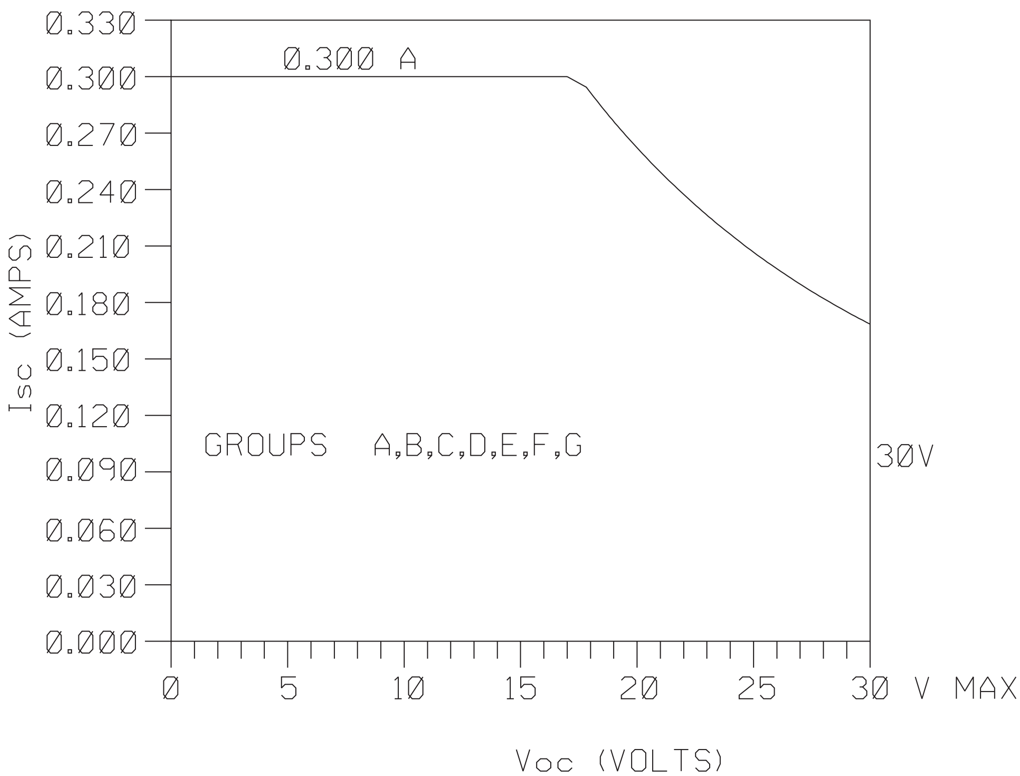
3051 WITH FOUNDATION FIELDBUS OR PROFIBUS.
(OUTPUT CODE F OR W)

BARRIER PARAMETERS (APPLICABLE TO OUTPUT CODE F OR W)
Pmax = 1.3 WATT



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DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ——	SHEET 7 OF 12

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REVISIONS				
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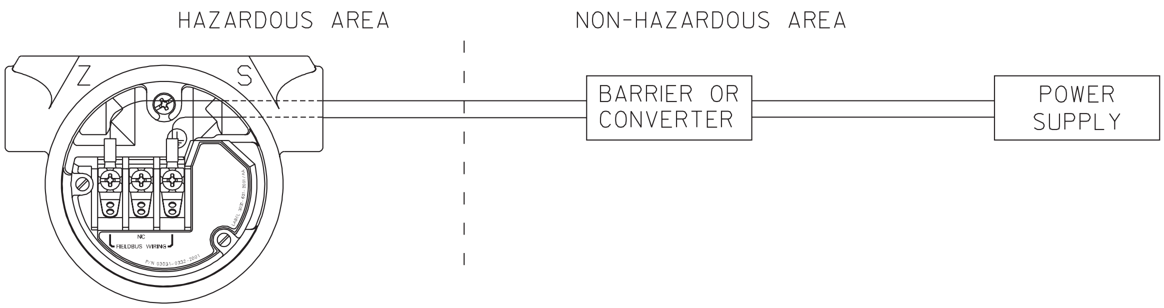
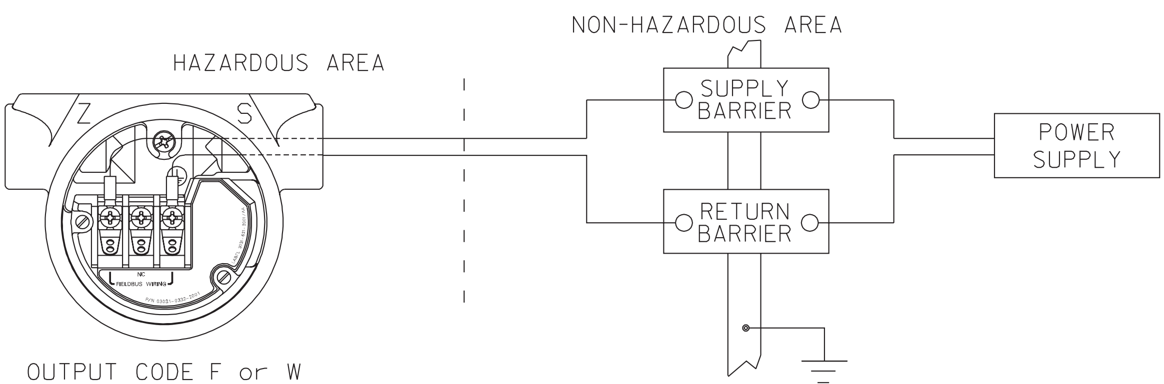
CIRCUIT DIAGRAM 1
ONE BARRIER OR CONVERTER:
SINGLE OR DUAL CHANNEL



OUTPUT CODE F or W
MODELS INCLUDED
305IC, L, P, H, T, CA
300IC, CL, CH

CIRCUIT DIAGRAM 2
SUPPLY AND RETURN BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



OUTPUT CODE F or W
MODELS INCLUDED
305IC, L, P, H, T, CA
300IC, CL, CH

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DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ————	SHEET 8 OF 12

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ENTITY CONCEPT APPROVALS

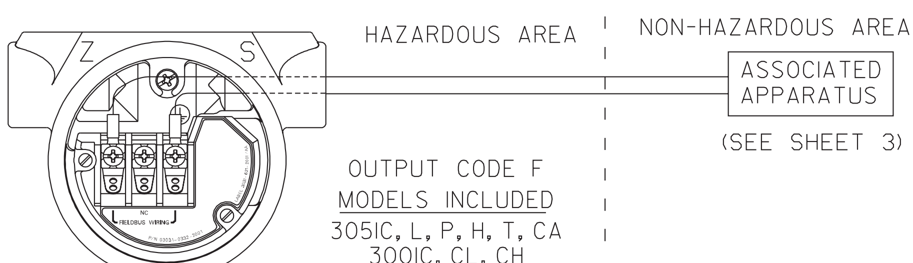
THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (Voc OR Vt) AND MAX. SHORT CIRCUIT CURRENT (Isc OR It) AND MAX.POWER (Voc X Isc/4) OR (Vt X It/4), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (Vmax), MAXIMUM SAFE INPUT CURRENT (Imax), AND MAXIMUM SAFE INPUT POWER (Pmax) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (Ca) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (C_1) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (La) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (L_1) OF THE INTRINSICALLY SAFE APPARATUS.

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

FOR OUTPUT CODE F or W

CLASS I, DIV. 1, GROUPS A, B, C AND D

V_{MAX} = 30V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 300mA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 300mA
P_{MAX} = 1.3 WATT	$(\frac{V_T X I_T}{4})$ OR $(\frac{Voc x Isc}{4})$ IS LESS THAN OR EQUAL TO 1.3 WATT
C_I = 0 μf	C_A IS GREATER THAN 0 μf
L_I = 0 μH	L_A IS GREATER THAN 0 μH



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DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ————	SHEET 9 OF 12

03031-1019A09A

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REVISIONS				
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FISCO CONCEPT APPROVALS

THE FISCO CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIALLY EXAMINED IN SUCH COMBINATION. FOR THIS INTERCONNECTION TO BE VALID THE VOLTAGE (U_I or Vmax), THE CURRENT (I_I or Imax), AND THE POWER (P_I or Pma) THAT INTRINSICALLY SAVE APPARATUS CAN RECEIVE AND REMAIN INTRINSICALY SAFE, INCLUDING FAULTS, MUST BE EQUAL OR GREATER THAN THE VOLTAGE (U_o, Voc, or Vt), THE CURRENT (I_o, Isc, or It), AND THE POWER (P_o or Pmax) LEVELS WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS, CONSIDERING FAULTS AND APPLICABLE FACTORS. ALSO, THE MAXIMUM UNPROTECTED CAPACITANCE (C_I) AND THE INDUCTANCE (L_I) OF EACH APPARATUS (BESIDES THE TERMINATION) CONNECTED TO THE FIELDBUS MUST BE LESS THAN OR EQUAL TO 5nF AND 10µH RESPECTVELY.

ONLY ONE ACTIVE DEVICE IN EACH SECTION (USUALLY THE ASSOCIATED APPARATUS) IS ALLOWED TO CONTRIBUTE THE DESIRED ENERGY FOR THE FIELDBUS SYSTEM. THE ASSOCIATED APPARATUS' VOLTAGE U_o (or Voc or Vt) IS LIMITED TO A RANGE OF 14V TO 24 V.D.C. ALL OTHER EQUIPENT COMBINED IN THE BUS CABLE MUST BE PASSIVE (THEY CANNOT PROVIDE ENERGY TO THE SYSTEM, EXCEPT A LEAKAGE CURRENT OF 50 µA FOR EACH CONNECTED DEVICE) SEPARATELY POWERED EQUIPMENT REQUIRES A GALVANIC ISOLATION TO AFFIRM THAT THE INTRINSICALLY SAFE FIELDBUS CIRCUIT WILL REMAIN PASSIVE. THE PARAMETER OF THE CABLE USED TO INTERCONNECT THE DEVICES MUST BE IN THE FOLLOWING RANGE:

LOOP RESISTANCE R':	15...150 OHM/km
INDUCTANCE PER UNIT LENGTH L':	0.4...1mH/KM
CAPACITANCE PER UNLIT LENGTH C':	80...200nF

C' = C' LINE/LINE +0.5C' LINE/SCREEN, IF BOTH LINES ARE FLOATING, OR
C' = C' LINE/LINE +C' LINE/SCREEN, IF THE SCREEN IS CONNECTED TO ONE LINE

TRUNK CABLE LENGTH:	≤ 1000 m
SPUR CABLE LENGTH:	≤ 30 m
SPLICE LENGTH:	≤ 1 m

AN APPROVED INFALLIBLE LINE TERMINATION TO EACH END OF THE TRUNK CABLE, WITH THE FOLLOWING PARAMETERS IS APPROPRIATE:

R = 90...100 OHMS   C = 2.2µF

AN ALLOWED TERMINATION MIGHT ALREADY BE LINKED IN THE ASSOCIATED APPARATUS. DUE TO I.S. REASONS, THE NUMBER OF PASSIVE APPARATUS CONNECTED TO THE BUS SEGMENT IS NOT LIMITED. IF THE RULES ABOVE ARE FOLLOWED, UP TO A TOTAL LENGTH OF 1000 m (THE SUMMATION OF TRUNK AND ALL SPUR CABLES), THE INDUCTANCE AND THE CAPACITANCE OF THE CABLE WILL NOT DAMAGE THE INTRINSIC SAFETY OF THE SYSTEM.

NOTES:
INTRINSICALLY SAFE CLASS I, DIV. 1, GROUPS A, B, C, D

1. THE MAXIMUM NON-HAZARDOUS AREA VOLTAGE MUST NOT EXCEED 250 V.
2. CAUTION: ONLY USE SUPPLY WIRES SUITABLE FOR 5°C ABOVE SURROUNDING TEMPERATURE.
3. WARNING: REPLACEMENT OF COMPONENTS MAY DAMAGE INTRINSIC SAFETY.

