Micro Motion™ F-Series Coriolis Flow and Density Sensors

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Safety messages

Safety messages are provided throughout this manual to protect personnel and equipment. Read each safety message carefully before proceeding to the next step.

Safety and approval information

This Micro Motion product complies with all applicable European directives when properly installed in accordance with the instructions in this manual. Refer to the EU declaration of conformity for directives that apply to this product. The EU declaration of conformity, with all applicable European directives, and the complete ATEX Installation Drawings and Instructions are available on the internet at www.emerson.com or through your local Micro Motion support center.

Information affixed to equipment that complies with the Pressure Equipment Directive, can be found on the internet at www.emerson.com.

For hazardous installations in Europe, refer to standard EN 60079-14 if national standards do not apply.

Other information

Full product specifications can be found in the product data sheet. Troubleshooting information can be found in the configuration manual. Product data sheets and manuals are available from the Micro Motion web site at www.emerson.com.

Return policy

Follow Micro Motion procedures when returning equipment. These procedures ensure legal compliance with government transportation agencies and help provide a safe working environment for Micro Motion employees. Micro Motion will not accept your returned equipment if you fail to follow Micro Motion procedures.

Return procedures and forms are available on our web support site at www.emerson.com, or by phoning the Micro Motion Customer Service department.

Emerson Flow customer service

Email:

- Worldwide: flow.support@emerson.com

- Asia-Pacific: APflow.support@emerson.com

Telephone:

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Mexico	+52 55 5809 5010	France	+33 (0) 800 917 901	India	800 440 1468
Argentina	+54 11 4809 2700	Germany	0800 182 5347	Pakistan	888 550 2682
Brazil	+55 15 3413 8000	Italy	+39 8008 77334	China	+86 21 2892 9000
Chile	+56 2 2928 4800	Central & Eastern	+41 (0) 41 7686 111	Japan	+81 3 5769 6803
Peru	+51 15190130	Russia/CIS	+7 495 995 9559	South Korea	+82 2 3438 4600
		Egypt	0800 000 0015	Singapore	+65 6 777 8211
		Oman	800 70101	Thailand	001 800 441 6426
		Qatar	431 0044	Malaysia	800 814 008
		Kuwait	663 299 01		
		South Africa	800 991 390		
		Saudi Arabia	800 844 9564		
		UAE	800 0444 0684		

Contents

1   Before you begin

1.1   About this document

This document provides information on planning, mounting, wiring, and grounding the F-Series sensor.

The information in this document assumes that users understand basic transmitter and sensor installation, configuration, and maintenance concepts and procedures.

1.2   Hazard messages

This document uses the following criteria for hazard messages based on ANSI standards Z535.6-2011 (R2017).

⚠ DANGER
Serious injury or death will occur if a hazardous situation is not avoided.

⚠ WARNING
Serious injury or death could occur if a hazardous situation is not avoided.

⚠ CAUTION
Minor or moderate injury will or could occur if a hazardous situation is not avoided.

NOTICE
Data loss, property damage, hardware damage, or software damage can occur if a situation is not avoided. There is no credible risk of physical injury.

Physical access

NOTICE
Unauthorized personnel can potentially cause significant damage and/or misconfiguration of end users' equipment. Protect against all intentional or unintentional unauthorized use.

Physical security is an important part of any security program and fundamental to protecting your system. Restrict physical access to protect users' assets. This is true for all systems used within the facility.

1.3   Related documentation

You can find all product documentation on the product documentation DVD shipped with the product or at www.emerson.com.

See any of the following documents for more information:

- The hazardous area approvals documentation shipped with the sensor or available at www.emerson.com/flowmeasurement.

- *Micro Motion F-Series Flow and Density Meters Product Data Sheet*

- *Micro Motion 9-Wire Flow Meter Cable Preparation and Installation Guide*

- The transmitter installation and configuration and use guides

2   Planning

2.1   Installation checklist

☐ Make sure that the hazardous area specified on the approval tag is suitable for the environment in which the meter will be installed.

> ⚠ **WARNING**
> Failure to abide by approvals can cause an explosion resulting in injury or death.

☐ Verify that the local ambient and process temperatures are within the limits of the meter.

☐ If your sensor has an integral transmitter, no wiring is required between the sensor and transmitter. Follow the wiring instructions in the transmitter installation manual for signal and power wiring.

☐ If your transmitter has remote-mounted electronics, follow the instructions in this manual for wiring between the sensor and the transmitter, and then follow the instructions in the transmitter installation manual for power and signal wiring.
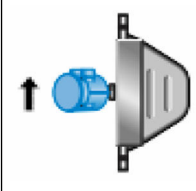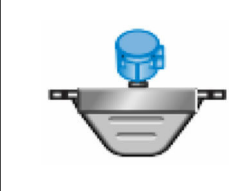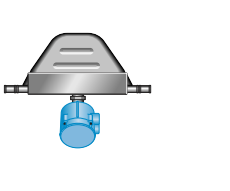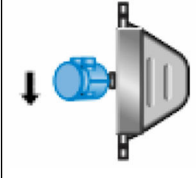
Table 2-1: Maximum cable lengths
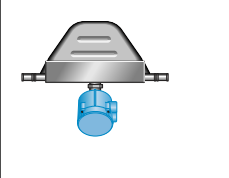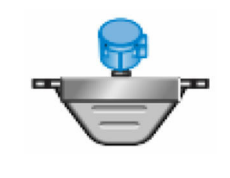
Cable type	To transmitter	Maximum length
Micro Motion 9-wire	9739 MVD and 5700 transmitter	1,000 ft (305 m)
	All other MVD transmitters	60 ft (18 m)
Micro Motion 4-wire	All 4-wire MVD transmitters	1,000 ft (305 m) without Ex-approval 500 ft (152 m) with IIC-rated sensors 1,000 ft (305 m) with IIB-rated sensors

Table 2-2: Maximum lengths for user-supplied 4-wire cable

Wire function	Wire size	Maximum length
Power (VDC)	22 AWG (0.326 mm²)	300 ft (91 m)
	20 AWG (0.518 mm²)	500 ft (152 m)
	18 AWG (0.823 mm²)	1,000 ft (305 m)
Signal (RS-485)	22 AWG (0.326 mm²) or larger	1,000 ft (305 m)

☐ For optimal performance, install the sensor in the preferred orientation. The sensor will work in any orientation as long as the flow tubes remain full of process fluid.

Table 2-3: Preferred sensor orientation

Process	Preferred orientation	Secondary preferred orientation	Alternate suitable orientation
Liquids & slurries			
Gases			

☐ Install the meter so that the flow direction arrow on the sensor case matches the actual forward flow of the process. (Flow direction is also software-selectable.)

2.2 Best practices

The following information can help you get the most from your sensor.

• There are no pipe run requirements for Micro Motion sensors. Straight runs of pipe upstream or downstream are unnecessary.

• If the sensor is installed in a vertical pipeline, liquids and slurries should flow upward through the sensor. Gases should flow downward.

• Keep the sensor tubes full of process fluid.

• For halting flow through the sensor with a single valve, install the valve downstream from the sensor.

• The sensor does not require external supports. The flanges will support the sensor in any orientation.

2.3 Temperature limits

Sensors can be used in the process and ambient temperature ranges shown in the temperature limit graphs. For the purposes of selecting electronics options, temperature limit graphs should be used only as a general guide. If your process conditions are close to the gray area, consult technical support.

Notes

• In all cases, the electronics cannot be operated where the ambient temperature is below -40 °F (-40.0 °C) or above 140 °F (60.0 °C). If a sensor is to be used where the ambient temperature is outside of the range permissible for the electronics, the electronics must be remotely located where the ambient temperature is within the permissible range, as indicated by the shaded areas of the temperature limit graphs.

- Temperature limits may be further restricted by hazardous area approvals. Refer to the hazardous area approvals documentation shipped with the sensor or at www.emerson.com/flowmeasurement.

- The extended-mount electronics option allows the sensor case to be insulated without covering the transmitter, core processor, or junction box, but does not affect temperature ratings. When insulating the sensor case at elevated process temperatures above 140 °F (60.0 °C), ensure electronics are not enclosed in insulation as this may lead to electronics failure.