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DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1019	
ISSUED	SCALE N/A	WT. ——	SHEET 10 OF 12	

03031-1019A10A

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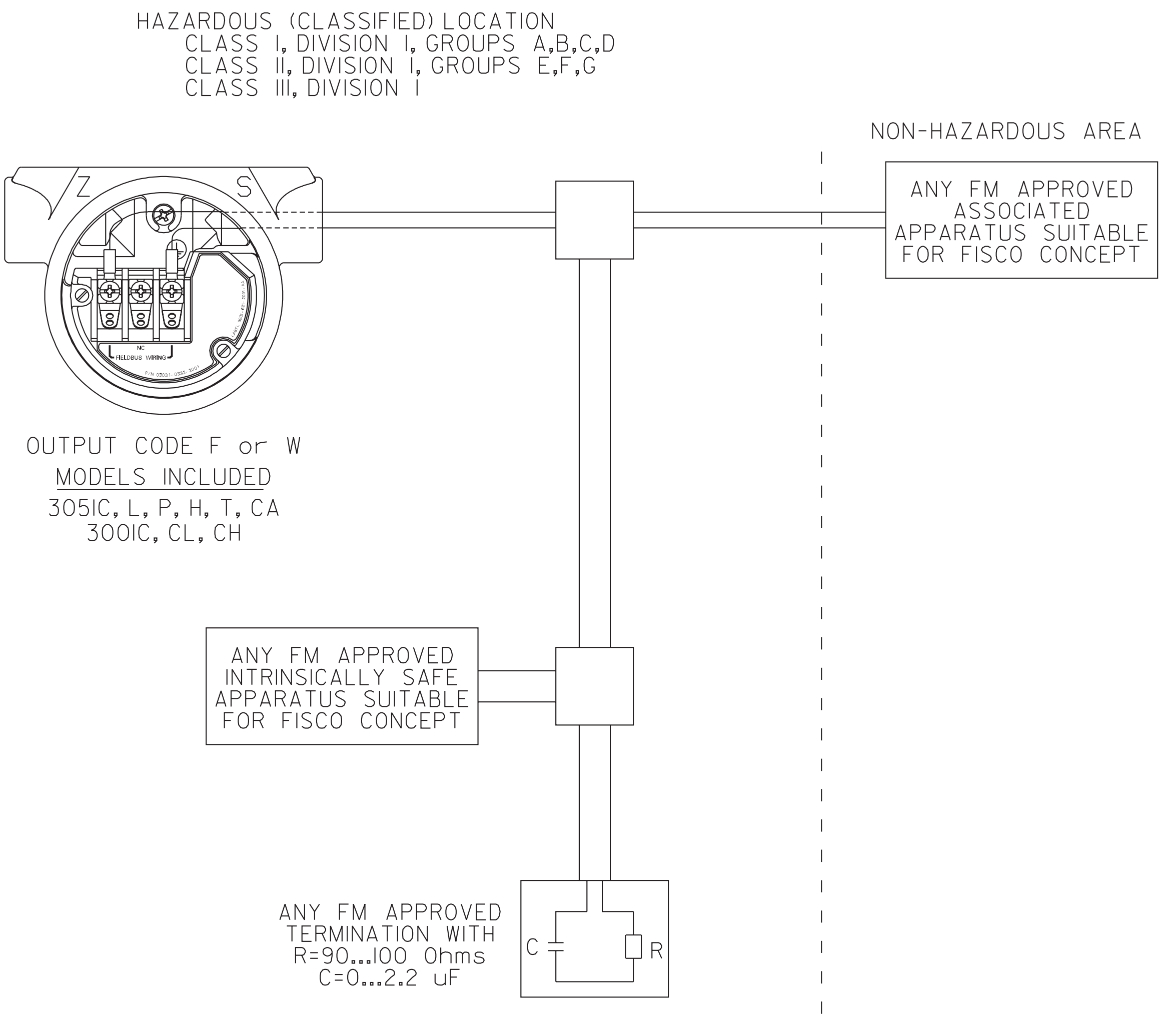

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CAD MAINTAINED (MicroStation)

DR. Myles Lee Miller	SIZE A	FSCM NO		DWG NO.	03031-1019
ISSUED	SCALE N/A	WT. ————		SHEET 11 OF 12	

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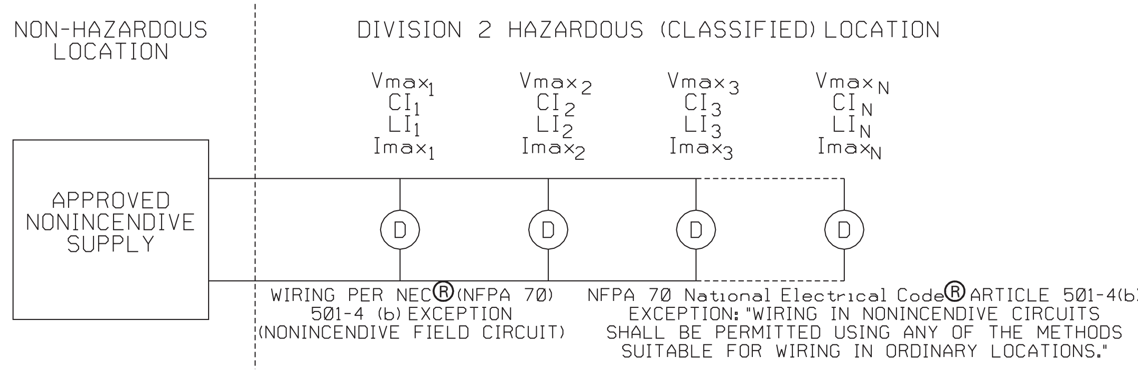
NONINCENDIVE FIELD CIRCUIT
CLASS I, DIV. 2 LOCATIONS



IN NORMAL OPERATION
DEVICES CONTROL THROUGH–CURRENT

PARAMETERS   DEVICE

V_{oc} <= Minimum of (V_{max1}, V_{max2}, ..., V_{maxN})

I_{max1} >= I_{q1} + $I_{signal1}$

I_{max2} >= I_{q1} + $I_{signal2}$

.
.
.

I_{maxN} >= I_{qN} + $I_{signalN}$

C_a <= $C_{i1} + C_{i2} + ... + C_{iN} + C_{cable}$

L_a <= $L_{i1} + L_{i2} + ... + L_{iN} + L_{cable}$

Imax for an individual device = Iq + Isignal

Iq =Quiescent current through device
(Maximum quiescent current for the device)

Isignal =Signaling current through device
(Protocol may limit signaling to one device at a time)

Operating Imax = $I_{q1} + I_{q2} + ... + I_{qN} + I_{signal\,max}$

$I_{signal\,max}$ = Max. of ($I_{signal1}$, $I_{signal2}$, ..., $I_{signalN}$)

ROSEMOUNT 3051/3001

	4-20mA / HART	FIELDBUS (F or W)
Vmax	40v	30v
Maximum normal operating current	22mA	27mA
Ca	.010uF	0uF
La	10uH	0uH

ROSEMOUNT 3051 TRANSMITTERS ARE CURRENT CONTROLLERS ON INDIVIDUAL PARALLEL BRANCHES WITH RESPECT TO THE POWER SUPPLY. IN NONINCENDIVE INSTALLATIONS THE Imax FOR EACH TRANSMITTER IS NOT RELATED TO THE MAXIMUM CURRENT OF THE POWER SUPPLY (Isc) IN THE SAME MANNER AS FOR TRANSMITTER INSTALLED PER I.S. REQUIREMENTS, BECAUSE NONINCENDIVE REQUIREMENTS INCLUDE ONLY NORMAL OPERATING CONDITIONS.

REFERENCE: APPENDIX A7.3 (FM3611)

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DR. Jon Steffens	SIZE A	FSCM NO	DWG NO. 03031-1019
ISSUED	SCALE N/A	WT. ————	SHEET 12 OF 12

03031-1019A12A

Figure B-2. FM Installation
Drawing 00268-0031, Rev. M
Page 1 of 7

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS

REV	DESCRIPTION	CHG. NO.	APP'D	DATE
G	ADD SHT 4&5, DELETE CLASS II &III.	636328	B.S.J.	08/01/90
H	ADD 3051 P/L/H, 3001C CL /CH	636904	K.D.V.	09/06/90
J	ADD SHT. 6, FIX TBL. 1.	638723	B.S.J.	01/02/91
K	ADD 3044C	641710	W.R.K.	06/13/91
L	ADD 3001S & SHT 7 FOR 3051C-LP	642380	G.E.M.	8/13/91
M	ADD 3095	653145	K.D.V.	4/8/93

THE ROSEMOUNT MODEL 268 SMART FAMILY INTERFACE IS APPROVED BY FACTORY MUTUAL AS INTRINSICALLY SAFE FOR THE CLASS I, DIVISION 1 GROUPS INDICATED WHEN USED IN CIRCUIT WITH THE BARRIERS AND CONVERTERS LISTED BELOW AND THE ROSEMOUNT SMART FAMILY TRANSMITTERS DEPICTED IN THE ACCOMPANYING CIRCUIT DIAGRAMS.

BARRIER MANUFACTURER	MODEL	APPROVED FOR CLASS I DIVISION 1, GROUPS
FOXBORO	2AI-I2V-FGB	A,B,C,D
	2AI-I3V-FGB	↓
	2AS-I3I-FGB	↓
	3A2-I2D-CS-E/FGB-A	↓
	3A2-I3D-CS-E/FGB-A	↓
HONEYWELL	38545-000-0110-113-F5B5	↓
	38545-000-0110-111/112-F5B5	C,D
MTL	115	A,B,C,D
	122	↓
	322	↓
	715	↓
	722	↓
R. STAHL	8901/31-199/100/7	↓
	8901/30-199/100/7	C,D
	8901/31-280/165/7	C,D
	8901/30-280/165/7	C,D
	[8903/51-200/050/7	A,B,C,D
	[8901/31-086/150/7	A,B,C,D
	[8901/31-280/165/7	C,D
	[8901/31-086/150/7	C,D
	9005/01-245/060	A,B,C,D
	9005/01-252/100	A,B,C,D
TAYLOR	5850FL81200	C,D
	5851FL81200	↓
	1130FF21000	↓
	1130FF22000	↓
	1135FF21000	↓
	1135FF22000	↓

CAD Maintained, (MICROSTATION).

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125

-TOLERANCE-
.X ± .1 [2.5]
.XX ± .02 [0.5]
.XXX ± .010 [0.25]
FRACTIONS ± 1/32 ANGLES ± 2°

DO NOT SCALE PRINT

CONTRACT NO.
DR. MIKE DOBE 2/7/90
CHK'D
APP'D. K.CARLSON 03/13/90
APP'D. GOVT.

ROSEMOUNT® MEASUREMENT
FISHER-ROSEMOUNT
ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

TITLE INDEX OF I.S. BARRIER SYSTEMS FOR MOD. 268 SMART FAMILY INTERFACE

SIZE A | FSCM NO | DWG NO. 00268-0031
SCALE | WT. | SHEET 1 OF 7

0031A01A

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REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAXIMUM OPEN CIRCUIT VOLTAGE (V_T OR V_{OC}) AND MAXIMUM SHORT CIRCUIT CURRENT (I_T OR I_{SC}) AND MAXIMUM OUTPUT POWER ($\frac{VOC \times ISC}{4}$ OR $\frac{V_T \times I_T}{4}$), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (V_{MAX}), MAXIMUM SAFE INPUT CURRENT (I_{MAX}) AND MAXIMUM SAFE INPUT POWER (P_{MAX}) OF THE INTRINSICALLY SAFE APPARATUS, IN ADDITION, THE APPROVED MAXIMUM ALLOWABLE CONNECTED CAPACITANCE (C_A) AND INDUCTANCE (L_A) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE MAXIMUM UNPROTECTED INTERNAL CAPACITANCE (C_I) AND INDUCTANCE (L_I) OF THE INTRINSICALLY SAFE APPARATUS. THE APPROVED ENTITY CONCEPT PARAMETERS ARE AS FOLLOWS: ARE AS FOLLOWS:

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

INPUT PARAMETERS (CLASS I, DIV. 1, GROUPS A, B, C, D)				
VMAX = 32 VDC				V_T or Voc of barrier must be $\leq$ 32 Vdc
IMAX = 186 MA				I_T or Isc of barrier must be $\leq$ 186 mA
CI = 0.01 UF				C_A of barrier must be $\geq$ 0.01 μF
LI = 1.1 MH				L_A of barrier must be $\geq$ 1.1 mH
PMAX:	1.1W	0.8W	0.6W	$\frac{Voc \times Isc}{4}$ of barrier must be $\leq$ specified value.
TEMP CODE	T4A	T5	T6	

OUTPUT PARAMETERS
VOC = 1.5 VD.C.
ISC = 27 MA
C_A = 10,000 UF
L_A = 46 MH

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. D.PEARSON	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT. ————	SHEET 2 OF 7

0031A02A

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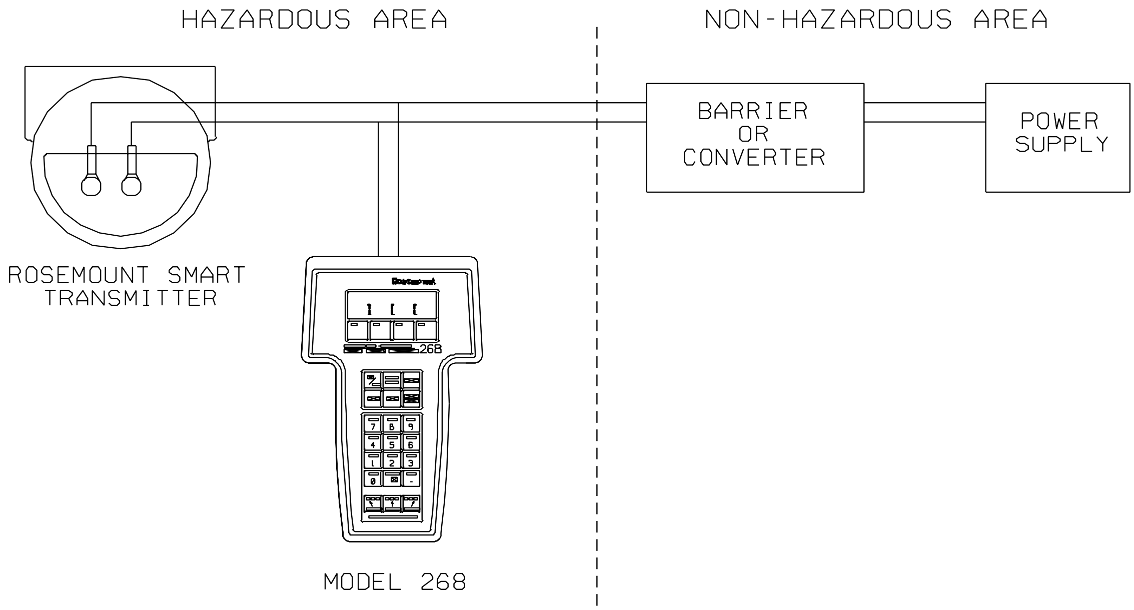
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		



ROSEMOUNT SMART TRANSMITTERS

MODEL	1151 SMART
MODEL	3051
MODEL	3051C, 3051P, 3051L, 3051H, 3051CA
MODEL	3044
MODEL	3044C
MODEL	3001C, 3001CL, 3001CH
MODEL	3311
MODEL	3001S, 3001SL, 3001SH
MODEL	3095

UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
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DR. D.PEARSON	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT. ———	SHEET 3 OF 7

0031A03A

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REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

THE MAXIUM ALLOWABLE CONNECTED INDUCTANCE (La) OF THE ASSOCIATED APPARATUS IS DETERMINED BY ADDING 27 mA TO THE Isc OF THE BARRIER (Im=Isc + 27mA AND ENTERING TABLE 1 (SHT 5) AT THE RESULTING VALUE, Im, OR THE NEXT HIGHER VALUE OF Im, TO DETERMINE THE La, (THE La MUST INCLUDE THE L_1 OF THE MODEL 268, WHICH IS 1.1mH).