### Ambient and process temperature limits for standard-temperature models

The following chart shows ambient and process temperature limits for standard temperature models using 316L stainless steel (S), nickel alloy C22 (H), and high pressure (P).
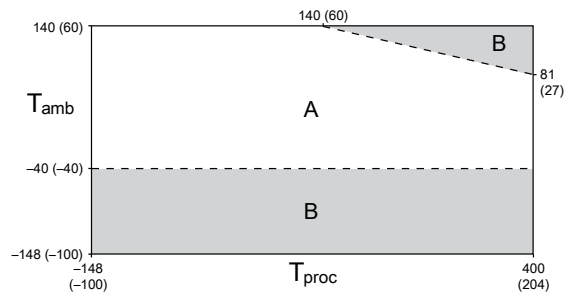
T_{amb} = Ambient temperature °F (°C)
T_{proc} = Process temperature °F (°C)
A = All available electronic options
B = Remote mount electronics only

Ambient and process temperature limits for high-temperature models

The following chart shows ambient and process temperature limits for high temperature models using 316L stainless steel (A) and nickel alloy C22 (B).
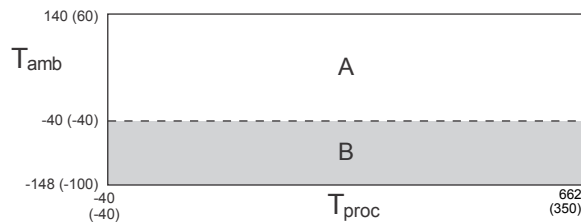
T_{amb} = Ambient temperature °F (°C)
T_{proc} = Process temperature °F (°C)
A = All available electronic options
B = Remote mount electronics only

3   Mounting

## 3.1   Mount the sensor

NOTICE

- Lifting the sensor by the electronics or purge connections can damage the device.

- To reduce the risk of collecting liquid in the electronics housing, do not orient transmitters or sensor junction boxes with their conduit openings pointing upward.

Procedure

Mount the sensor.

Notes

- Do not use the sensor to support the piping.

- The sensor does not require external supports. The flanges will support the sensor in any orientation.
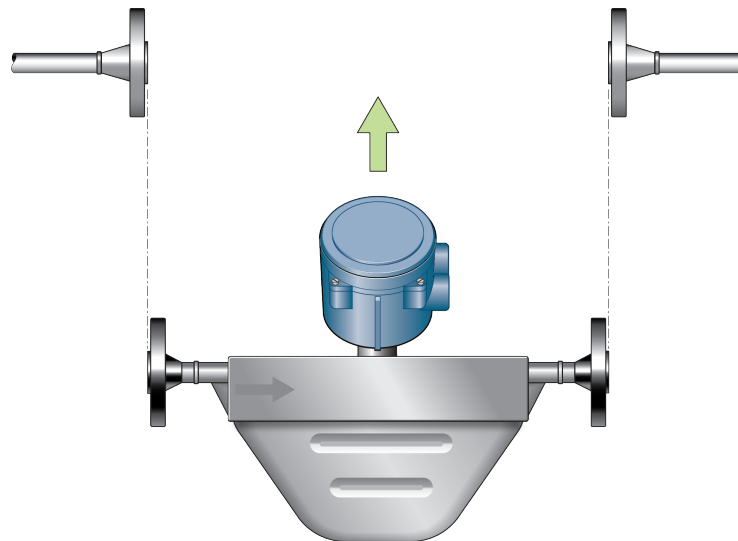
3.2   Attach extended electronics

If your installation has a sensor with extended electronics, you will need to install the extender onto the sensor case.

Extended core processors are matched at the factory to specific sensors. Keep each core processor together with the sensor with which it was shipped.
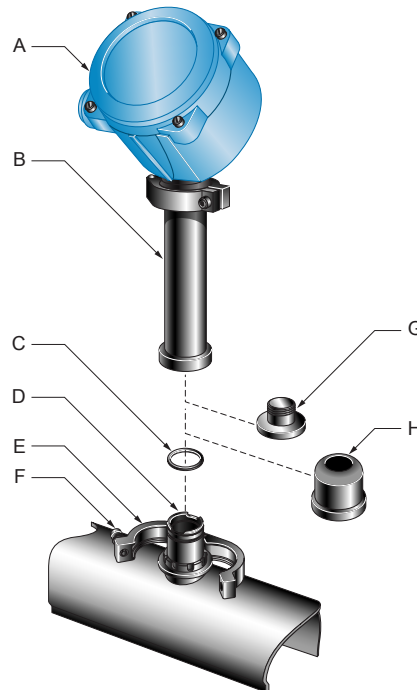
NOTICE
Keep the extender and feedthrough clean and dry. Moisture or debris in the extender or feedthrough can damage electronics and result in measurement error or flowmeter failure.

Procedure

1. Remove and recycle the plastic cap from the feedthrough on the sensor.

   Figure 3-1: Feedthrough and extender components

   A. *Transmitter or core processor*
   B. *Extender*
   C. *O-ring*
   D. *Feedthrough*
   E. *Clamping ring*
   F. *Clamping screw*
   G. *Plastic plug*
   H. *Plastic cap*

2. Loosen the clamping screw and remove the clamping ring. Leave the O-ring in place on the feedthrough.

3. Remove and recycle the plastic plug from the extender.

4. Fit the extender onto the feedthrough by carefully aligning the notches on the bottom of the extender with the notches on the feedthrough.

5. Close the clamping ring and tighten the clamping screw to 13 in lbf (1.47 N m) to 18 in lbf (2.03 N m).

4 Wiring

4.1 Options for wiring

The wiring procedure you follow depends on which electronics option you have.

Table 4-1: Wiring procedures by electronics option

Electronics option	Wiring procedure
Integral transmitter	The transmitter is already connected to the sensor. No wiring is required between sensor and transmitter. See the transmitter installation manual for wiring the power and signal cable to the transmitter.
Extended electronics	The electronics are separated from the sensor by an extender and must be attached as described in Attach extended electronics. There is no wiring required because the physical connection includes the electrical connection.
MVD™ Direct Connect ™	There is no transmitter to wire. See the *Micro Motion MVD Direct Connect Meters* manual for wiring the power and signal cable between the sensor and the direct host.
Integral core processor with remote transmitter	The core processor is already connected to the sensor. Connect a 4-wire cable between the core processor and transmitter. Refer to Connect 4-wire cable.
Remote core processor attached to transmitter	Connect a 9-wire cable between the sensor and the transmitter/core processor. Refer to Connect the 9-wire cable , as well as the Micro Motion *Micro Motion 9-Wire Flow Meter Cable Preparation and Installation Guide*.
Remote core processor separate from transmitter – *double-hop*	• Connect a 4-wire cable between the core processor and transmitter. Refer to Connect 4-wire cable. • Connect a 9-wire cable between the sensor and the core processor. Refer to Connect the 9-wire cable , as well as the Micro Motion *Micro Motion 9-Wire Flow Meter Cable Preparation and Installation Guide*

⚠ **WARNING**

Make sure the hazardous area specified on the sensor approval tag is suitable for the environment in which the sensor will be installed. Failure to comply with the requirements for intrinsic safety in a hazardous area could result in an explosion resulting in injury or death.

NOTICE

Fully close and tighten all housing covers and conduit openings. Improperly sealed housings can expose electronics to moisture, which can cause measurement error or flowmeter failure. Inspect and grease all gaskets and O-rings.

4.2   Connect 4-wire cable

4.2.1   4-wire cable types and usage

Micro Motion offers two types of 4-wire cable: shielded and armored. Both types contain shield drain wires.

The cable supplied by Micro Motion consists of one pair of red and black 18 AWG (0.823 mm²) wires for the VDC connection, and one pair of white and green 22 AWG (0.326 mm²) wires for the RS-485 connection.

User-supplied cable must meet the following requirements:

- Twisted pair construction.

- Applicable hazardous area requirements, if the core processor is installed in a hazardous area.

- Wire gauge appropriate for the cable length between the core processor and the transmitter, or the host.

Wire gauge	Maximum cable length
VDC 22 AWG (0.326 mm²)	300 ft (91 m)
VDC 20 AWG (0.518 mm²)	500 ft (152 m)
VDC 18 AWG (0.823 mm²)	1,000 ft (305 m)
RS-485 22 AWG (0.326 mm²) or larger	1,000 ft (305 m)

### 4.2.2   Prepare a cable with a metal conduit

Procedure

1. Remove the core processor cover using a flat-blade screw driver.
2. Run the conduit to the sensor.
3. Pull the cable through the conduit.
4. Cut the drain wires and let them float at both ends of the conduit.