EXAMPLE #1: Isc OF BARRIER = 100mA.

Im = 100mA + 27mA = 127mA

ENTER TABLE AT Im = 130mA; La = 2.0mH

--WARNING-- BEFORE CONNECTING THE MODEL 268 INTO THE LOOP, DETERMINE THE CONNECTED INDUCTANCE OF THE SYSTEM BY ADDING THE L_1 OF THE TRANSMITTER, CABLE, AND MODEL 268. THE SUM MUST BE LESS THAN THE La DETERMINED FROM THE TABLE IN ORDER FOR THE MODEL 268 TO BE CONNECTED INTO THE LOOP. IF THE CONNECTED INDUCTANCE IS GREATER THAN THE VALUE DETERMINED FROM THE TABLE, A BARRIER WITH A LOWER Isc MUST BE CHOSEN.

EXAMPLE #2: BARRIER ISC = 41.8mA; BARRIER LA = 20.0mH

IM = 41.8mA + 27mA = 68.8mA;

ENTER TABLE AT 70mA AND READ La = 7.5mH

ADD CONNECTED INDUCTANCE OF SYSTEM:

MODEL 268	L_1 = 1.1mH
MODEL 3051 TRANSMITTER	L_1 = 0.48mH
INDUCTANCE OF LOOP WIRING	1.0mH
TOTAL CONNECTED INDUCTANCE	= 2.58mH

TOTAL CONNECTED INDUCTANCE IS LESS THAN La = 7.5 mH AS DETERMINED ABOVE AND IS ALSO LESS THAN THE BARRIER La. THE MODEL 268 MAY SAFELY BE CONNECTED INTO THE LOOP. IF THE MODEL 751 INDICATORS ARE USED, THEIR TOTAL INDUCTANCE (LABEL VALUE * NUMBER OF INDICATORS) MUST ALSO BE INCLUDED.

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. S.BARDUSON 30JUL90	SIZE A	FSCM NO	DWG NO. 00268-0031	
ISSUED	SCALE N/A	WT.	SHEET 4 OF 7	

0031A04A

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REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		

Im (mA)	La ()mH)
150	1.3
145	1.5
140	1.6
130	2.0
120	2.5
110	3.0
100	4.0
90	5.0
85	5.5
80	6.0
75	6.7
70	7.5
65	8.8
62	9.5
60	10.0
57	11.0
55	12.0
50	15.0
45	19.0
40	23.0
35	31.0

TABLE 1

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. S.BARDUSON 30JUL90	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT.	SHEET 5 OF 7

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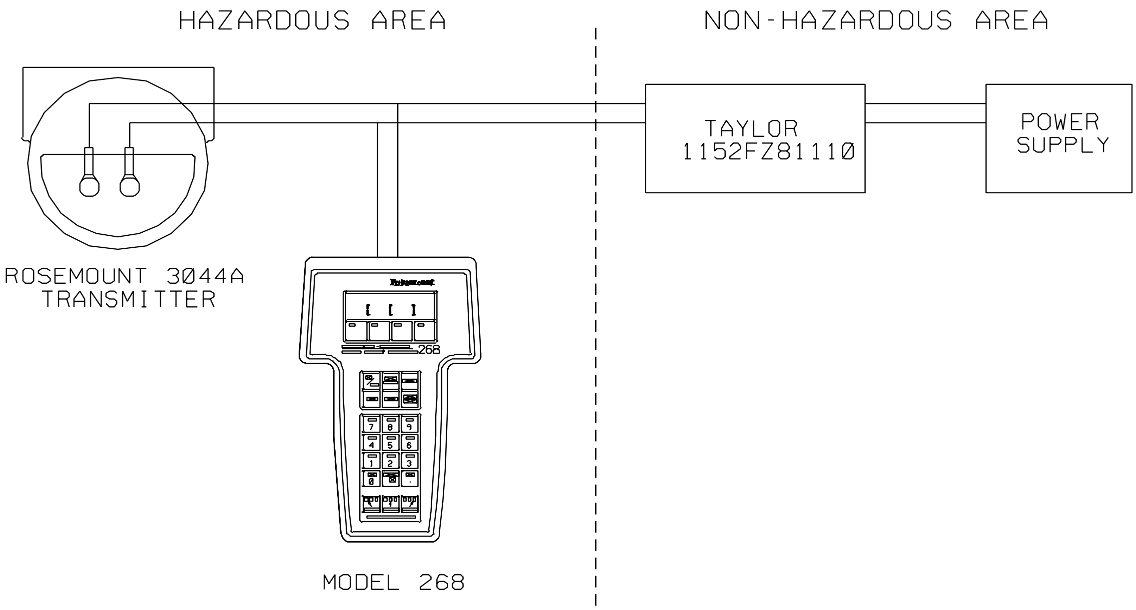
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE

TAYLOR 1152FZ81110 SYSTEM



ROSEMOUNT 3044A SMART TRANSMITTERS MAY BE PLACED IN A CLASS I, DIVISION I, GROUP A, B, C, D HAZARDOUS LOCATION AS SHOWN ABOVE. THE LOOP POWER IS LIMITED BY A TAYLOR 1152FZ81110 INTRINSIC SAFETY BARRIER. THE ROSEMOUNT 268 MAY ALSO BE CONNECTED IN THE LOOP AS SHOWN. FOR CABLE WITH CAPACITANCE OF 60 PF/FT OR LESS AND INDUCTANCE OF .2 UH/FT OR LESS; CABLE LENGTHS OF UP TO 1600 FEET ARE ALLOWED .

TRANSMITTER: ROSEMOUNT 3044A
BARRIER: TAYLOR 1152FZ81110
COMMUNICATOR: ROSEMOUNT 268
CABLE: CMAX = 60 PF/FT
LMAX = .2 UH/FT
MAX. LENGTH = 1600 FT

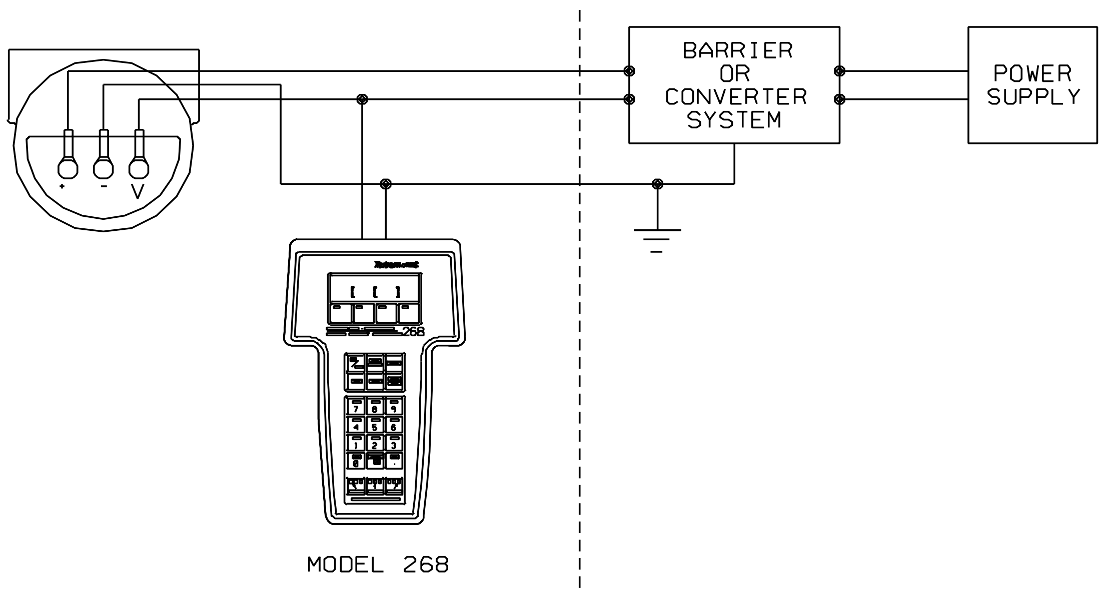
ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. C. SCRIBNER 12/21/90	SIZE A	FSCM NO	DWG NO. 00268-0031
ISSUED	SCALE N/A	WT.	SHEET 6 OF 7

Page 7 of 7

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
M		653145		



CONNECTION FOR LOW POWER VERSIONS
OF THE FOLLOWING
ROSEMOUNT SMART TRANSMITTERS

MODEL 3051C, 3051P, 3051L, 3051H, 3051CA
MODEL 3001C, 3001CL, 3001CH
MODEL 3001S, 3001SL, 3001SH

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA	CAD Maintained, (MICROSTATION).			
DR. SANDI MANSON 8/8/91	SIZE A	FSCM NO	DWG NO. 00268-0031	
ISSUED	SCALE N/A	WT.	SHEET 7 OF 7	

0031A07A

Figure B-3. CSA Installation
Drawing 03031-1024, Rev. AD
Page 1 of 9

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS

REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AA	ADD FIELDBUS	RTC1004232	M.L.M.	5/28/98
AB	ADD PROFIBUS, ENTITY PARAMETERS	RTC1008326	P.C.S.	2/4/00
AC	REM It, Vt FROM ENTITY PARAMETERS	RTC1009279	W.C.R.	7/11/00
AD	ADD FISCO FIELDBUS	RTC1012624	J.P.W.	4/4/02

APPROVALS FOR

3051C	3001C
3051L	3001CL
3051P	3001CH
3051H	3001S
3051CA	3001SL
3051T	3001SH

OUTPUT CODE A (4-20 mA HART) I.S. SEE SHEETS 2-3
OUTPUT CODE M (LOW POWER) I.S. SEE SHEETS 3-4
OUTPUT CODE F/W (FIELDBUS) I.S. SEE SHEETS 5-7
OUTPUT CODES A,F,W I.S. ENTITY PARAMETERS SHEET 8-9

TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM.

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

CAD MAINTAINED (MicroStation)

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125

-TOLERANCE-
.X ± .1 [2,5]
.XX ± .02 [0,5]
.XXX ± .010 [0,25]
FRACTIONS ± 1/32
ANGLES ± 2°

DO NOT SCALE PRINT

CONTRACT NO.
DR. Mike Dobe 08/27/90
CHK'D
APP'D. GLEN MONZO 8/31/90
APP'D. GOVT.

EMERSON. Process Management
ROSEMOUNT®
8200 Market Boulevard • Chanhassen, MN 55317 USA

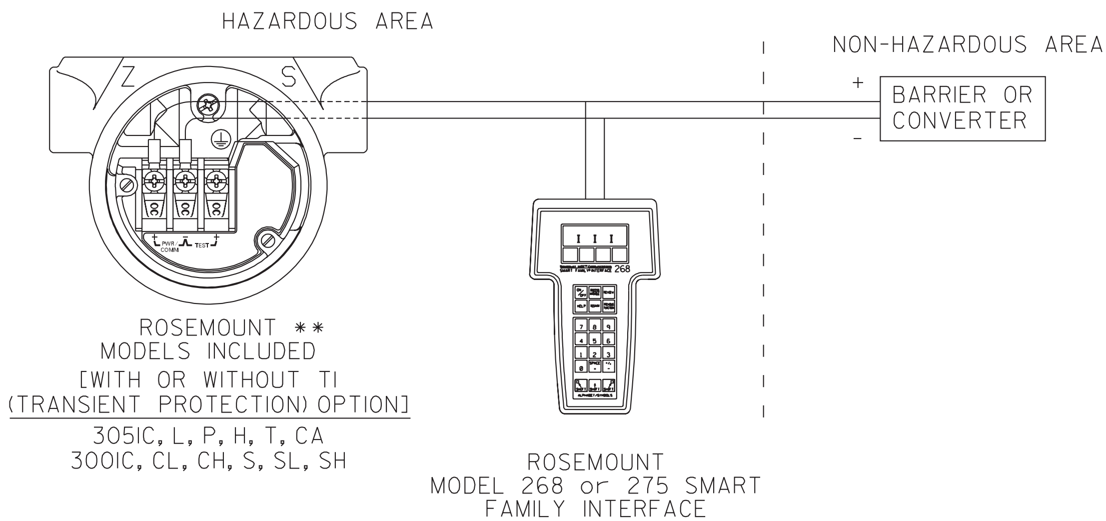
TITLE INDEX OF I.S. CSA FOR 3051C/L/P/H/T & 3001C/S

SIZE A | FSCM NO | DWG NO. 03031-1024
SCALE N/A | WT. | SHEET 1 OF 9

03031-1024A01A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

CSA INTRINSIC SAFETY APPROVALS
CIRCUIT CONNECTION WITH BARRIER OR CONVERTER
Ex ia
INTRINSICALLY SAFE/SECURITE INTRINSEQUE
4-20 mA, ("A" OUTPUT CODE)



** FOR THE LOW POWER OPTION, SEE PAGE 4 FOR THE CIRCUIT CONNECTION WITH BARRIER OR CONVERTER. FOR FIELDBUS OPTIONS("F" or "W" OUTPUT CODE), SEE PAGE 5 FOR PARAMETERS AND CIRCIUT CONNECTION TO BARRIER.

Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA

CAD MAINTAINED (MicroStation)

DR. Mike Dobe 08/27/90	SIZE A	FSCM NO	DWG NO.	Ø3Ø31-1Ø24
ISSUED	SCALE N/A	WT. ——	SHEET 2 OF 9	

03031-1024A02A

Page 3 of 9

REVISIONS

REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

4-20 mA, ("A" OUTPUT CODE)

DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV. I
CSA APPROVED SAFETY BARRIER	* 30 V OR LESS, 330 OHMS OR MORE * 28 V OR LESS, 300 OHMS OR MORE 25 V OR LESS, 200 OHMS OR MORE * 22 V OR LESS, 180 OHMS OR MORE	GROUPS A, B, C, D
FOXBORO CONVERTER 2AI-I2V-CGB, 2AI-I3V-CGB, 2AS-I3I-CGB, 3A2-I2D-CGB, 3A2-I3D-CGB, 3AD-I3I-CGB, 3A4-I2D-CGB, 2AS-I2I-CGB, 3F4-I2DA		GROUPS B, C, D
CSA APPROVED SAFETY BARRIER	30 V OR LESS, 150 OHMS OR MORE	GROUPS C, D

LOW POWER, ("M" OUTPUT CODE)

DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV. I
CSA APPROVED SAFETY BARRIER	Supply $\leq$ 28V, $\geq$ 300 Ω Return $\leq$ 10V, $\geq$ 47 Ω	GROUPS A, B, C, D
	Supply $\leq$ 30V, $\geq$ 150 Ω Return $\leq$ 10V, $\geq$ 47 Ω	GROUPS C, D

* MAY BE USED WITH ROSEMOUNT MODEL 268 or 275 SMART FAMILY INTERFACE.

Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA

CAD MAINTAINED (MicroStation)

DR. Mike Dobe	SIZE A	FSCM NO	DWG NO. 03031-1024
ISSUED	SCALE N/A	WT. ————	SHEET 3 OF 9

03031-1024A03A

Page 4 of 9

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

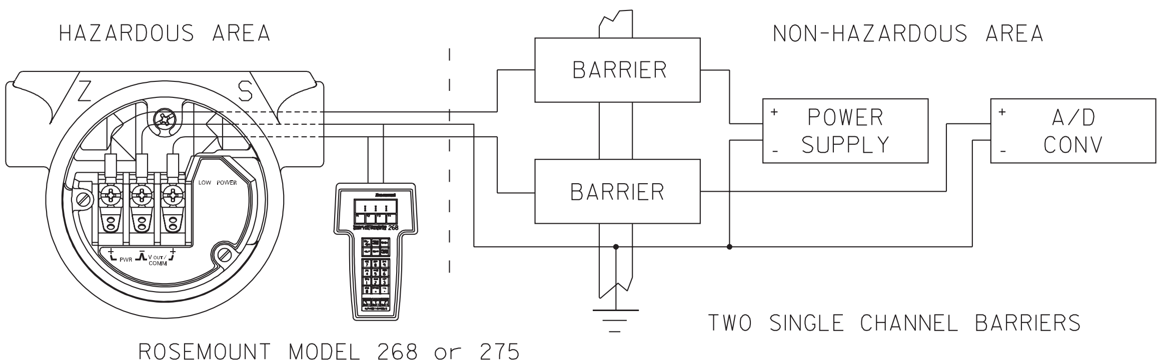
CSA INTRINSIC SAFETY APPROVALS

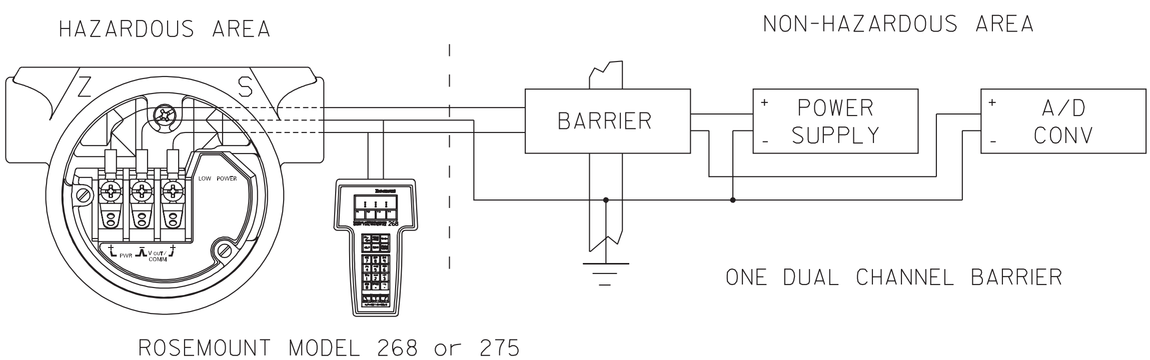
305IC LOW POWER CIRCUIT CONNECTION WITH INTRINSIC SAFETY BARRIERS

Ex ia

INTRINSICALLY SAFE/SECURITE INTRINSEQUE

LOWPOWER, ("M" OUTPUT CODE)





APPROVED FOR CLASS I, DIVISION I, GROUPS A,B,C,D WHEN USED IN CIRCUIT WITH TWO CSA APPROVED SINGLE CHANNEL SAFETY BARRIERS, ONE WITH APPROVED SAFETY PARAMETERS OF 28 VOLTS OR LESS AND 300 OHMS OR MORE IN +PWR LINE, AND ONE WITH APPROVED SAFETY PARAMETERS OF 10 VOLTS OR LESS AND 47 OHMS OR MORE IN Vout LINE, OR ONE CSA APPROVED DUAL CHANNEL SAFETY BARRIER WITH IDENTICAL APPROVED SAFETY PARAMETERS CONNECTED IN LIKE MANNER, AS ABOVE.

APPROVED FOR CLASS I, DIVISION I, GROUPS C,D WHEN USED IN CIRCUIT WITH TWO CSA APPROVED SINGLE CHANNEL SAFETY BARRIERS, ONE WITH APPROVED SAFETY PARAMETERS OF 30 VOLTS OR LESS AND 150 OHMS OR MORE IN +PWR LINE AND ONE WITH APPROVED SAFETY PARAMETERS OF 10 VOLTS OR LESS AND 47 OHMS OR MORE IN Vout LINE.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA	CAD MAINTAINED (MicroStation)			
DR. SANDI MANSON	SIZE A	FSCM NO	DWG NO. 03031-1024	
ISSUED	SCALE N/A	WT. ————	SHEET 4 OF 9	

03031-1024A04A

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

FIELDBUS, ("F" or "W" OUTPUT CODE)

DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV.I
CSA APPROVED SAFETY BARRIER	30 V OR LESS 300 OHMS OR MORE 28 V OR LESS 235 OHMS OR MORE 25 V OR LESS 160 OHMS OR MORE 22 V OR LESS 100 OHMS OR MORE	GROUPS A, B, C, D

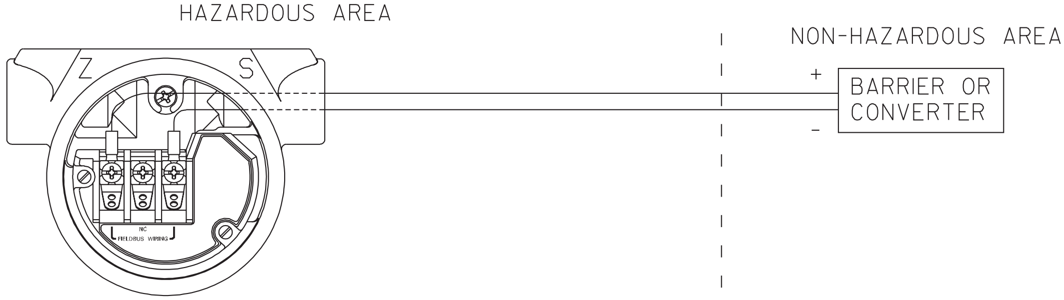
CSA INTRINSIC SAFETY APPROVALS

CIRCUIT CONNECTION WITH BARRIER OR CONVERTER

Ex ia

INTRINSICALLY SAFE/SECURITE INTRINSEQUE

FIELDBUS, ("F" or "W" OUTPUT CODE)



ROSEMOUNT **
MODELS INCLUDED
[WITH OR WITHOUT TI
(TRANSIENT PROTECTION) OPTION]

3051C, L, P, H, T, CA
3001C, CL, CH, S, SL, SH

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA	CAD MAINTAINED (MicroStation)			
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1024	
ISSUED	SCALE N/A	WT. ———	SHEET 5 OF 9	

03031-1024A05A

Page 6 of 9

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

FISCO CONCEPT APPROVALS

THE FISCO CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIALLY EXAMINED IN SUCH COMBINATION. FOR THIS INTERCONNECTION TO BE VALID THE VOLTAGE (U_i or Vmax), THE CURRENT (I_i or Imax), AND THE POWER (P_i or Pma) THAT INTRINSICALLY SAVE APPARATUS CAN RECEIVE AND REMAIN INTRINSICALY SAFE, INCLUDING FAULTS, MUST BE EQUAL OR GREATER THAN THE VOLTAGE (U_o, Voc, or Vt), THE CURRENT (I_o, Isc, or It), AND THE POWER (P_o or Pmax) LEVELS WHICH CAN BE DELIVERED BY THE ASSOCIATED APPARATUS, CONSIDERING FAULTS AND APPLICABLE FACTORS. ALSO, THE MAXIMUM UNPROTECTED CAPACITANCE (C_i) AND THE INDUCTANCE (L_i) OF EACH APPARATUS (BESIDES THE TERMINATION) CONNECTED TO THE FIELDBUS MUST BE LESS THAN OR EQUAL TO 5nF AND 10μH RESPECTVELY.
ONLY ONE ACTIVE DEVICE IN EACH SECTION (USUALLY THE ASSOCIATED APPARATUS) IS ALLOWED TO CONTRIBUTE THE DESIRED ENERGY FOR THE FIELDBUS SYSTEM. THE ASSOCIATED APPARATUS' VOLTAGE U_o (or Voc or Vt) IS LIMITED TO A RANGE OF 14V TO 24 V.D.C. ALL OTHER EQUIPENT COMBINED IN THE BUS CABLE MUST BE PASSIVE (THEY CANNOT PROVIDE ENERGY TO THE SYSTEM, EXCEPT A LEAKAGE CURRENT OF 50 μA FOR EACH CONNECTED DEVICE) SEPARATELY POWERED EQUIPMENT REQUIRES A GALVANIC ISOLATION TO AFFIRM THAT THE INTRINSICALLY SAFE FIELDBUS CIRCUIT WILL REMAIN PASSIVE. THE PARAMETER OF THE CABLE USED TO INTERCONNECT THE DEVICES MUST BE IN THE FOLLOWING RANGE:

LOOP RESISTANCE R':	15...150 OHM/km
INDUCTANCE PER UNIT LENGTH L':	0.4...1mH/KM
CAPACITANCE PER UNLIT LENGTH C':	80...200nF

C' = C' LINE/LINE +0.5C' LINE/SCREEN, IF BOTH LINES ARE FLOATING, OR
C' = C' LINE/LINE +C' LINE/SCREEN, IF THE SCREEN IS CONNECTED TO ONE LINE

TRUNK CABLE LENGTH:	≤ 1000 m
SPUR CABLE LENGTH:	≤ 30 m
SPLICE LENGTH:	≤ 1 m

AN APPROVED INFALLIBLE LINE TERMINATION TO EACH END OF THE TRUNK CABLE, WITH THE FOLLOWING PARAMETERS IS APPROPRIATE:

R = 90...100 OHMS   C = 2.2μF

AN ALLOWED TERMINATION MIGHT ALREADY BE LINKED IN THE ASSOCIATED APPARATUS. DUE TO I.S. REASONS, THE NUMBER OF PASSIVE APPARATUS CONNECTED TO THE BUS SEGMENT IS NOT LIMITED. IF THE RULES ABOVE ARE FOLLOWED, UP TO A TOTAL LENGTH OF 1000 m (THE SUMMATION OF TRUNK AND ALL SPUR CABLES), THE INDUCTANCE AND THE CAPACITANCE OF THE CABLE WILL NOT DAMAGE THE INTRINSIC SAFETY OF THE SYSTEM.