4.2.3   Prepare a cable with user-supplied cable glands

Procedure

1. Remove the core processor cover using a flat-blade screw driver.
2. Pass the wires through the gland nut and gland body.
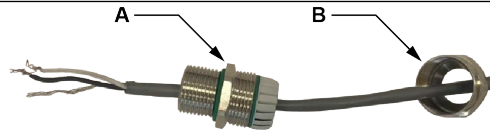
A. Gland body
B. Gland nut

3. Terminate the RS-485 shield and drain wires to the housing internal grounding screw.

4. Assemble the gland according to vendor instructions.

4.2.4 Prepare a cable with Micro Motion-supplied cable glands

Procedure

1. Remove the core processor cover using a flat-blade screw driver.

2. Pass the wires through the gland nut and clamping insert.
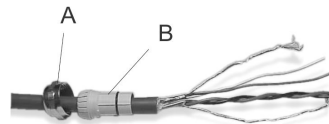

A. Gland nut
B. Clamping insert

3. Strip the cable jacket.

Option	Description
NPT gland type	Strip 4.5 in (114 mm)
M20 gland type	Strip 4.25 in (108 mm)

4. Remove the clear wrap and filler material.

5. Strip most of the shielding.

Option	Description
NPT gland type	Strip all but 0.75 in (19 mm)
M20 gland type	Strip all but 0.5 in (13 mm)

6. Wrap the drain wires twice around the shield and cut off the excess drain wires.
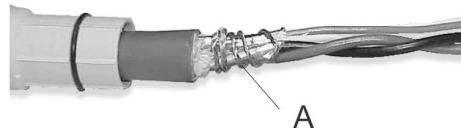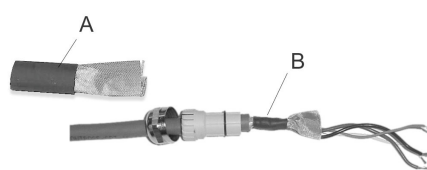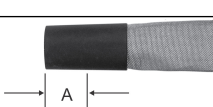

A. Drain wires wrapped around shield

7. For foil (shielded cable) only:

Note
For braided (armored cable) skip this step and contine to the next step.

Option	Description
NPT gland type	a. Slide the shielded heat shrink over the drain wires. Ensure that the wires are completely covered. b. Apply 250 °F (121.1 °C) heat to shrink the tubing. Do not burn the cable. c. Position the clamping insert so the interior end is flush with the braid of the heat shrink. A. Shielded heat shrink B. After heat is applied
M20 gland type	Trim 0.3 in (8 mm). A. Trim

8. Assemble the gland by folding the shield or braid back over the clamping insert and 0.125 in (3 mm) past the O-ring.
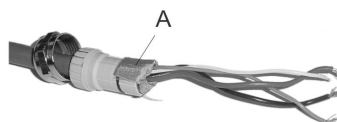
A. Shield folded back

9. Install the gland body into the conduit opening on the core processor housing.

10. Insert the wires through the gland body and tighten the gland nut onto the gland body.


A. *Shield folded back*
B. *Gland body*

4.2.5   Connect the wires to the core processor terminals

After the 4-wire cable has been prepared and shielded (if required), connect the individual wires of the 4-wire cable to the terminals on the core processor.

Procedure

1. Connect the wires to the core processor terminals.
   - If you are connecting to a standard core processor, use the following image and connections:
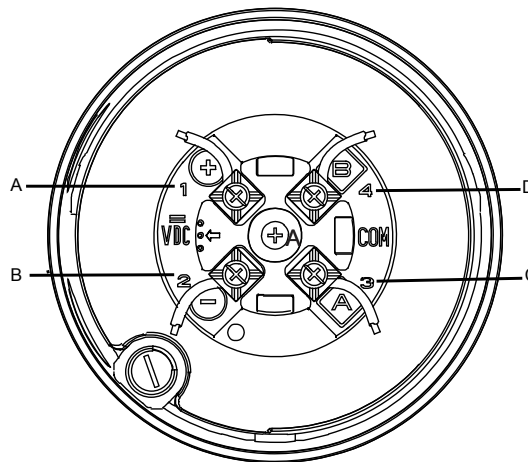
A. *Terminal 1 (Power supply +): Red wire*
B. *Terminal 2 (Power supply -): Black wire*
C. *Terminal 3 (RS-485/A): White wire*
D. *Terminal 4 (RS-485/B): Green wire*

   - If you are connecting to an enhanced core processor, use the following image and connections:
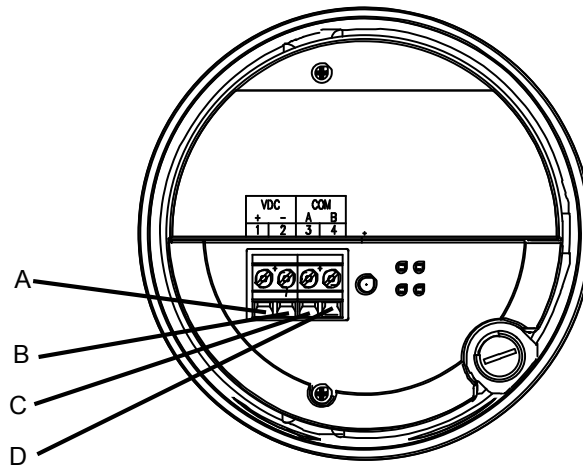
A. Terminal 1 (Power supply +): Red wire
B. Terminal 2 (Power supply -): Black wire
C. Terminal 3 (RS-485/A): White wire
D. Terminal 4 (RS-485/B): Green wire

2. Reinstall the core processor cover.

3. Torque the cover screws to:
   - For aluminum housing: 10 in lbf (1.13 N m) to 13 in lbf (1.47 N m)
   - For stainless steel housing: minimum 19 in lbf (2.15 N m)

   If properly seated, there will be no gap between cover and base.

4. Connect the wires to the transmitter terminals using the transmitter installation manual.

4.3 Connect the 9-wire cable

Procedure

1. Prepare and install the cable according to the instructions in the *Micro Motion 9-Wire Flow Meter Cable Preparation and Installation Guide*.

2. Insert the stripped ends of the individual wires into the terminal blocks of the junction box. Ensure that no bare wires remain exposed.

3. Match the wires color for color. For wiring at the transmitter or remote core processor, refer to the transmitter documentation.

4. Tighten the screws to hold the wires in place.

5. Ensure integrity of gaskets, then tightly close and seal the junction box cover and all housing covers.

6. Refer to the transmitter installation manual for signal and power wiring instructions.

5   Grounding

The meter must be grounded according to the standards that are applicable at the site. The customer is responsible for knowing and complying with all applicable standards.

Prerequisites

Use the following guides for grounding practices:

- In Europe, IEC 60079-14 is applicable to most installations, in particular sections 16.2.2.3 and 16.2.2.4.

- In the U.S.A. and Canada, ISA 12.06.01 Part 1 provides examples with associated applications and requirements.

If no external standards are applicable, follow these guidelines to ground the sensor:

- Use copper wire, 14 AWG (2.08 mm²) or larger wire size.

- Keep all ground leads as short as possible, less than 1 Ω impedance.

- Connect ground leads directly to earth, or follow plant standards.

NOTICE
Ground the flowmeter to earth, or follow ground network requirements for the facility. Improper grounding can cause measurement error.

Procedure

- Check the joints in the pipeline.
  - If the joints in the pipeline are ground-bonded, the sensor is automatically grounded and no further action is necessary (unless required by local code).

  - If the joints in the pipeline are not grounded, connect a ground wire to the grounding screw located on the sensor electronics.

    Tip
    The sensor electronics may be a transmitter, core processor, or junction box. The grounding screw may be internal or external.

6 Supplementary information

6.1 Purge the sensor case

Prerequisites

Make sure the following are available before beginning the purge procedure:

- Teflon™ tape
- Argon or nitrogen gas sufficient to purge the sensor case

Whenever a purge plug is removed from the sensor case, you must purge the case again.

Procedure

1. Shut down the process, or set control devices for manual operation.

   NOTICE

   Before performing the case purging procedure, shut down the process or set the control devices for manual operation. Performing the purge procedure while the flowmeter is operating could affect measurement accuracy, resulting in inaccurate flow signals.