NOTES:
INTRINSICALLY SAFE CLASS I, DIV. 1, GROUPS A, B, C, D

1. THE MAXIMUM NON-HAZARDOUS AREA VOLTAGE MUST NOT EXCEED 250 V.
2. CAUTION: ONLY USE SUPPLY WIRES SUITABLE FOR 5°C ABOVE SURROUNDING TEMPERATURE.
3. WARNING: REPLACEMENT OF COMPONENTS MAY DAMAGE INTRINSIC SAFETY.

Rosemount Inc. 8200 Market Boulevard Chanhassen, MN 55317 USA	CAD MAINTAINED (MicroStation)				
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03031-1024		
ISSUED	SCALE N/A	WT. ————	SHEET 6 OF 9		

03031-1024A06A

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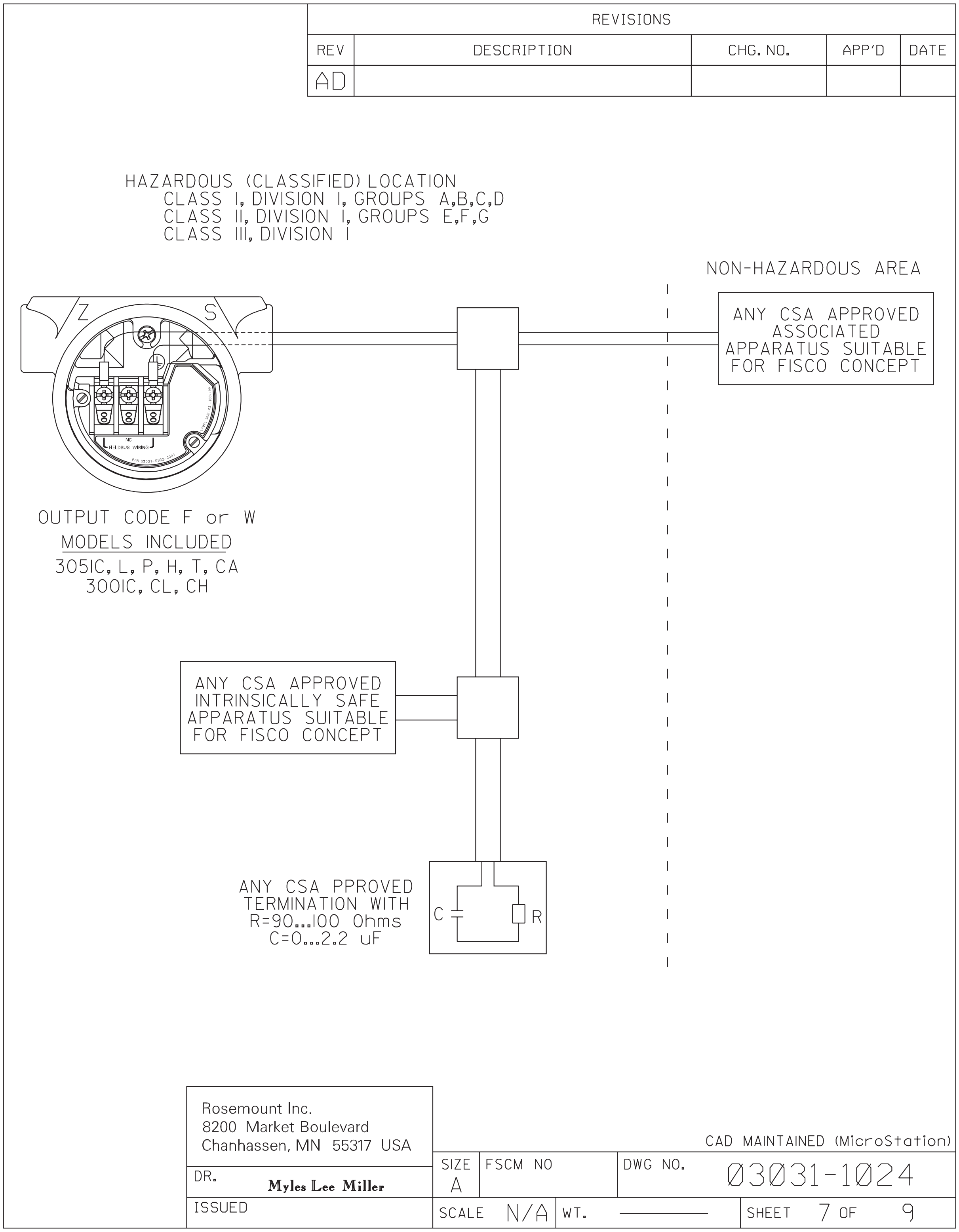

03031-1024A07A

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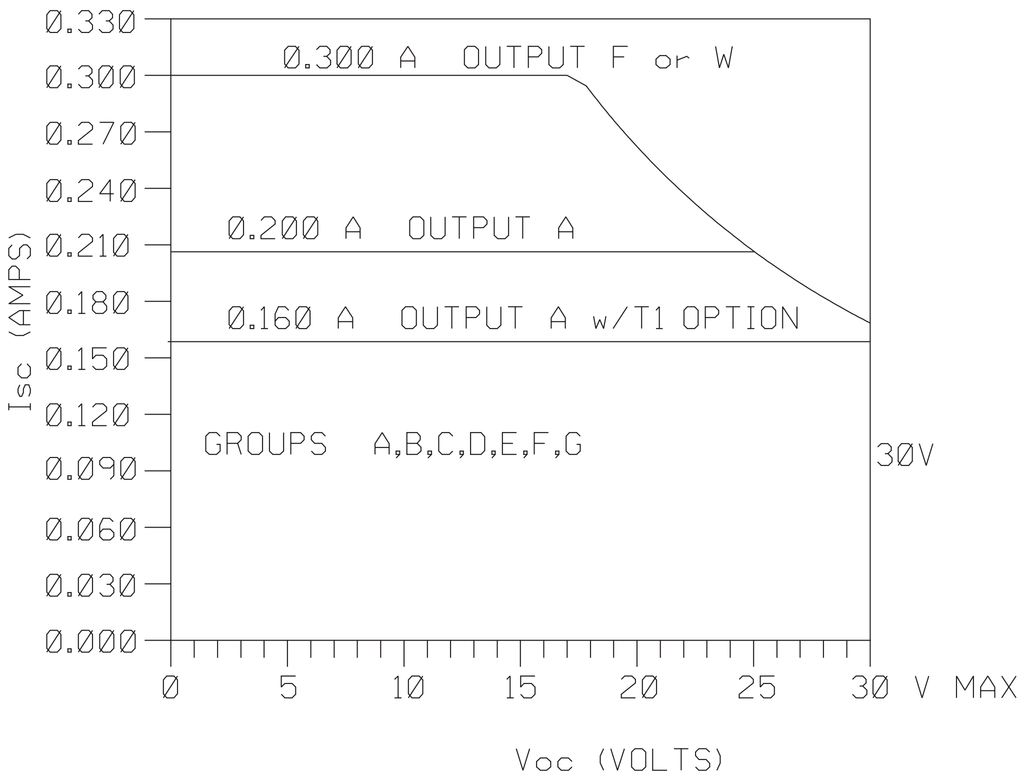
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

3051 I.S. ENTITY PARAMETERS. (OUTPUT CODE A,F, or W)

BARRIER PARAMETERS (APPLICABLE TO OUTPUT CODE A,F, or W)

Pmax = 1.3 WATT OUTPUT F or W
Pmax = 1.0 WATT OUTPUT A



Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA

CAD MAINTAINED (MicroStation)

DR. JON STEFFENS	SIZE A	FSCM NO	DWG NO. 03031-1024
ISSUED	SCALE N/A	WT. ————	SHEET 8 OF 9

03031-1024A08A

Page 9 of 9

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AD				

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (Voc) AND MAX. SHORT CIRCUIT CURRENT (Isc) AND MAX.POWER (Voc X Isc/4), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (Vmax), MAXIMUM SAFE INPUT CURRENT (Imax), AND MAXIMUM SAFE INPUT POWER (Pmax) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (Ca) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (C_I) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (La) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (L_I) OF THE INTRINSICALLY SAFE APPARATUS.

FOR OUTPUT CODE A

CLASS I, DIV. 1, GROUPS A, B, C AND D

V_{MAX} = 30V	V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 200mA	I_{SC} IS LESS THAN OR EQUAL TO 200mA
P_{MAX} = 1 WATT	$(\frac{Voc \times Isc}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .01µf	C_A IS GREATER THAN .01µf + C CABLE
L_I =10µH	L_A IS GREATER THAN 10µH + L CABLE

* FOR T1 OPTION:

Imax = 160mA	I_{SC} IS LESS THAN OR EQUAL TO 160mA
L_I =1.05mH	L_A IS GREATER THAN 1.05mH + L CABLE

FOR OUTPUT CODE F or W

CLASS I, DIV. 1, GROUPS A, B, C AND D

V_{MAX} = 30V	V_{OC} IS LESS THAN OR EQUAL TO 30V
I_{MAX} = 300mA	I_{SC} IS LESS THAN OR EQUAL TO 300mA
P_{MAX} = 1.3 WATT	$(\frac{Voc \times Isc}{4})$ IS LESS THAN OR EQUAL TO 1.3 WATT
C_I = 0µf	C_A IS GREATER THAN 0µf + C CABLE
L_I = 0µH	L_A IS GREATER THAN 0µH + L CABLE

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA

CAD MAINTAINED (MicroStation)

DR. JON STEFFENS	SIZE A	FSCM NO	DWG NO. 03031-1024
ISSUED	SCALE N/A	WT. ———	SHEET 9 OF 9

03031-1024A09A

Figure B-4. FM Installation
Drawing 03095-1025, Rev. AA
Page 1 of 3

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AA	ADD 2055	RTC1004207	L.M.E.	5/13/98

12. INSTALLATION TO BE IN ACCORDANCE WITH NATIONAL ELECTRICAL CODE.

9. NON-INCENDIVE FIELD WIRING METHODS MAY BE USED FOR CONNECTING THE TEMPERATURE SENSING ASSEMBLY. WHEN USING NON-INCENDIVE FIELD WIRING, THE CONNECTION HEAD AND TEMPERATURE SENSOR ASSEMBLY NEED NOT BE EXPLOSION PROOF, BUT ALL COMPONENTS CONNECTED TO THE TEMP SENSOR CONNECTOR MUST BE CLASSIFIED "SIMPLE APPARATUS". SIMPLE APPARATUS ARE DEVICES WHICH ARE INCAPABLE OF GENERATING OR STORING MORE THAN 1.2V, 0.1A, 25MW, OR 20μJ (RTD'S QUALIFY AS SIMPLE APPARATUS).

8. DIVISION 2 WIRING METHOD.

6. CLASS II INSTALLATIONS MUST USE A CSA APPROVED DUST-IGNITIONPROOF SENSOR.

5. IN AMBIENTS GREATER THAN 40°C, SPRING LOADED TEMPERATURE SENSORS USED WITHOUT AN EXPLOSIONPROOF THERMOWELL MUST BE RATED FOR AT LEAST 85°C.

4. COMPONENTS REQUIRED TO BE APPROVED MUST BE APPROVED FOR GAS GROUP APPROPRIATE TO AREA CLASSIFICATION.

3. ALL CONDUIT THREADS TO BE ASSEMBLED WITH FIVE FULL THREADS MINIMUM.

2. TRANSMITTER MUST NOT BE CONNECTED TO EQUIPMENT GENERATING MORE THAN 250VAC.

1. WIRING METHOD SUITABLE FOR CLASS I, DIV 1, ANY LENGTH.

NOTES:

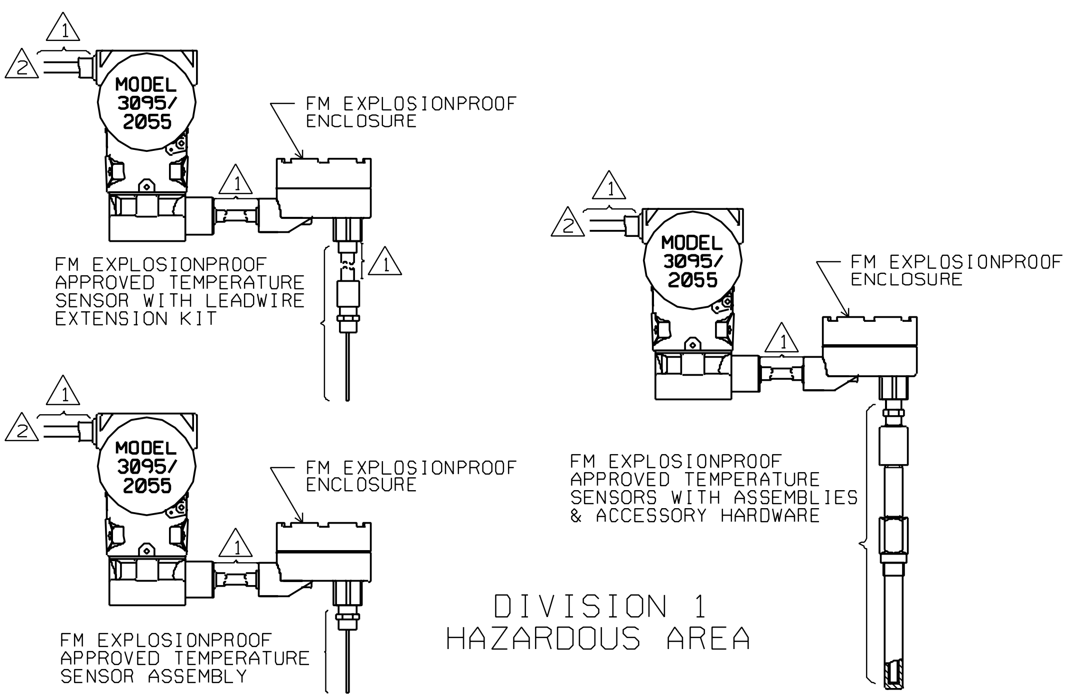
CAD Maintained, (MICROSTATION).

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125	CONTRACT NO.	ROSEMOUNT® MEASUREMENT FISHER-ROSEMOUNT	ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA
	DR. Myles Lee Miller 7/21/93	TITLE MODEL 3095/2055 EXPLOSIONPROOF INSTALLATION DRAWING, FACTORY MUTUAL	
-TOLERANCE- .X ± .1 [2.5] .XX ± .02 [0.5] .XXX ± .010 [0.25] FRACTIONS ± 1/32 ANGLES ± 2°	CHK'D BLL		
	APP'D. BEN LOUWAGIE 8/17/93	SIZE A	FSCM NO / DWG NO. 03095-1025
	APP'D. GOVT.		
DO NOT SCALE PRINT		SCALE / WT.	SHEET 1 OF 3

3095-1025A01A

Page 2 of 3

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AA		RTC1004207		



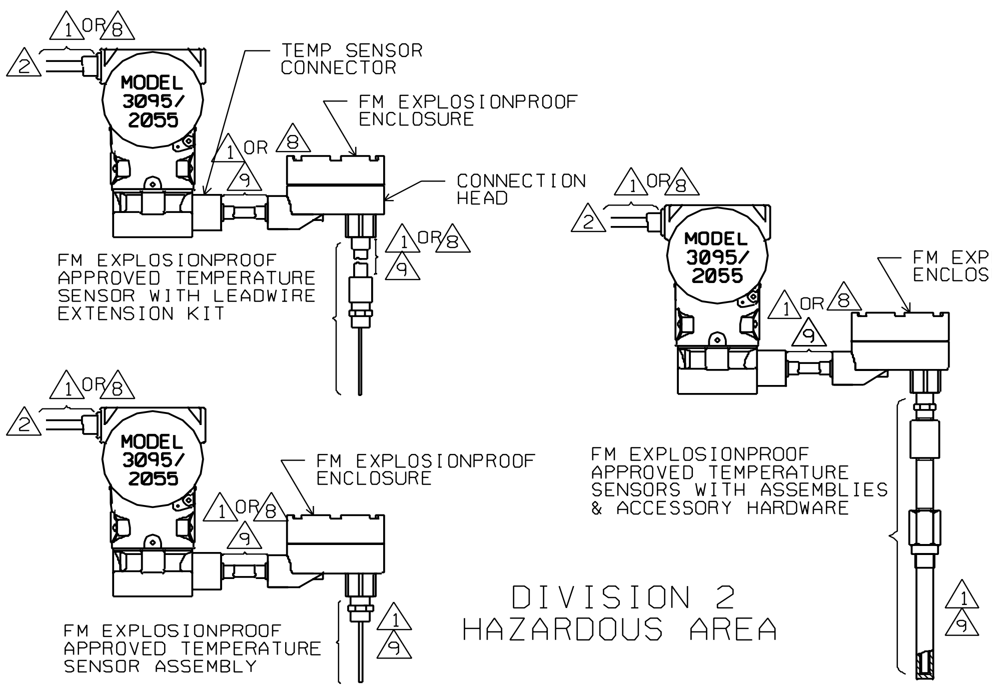
CAD Maintained, (MICROSTATION).

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA				
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1025	
ISSUED	SCALE N/A	WT. ————	SHEET 2 OF 3	

3095-1025A02A

Page 3 of 3

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AA		RTC1004207		



ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1025
ISSUED	SCALE N/A	WT. ————	SHEET 3 OF 3

3095-1025A03A

Figure B-5. FM Installation
Drawing 03095-1020, Rev. AB
Page 1 of 8

CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS

REV	DESCRIPTION	CHG. NO.	APP'D	DATE
B	ADD OPTIONAL COMPUTER CONNECTION	655550	D.E.W.	8/17/94
C	CORRECT ENTITY PARAMETERS	660398	K.D.V.	5/16/94
D	INCREASE VMAX	660728	K.D.V.	6/1/94
AA	ADD 3095C	RTC1003705	G.H.	4/17/98
AB	ADD 2055	RTC1004254	L.M.E.	6/9/98

ENTITY APPROVALS
FOR
3095/2055

THE ROSEMOUNT TRANSMITTERS LISTED ABOVE ARE F.M. APPROVED AS INTRINSICALLY SAFE WHEN USED IN CIRCUIT WITH F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED IN THE CLASS I, II, AND III, DIVISION 1 GROUPS INDICATED, TEMP CODE T4. ADDITIONALLY, THE ROSEMOUNT 751 FIELD SIGNAL INDICATOR F.S.M. APPROVED AS INTRINSICALLY SAFE WHEN CONNECTED IN CIRCUIT WITH ROSEMOUNT TRANSMITTERS (FROM ABOVE) AND F.M. APPROVED BARRIERS WHICH MEET THE ENTITY PARAMETERS LISTED FOR CLASS I, II, AND III, DIVISION 1, GROUPS INDICATED, TEMP CODE T4.

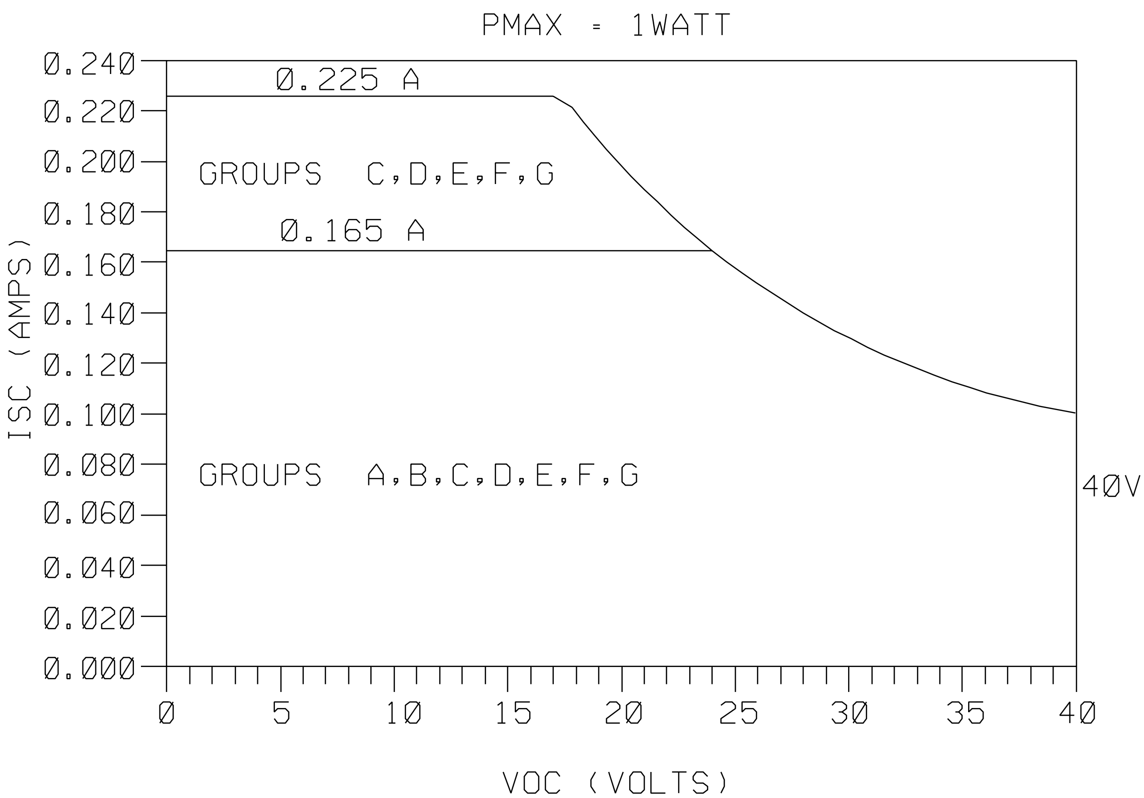
TO ASSURE AN INTRINSICALLY SAFE SYSTEM, THE TRANSMITTER AND BARRIER MUST BE WIRED IN ACCORDANCE WITH THE BARRIER MANUFACTURER'S FIELD WIRING INSTRUCTIONS AND THE APPLICABLE CIRCUIT DIAGRAM INDICATED ON SHEET 3, 5, OR 7.

CAD Maintained, (MICROSTATION).

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125	CONTRACT NO.	ROSEMOUNT MEASUREMENT / FISHER-ROSEMOUNT — ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA
-TOLERANCE- .X ± .1 [2.5] .XX ± .02 [0.5] .XXX ± .010 [0.25] FRACTIONS ± 1/32 ANGLES ± 2°	DR. Myles Lee Miller 3/19/93	TITLE INDEX OF I.S. F.M. FOR 3095
	CHK'D	
	APP'D. Kevin Voegele 4/8/93	SIZE A · FSCM NO · DWG NO. 03095-1020
DO NOT SCALE PRINT	APP'D. GOVT.	SCALE N/A · WT. ——— · SHEET 1 OF 8

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

BARRIER PARAMETERS



ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1020		
ISSUED	SCALE N/A	WT. ————		SHEET 2 OF 8	

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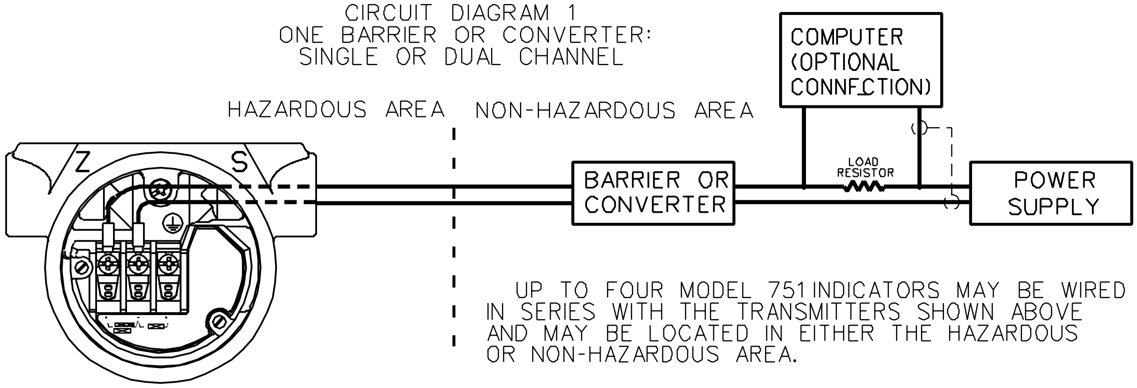
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

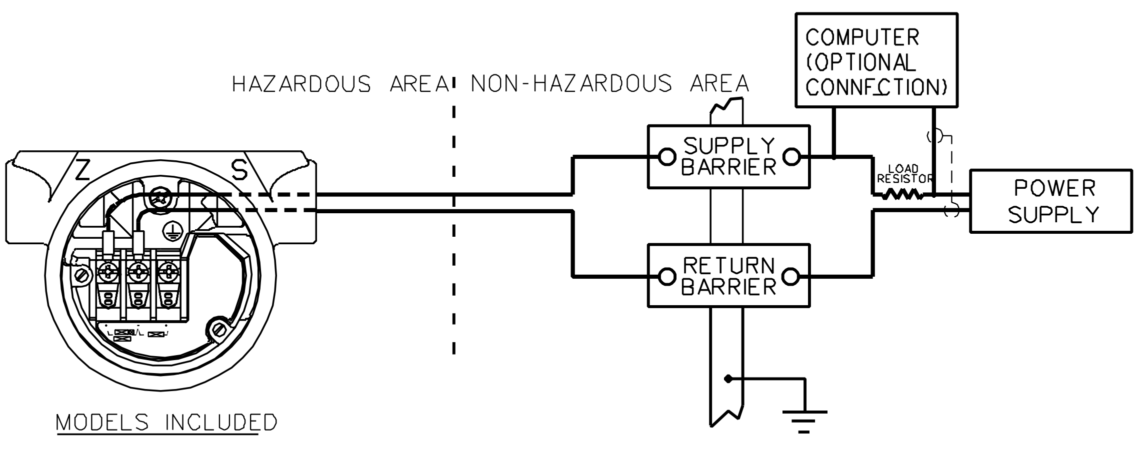
CIRCUIT DIAGRAM 1
ONE BARRIER OR CONVERTER:
SINGLE OR DUAL CHANNEL



UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

MODELS INCLUDED
3095M

CIRCUIT DIAGRAM 2
SUPPLY AND RETURN BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



MODELS INCLUDED
3095M

UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA	CAD Maintained, (MICROSTATION).			
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1020	
ISSUED	SCALE N/A	WT. ————	SHEET 3 OF 8	

REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (VOC OR VT) AND MAX. SHORT CIRCUIT CURRENT (ISC OR IT) AND MAX.POWER (VOC X ISC/4) OR (VT X IT/4), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (VMAX), MAXIMUM SAFE INPUT CURRENT (IMAX), AND MAXIMUM SAFE INPUT POWER (PMAX) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (CA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (CI) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (LA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (LI) OF THE INTRINSICALLY SAFE APPARATUS.