2. Remove both purge plugs from the sensor case. If purge lines are being used, open the valve in the purge lines.

   ⚠️ **WARNING**
   - If a rupture disk has been installed on the purge fitting, stay clear of the rupture disk pressure relief area. High-pressure fluid escaping from the sensor can cause severe injury or death. Orient the sensor so that personnel and equipment will not be exposed to any discharge along the pressure relief path.
   - Take all necessary precautions when removing purge plugs. Removing a purge plug compromises the secondary containment of the sensor and could expose the user to process fluid.
   - Improper pressurization of the sensor case could result in injury.

   NOTICE

   If a rupture disk has been installed on the purge fitting, use thread protectors when removing the purge fitting so as not to damage the disk membrane surrounding the rupture disk.

3. Prepare the purge plugs for reinstallation by wrapping them with 2–3 turns of Teflon tape.

4. Connect the supply of nitrogen or argon gas to the inlet purge connection or open inlet purge line. Leave the outlet connection open.

   NOTICE
   - Exercise caution to avoid introducing dirt, moisture, rust, or other contaminants into the sensor case.

- If the purge gas is heavier than air (such as argon), locate the inlet lower than the outlet, so that the purge gas will displace air from bottom to top.

- If the purge gas is lighter than air (such as nitrogen), locate the inlet higher than the outlet, so that the purge gas will displace air from top to bottom.

5. Make sure that there is a tight seal between the inlet connection and sensor case, so that air cannot be drawn by suction into the case or purge line during the purging process.

6. Run purge gas through the sensor.

   The purge time is the amount of time required for full exchange of atmosphere to inert gas. The larger the line size, the greater amount of time is required to purge the case. If purge lines are being used, increase the purge time to fill the additional volume of the purge line.

   Important
   Keep the purge gas pressure below 7.25 psi (0.5 bar).

   Table 6-1: Purge time

Sensor model	Purge rate	Time, in minutes
F025	20 ft3/h (566.3 l/h)	4 1/2
F050	20 ft3/h (566.3 l/h)	4 1/2
F100	20 ft3/h (566.3 l/h)	6
F200	20 ft3/h (566.3 l/h)	15
F300	20 ft3/h (566.3 l/h)	25
F400	20 ft3/h (566.3 l/h)	25

7. At the appropriate time, shut off the gas supply, then immediately seal the purge outlet and inlet connections with the purge plugs.

   Avoid pressurizing the sensor case. If pressure inside the case elevates above atmospheric pressure during operation, the flowmeter density calibration will be inaccurate.

8. Make sure that the purge fitting seals are tight so that air cannot be drawn by suction into the sensor case.

6.2 Pressure relief

F-Series sensors are available with a rupture disk installed on the case. Rupture disks vent process fluid from the sensor case in the unlikely event of a flow tube breach. Some users connect a pipeline to the rupture disk to help contain escaping process fluid. For more information about rupture disks, contact customer service.

If the sensor has a rupture disk, keep it installed at all times as it would otherwise be necessary to re-purge the case. If the rupture disk is activated by a tube breach, the seal in the rupture disk will be broken, and the Coriolis meter should be removed from service.
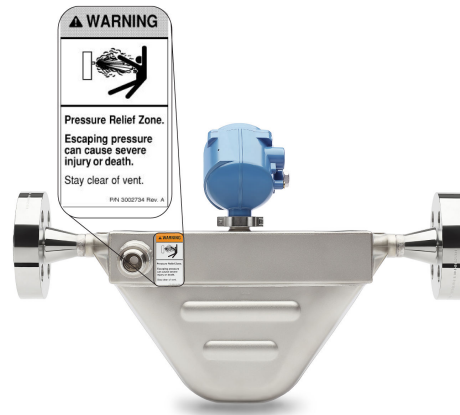
⚠ WARNING

- Orient the sensor so that personnel and equipment will not be exposed to any discharge along the pressure relief path.

- Stay clear of the rupture disk pressure relief area. High-pressure fluid escaping from the sensor can cause severe injury or death.

Important

If using a rupture disk, the housing can no longer assume a secondary containment function.

NOTICE

Removing the purge fitting, blind plug, or rupture disks compromises the Ex-i Safety Certification, the Ex-tc Safety Certification, and the IP-rating of the Coriolis meter. Any modification to the purge fitting, blind plug, or rupture disks must maintain a minimum of IP66/IP67 Ratings.

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