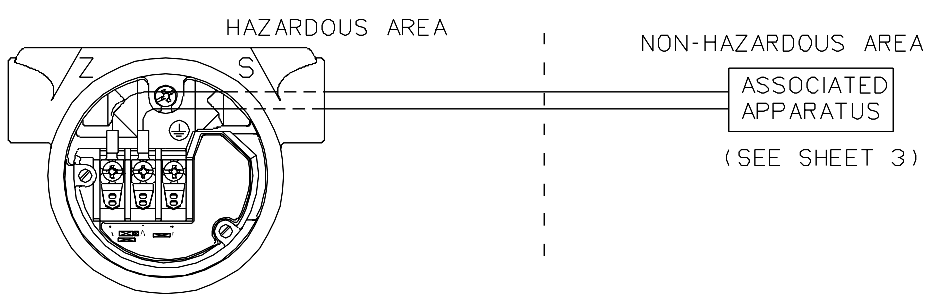
NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

CLASS I, DIV. 1, GROUPS A AND B

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
I_{MAX} = 165MA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 165MA
P_{MAX} = 1 WATT	$(\frac{V_T \times I_T}{4})$ OR $(\frac{VOC \times ISC}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .012μF	C_A IS GREATER THAN .012μF
L_I = 20μH	L_A IS GREATER THAN 20μH

CLASS I, DIV. 1, GROUPS C AND D

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
I_{MAX} = 225MA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225MA
P_{MAX} = 1 WATT	$(\frac{V_T \times I_T}{4})$ OR $(\frac{VOC \times ISC}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .012μF	C_A IS GREATER THAN .012μF
L_I = 20μH	L_A IS GREATER THAN 20μH



MODELS INCLUDED

3095M

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA	CAD Maintained, (MICROSTATION).				
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1020		
ISSUED	SCALE N/A	WT. ————	SHEET 4 OF 8		

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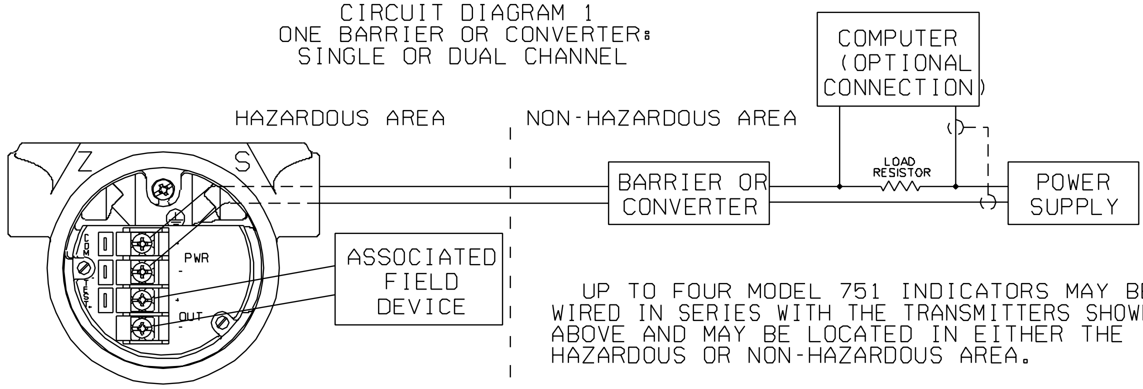
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

CIRCUIT DIAGRAM 1
ONE BARRIER OR CONVERTER:
SINGLE OR DUAL CHANNEL

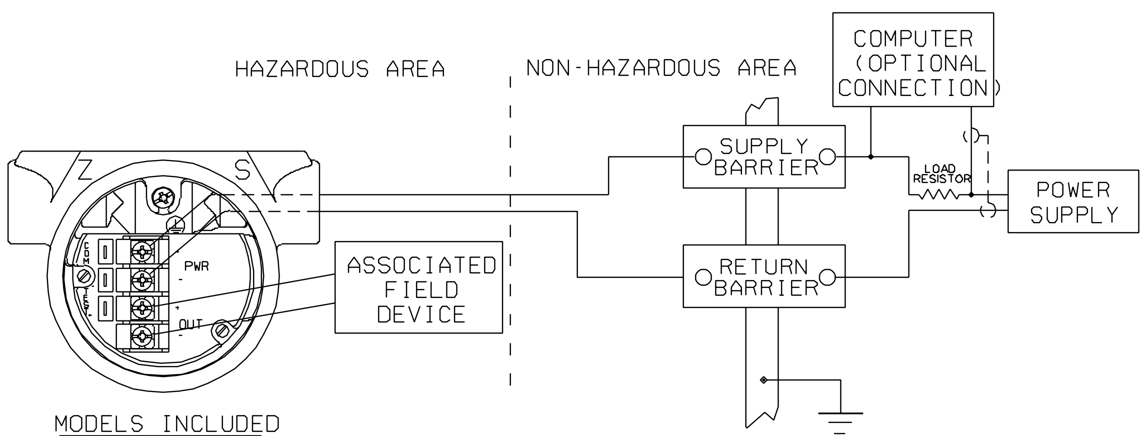


UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

MODELS INCLUDED

3095C

CIRCUIT DIAGRAM 2
SUPPLY AND RETURN BARRIERS
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



MODELS INCLUDED

3095C

UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1020
ISSUED	SCALE N/A	WT. ————	SHEET 5 OF 8

REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (VOC OR VT) AND MAX. SHORT CIRCUIT CURRENT (ISC OR IT) AND MAX.POWER (VOC X ISC/4) OR (VT X IT/4), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (VMAX), MAXIMUM SAFE INPUT CURRENT (IMAX), AND MAXIMUM SAFE INPUT POWER (PMAX) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (CA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (CI) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (LA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (LI) OF THE INTRINSICALLY SAFE APPARATUS.

NOTE: ENTITY PARAMETERS ARE FOR 3095C ONLY. USER MUST TAKE ENTITY PARAMETERS OF THE ASSOCIATED FIELD DEVICE INTO CONSIDERATION FOR INSTALLATION.

CLASS I, DIV. 1, GROUPS A AND B

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
I_{MAX} = 165MA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 165MA
P_{MAX} = 1 WATT	$(\frac{V_T \times I_T}{4})$ OR $(\frac{VOC \times ISC}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .012μF	C_A IS GREATER THAN .012μF
L_I = 20μH	L_A IS GREATER THAN 20μH

CLASS I, DIV. 1, GROUPS C AND D

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
I_{MAX} = 225MA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225MA
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C_I = .012μF	C_A IS GREATER THAN .012μF
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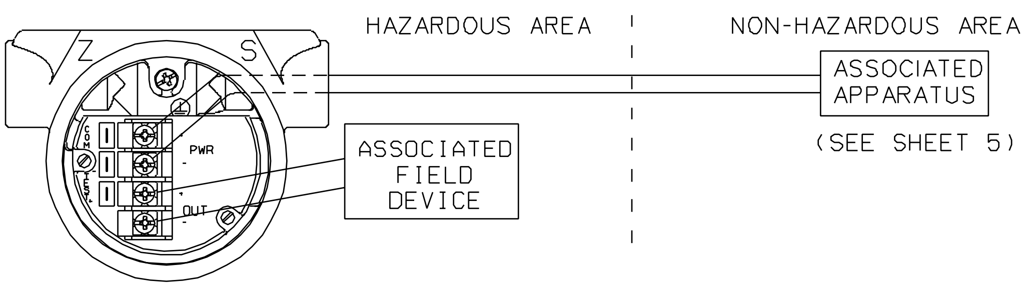

MODELS INCLUDED

3095C

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1020
ISSUED	SCALE N/A	WT. ————	SHEET 6 OF 8

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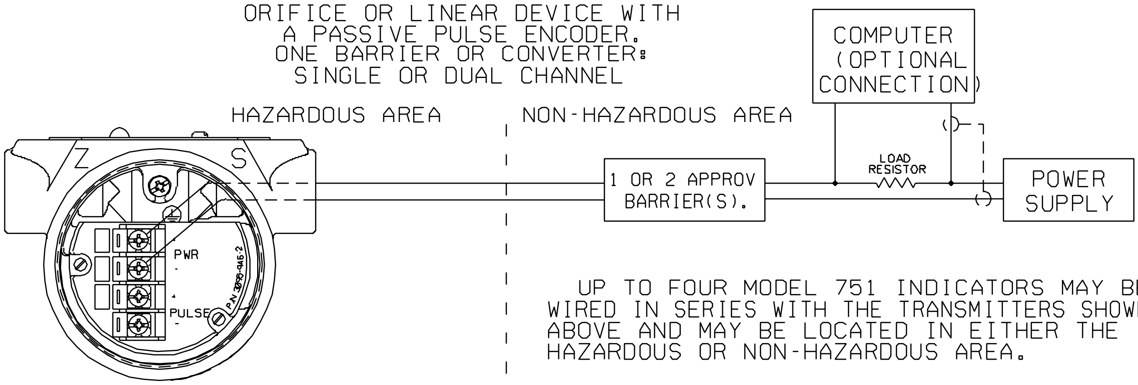
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

CIRCUIT DIAGRAM 1
ORIFICE OR LINEAR DEVICE WITH
A PASSIVE PULSE ENCODER.
ONE BARRIER OR CONVERTER:
SINGLE OR DUAL CHANNEL

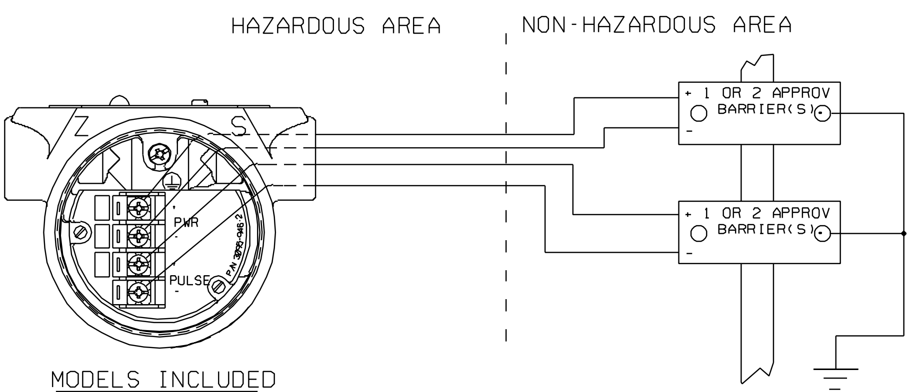


UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

MODELS INCLUDED

2055/3095FT

CIRCUIT DIAGRAM 2
LINEAR DEVICE WITH AN ACTIVE PULSE SIGNAL
REQUIRING EXTERNAL POWER.
(ONLY FOR USE WITH BARRIERS APPROVED IN THIS CONFIGURATION)



MODELS INCLUDED

2055/3095FT

UP TO FOUR MODEL 751 INDICATORS MAY BE WIRED IN SERIES WITH THE TRANSMITTERS SHOWN ABOVE AND MAY BE LOCATED IN EITHER THE HAZARDOUS OR NON-HAZARDOUS AREA.

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1020
ISSUED	SCALE N/A	WT. ————	SHEET 7 OF 8

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REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

ENTITY CONCEPT APPROVALS

THE ENTITY CONCEPT ALLOWS INTERCONNECTION OF INTRINSICALLY SAFE APPARATUS TO ASSOCIATED APPARATUS NOT SPECIFICALLY EXAMINED IN COMBINATION AS A SYSTEM. THE APPROVED VALUES OF MAX. OPEN CIRCUIT VOLTAGE (VOC OR VT) AND MAX. SHORT CIRCUIT CURRENT (ISC OR IT) AND MAX.POWER (VOC X ISC/4) OR (VT X IT/4), FOR THE ASSOCIATED APPARATUS MUST BE LESS THAN OR EQUAL TO THE MAXIMUM SAFE INPUT VOLTAGE (VMAX), MAXIMUM SAFE INPUT CURRENT (IMAX), AND MAXIMUM SAFE INPUT POWER (PMAX) OF THE INTRINSICALLY SAFE APPARATUS. IN ADDITION, THE APPROVED MAX. ALLOWABLE CONNECTED CAPACITANCE (CA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE CAPACITANCE AND THE UNPROTECTED INTERNAL CAPACITANCE (CI) OF THE INTRINSICALLY SAFE APPARATUS, AND THE APPROVED MAX. ALLOWABLE CONNECTED INDUCTANCE (LA) OF THE ASSOCIATED APPARATUS MUST BE GREATER THAN THE SUM OF THE INTERCONNECTING CABLE INDUCTANCE AND THE UNPROTECTED INTERNAL INDUCTANCE (LI) OF THE INTRINSICALLY SAFE APPARATUS.

NOTE: ENTITY PARAMETERS LISTED APPLY ONLY TO ASSOCIATED APPARATUS WITH LINEAR OUTPUT.

CLASS I, DIV. 1, GROUPS A AND B

V_{MAX} = 40V	V_T OR V_{OC} IS LESS THAN OR EQUAL TO 40V
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C_I = .012µF	C_A IS GREATER THAN .012µF
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CLASS I, DIV. 1, GROUPS C AND D

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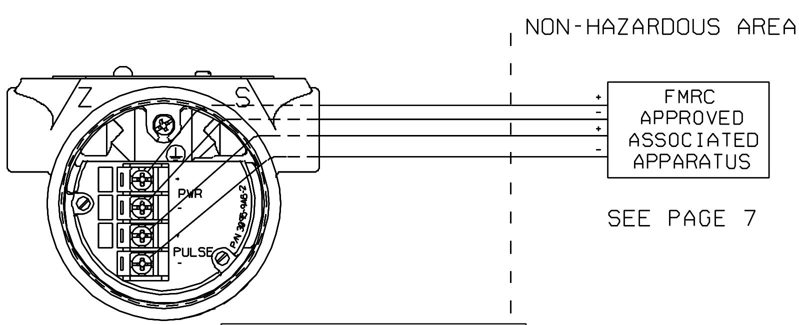
I_{MAX} = 225MA	I_T OR I_{SC} IS LESS THAN OR EQUAL TO 225MA
P_{MAX} = 1 WATT	$(\frac{V_T \times I_T}{4})$ OR $(\frac{VOC \times ISC}{4})$ IS LESS THAN OR EQUAL TO 1 WATT
C_I = .012µF	C_A IS GREATER THAN .012µF
L_I = 20µH	L_A IS GREATER THAN 20µH



MODELS INCLUDED	ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA	CAD Maintained, (MICROSTATION).				
2055/3095FT	DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1020		
	ISSUED	SCALE N/A	WT. ————	SHEET 8 OF 8		

Figure B-6. CSA Installation
Drawing 03095-1021, Rev. AB
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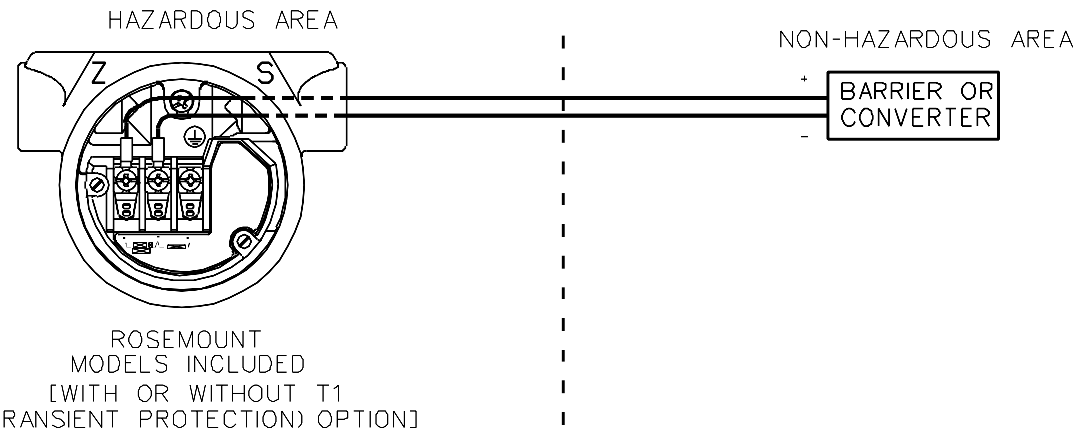
CONFIDENTIAL AND PROPRIETARY INFORMATION IS CONTAINED HEREIN AND MUST BE HANDLED ACCORDINGLY

REVISIONS

REV	DESCRIPTION	CHG. NO.	APP'D	DATE
C	ADD 3095-5000 TO DEVICES	656973	M.L.S.	11/03/93
AA	ADD 3095C	RTC1003705	G.H.	4/17/98
AB	ADD 2055	RTC1004254	L.M.E.	6/9/98

CSA INTRINSIC SAFETY APPROVALS
CIRCUIT CONNECTION WITH BARRIER OR CONVERTER
Ex ia
INTRINSICALLY SAFE/SECURITE INTRINSEQUE



ROSEMOUNT
MODELS INCLUDED
[WITH OR WITHOUT T1
(TRANSIENT PROTECTION) OPTION]
3095M

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

CAD Maintained, (MICROSTATION).

UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES [mm]. REMOVE ALL BURRS AND SHARP EDGES. MACHINE SURFACE FINISH 125

-TOLERANCE-
.X ± .1 [2.5]
.XX ± .02 [0.5]
.XXX ± .010 [0.25]
FRACTIONS ± 1/32
ANGLES ± 2°

DO NOT SCALE PRINT

CONTRACT NO.
DR. Myles Lee Miller 3/19/93
CHK'D
APP'D. Kevin Voegele 4/8/93
APP'D. GOVT.

ROSEMOUNT® MEASUREMENT
FISHER-ROSEMOUNT
ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

TITLE
INDEX OF I.S. CSA FOR 3095/2055

SIZE A | FSCM NO | DWG NO. 03095-1021
SCALE N/A | WT. | SHEET 1 OF 4

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REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

DEVICE	PARAMETERS	APPROVED FOR CLASS I, DIV.1
CSA APPROVED SAFETY BARRIER	30 V OR LESS 330 OHMS OR MORE 28 V OR LESS 300 OHMS OR MORE 25 V OR LESS 200 OHMS OR MORE 22 V OR LESS 180 OHMS OR MORE	GROUPS A, B, C, D
FOXBORO CONVERTER 2A1-12V-CGB, 2AI-13V-CGB, 2AS-131-CGB, 3A2-12D-CGB, 3A2-13D-CGB, 3AD-131-CGB, 3A4-12D-CGB, 2AS-121-CGB, 3F4-12DA		GROUPS B, C, D
CSA APPROVED SAFETY BARRIER	30 V OR LESS 150 OHMS OR MORE	GROUPS C, D
ROSEMOUNT 03095-5000-1012 03095-5000-2002	19 V OR LESS 200 OHMS OR MORE	GROUPS A, B, C, D

ROSEMOUNT INC.
12001 TECHNOLOGY DRIVE
EDEN PRAIRIE, MN 55344 USA

CAD Maintained, (MICROSTATION).

DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1021
ISSUED	SCALE N/A	WT. ————	SHEET 2 OF 4

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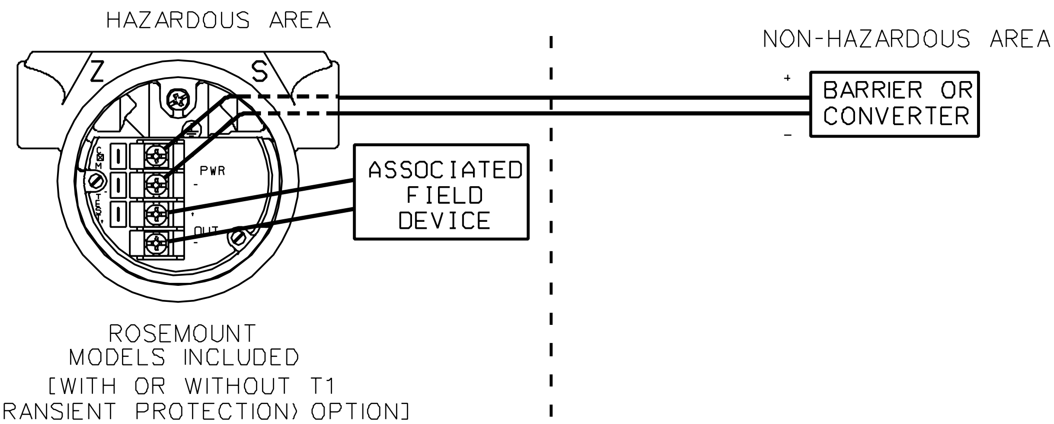
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

CSA INTRINSIC SAFETY APPROVALS

CIRCUIT CONNECTION WITH BARRIER OR CONVERTER

Ex ia

INTRINSICALLY SAFE/SECURITE INTRINSEQUE



ROSEMOUNT
MODELS INCLUDED
[WITH OR WITHOUT T1
(TRANSIENT PROTECTION) OPTION]

3095C

NOTE: SEE I.S. INSTALLATION DRAWING OF ASSOCIATED APPARATUS TO INSURE PROPER INSTALLATATION.

WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.

AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA	CAD Maintained, (MICROSTATION).			
DR. Myles Lee Miller	SIZE A	FSCM NO	DWG NO. 03095-1021	
ISSUED	SCALE N/A	WT. ————	SHEET 3 OF 4	

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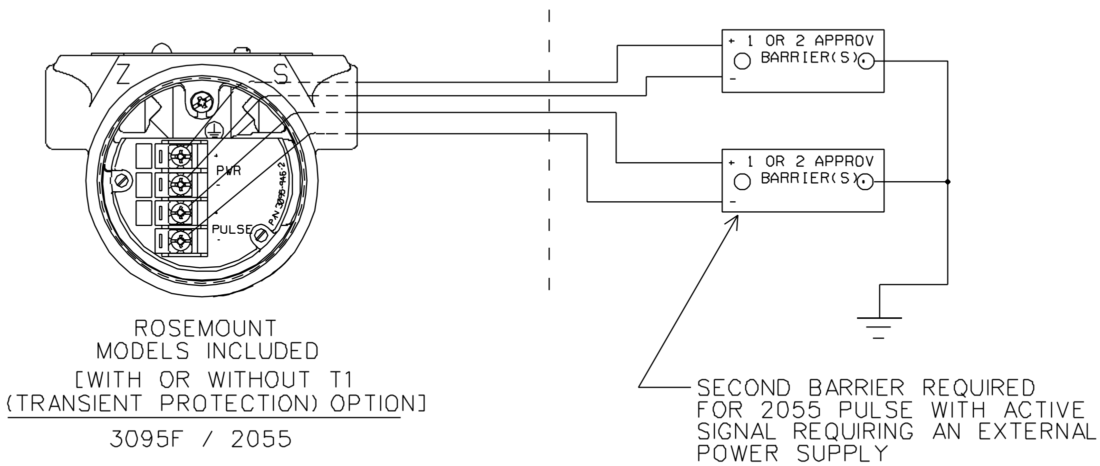
REVISIONS				
REV	DESCRIPTION	CHG. NO.	APP'D	DATE
AB		RTC1004254		

CSA INTRINSIC SAFETY APPROVALS
CIRCUIT CONNECTION WITH BARRIER OR CONVERTER
Ex ia
INTRINSICALLY SAFE/SECURITE INTRINSEQUE
*INTRINSICALLY SAFE OUTPUT PARAMETERS (SEE PAGE 2)



NOTE: SEE I.S. INSTALLATION DRAWING OF ASSOCIATED APPARATUS TO INSURE PROPER INSTALLATATION.

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AVERTISSEMENT - RISQUE D'EXPLOSION - LA SUBSTITUTION DE COMPOSANTS PEUT RENDRE CE MATERIEL INACCEPTABLE POUR LES EMPLACEMENTS DE CLASSE I, DIVISION 2.

* WHEN USING MORE THAN ONE CHANNEL OF A CSA APPROVED BARRIER, THE EFFECTIVE VOLTAGE AND RESISTANCE OF THE COMBINED LINES MUST COMPLY WITH THE LISTED INTRINSICALLY SAFE OUTPUT PARAMETERS. THE EFFECTIVE VOLTAGE AND RESISTANCE ARE TO BE CALCULATED AS FOLLOWED:

VOLTAGE: EFFECTIVE VOLTAGE= HIGHEST BARRIER VOLTAGE (NOTE: BOTH LINES MUST BE REFERERCED TO A COMMON GROUND)

RESISTANCE: EFFECTIVE RESISTANCE= PARRELLEL COMBINATION OF EACH LINE (NOTE: DIODE RETURNS DO NOT NEED TO BE INCLUDED FOR THIS CALCULATION).

ROSEMOUNT INC. 12001 TECHNOLOGY DRIVE EDEN PRAIRIE, MN 55344 USA	CAD Maintained, (MICROSTATION).				
DR. Jon T Steffens	SIZE A	FSCM NO	DWG NO. 03095-1021		
ISSUED	SCALE N/A	WT. ————	SHEET 4 OF 4		

Index

Annubar Flowmeter Series

Emerson Process Management

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F (952) 949-7001

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