

Rosemount™ 8800D Vortex Flow Meter

For Meters with Pressure Compensation (MPA) or
Pressure+Temperature Compensation (MCA)



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1 Safety messages

 **WARNING**

Explosion hazards. Failure to follow these instructions could cause an explosion, resulting in death or serious injury.

- Verify the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.
- Installation of this transmitter in an explosive environment must be in accordance with the appropriate local, national, and international standards, codes, and practices. Review the approvals documents for any restrictions associated with a safe installation.
- Do not remove transmitter covers or thermocouple (if equipped) in explosive atmospheres when the circuit is live. Both transmitter covers must be fully engaged to meet explosion-proof requirements.
- Before connecting a hand-held 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.

 **WARNING**

Electrical shock hazard. Failure to follow this instruction could result in death or serious injury. Avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

 **WARNING**

General hazard. Failure to follow these instructions could result in death or serious injury.

- This product is intended to be used as a flowmeter for liquid, gas, or steam applications. Do not use for any other purpose.
- Make sure only qualified personnel perform the installation.

2 Introduction

2.1 Overview

System description

The Vortex Flow Meter consists of a meter body and transmitter, and measures volumetric flow rate by detecting the vortices created by a fluid passing by the shedder bar.

The meter body is installed in-line with process piping. A sensor is located at the end of the shedder bar which creates a sine wave signal due to the passing vortices. The transmitter measures the frequency of the sine wave and converts it into a flow rate.

Safety messages

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

Chapters

Section	Who uses	Description
Pre-installation	Planners and installers	Reference information to help you verify compatibility between the meter and its application and installation location
Basic installation	Planners and installers	Mechanical and electrical installation instructions typically required as initial setup in all applications
Basic configuration	Operations technicians	Configuration parameters typically required as initial setup in all applications
Advanced installation	Installers	Installation procedures required after initial setup for some applications
Advanced configuration	Operations technicians	Configuration procedures required after initial setup for some applications
Operation	Operations technicians	Information on advanced configuration parameters and functions that can aid in maintaining the flow meter
Troubleshooting	Installers and operations technicians	Troubleshooting techniques, diagnostic information, and transmitter verification procedures
Maintenance	Operations technicians	Information on maintaining the flow meter

Appendixes

Appendixes include supplementary information that may be useful in some situations.

3 Pre-installation

3.1 Planning

3.1.1 Sizing

To determine the correct meter size for optimal flow meter performance:

- Determine the limits of measuring flow.
- Determine the process conditions so that they are within the stated requirements for Reynolds number and velocity.

For sizing details, see [Product Specifications](#).

Sizing calculations are required to select the proper flow meter size. These calculations provide pressure loss, accuracy, and minimum and maximum flow rate data to guide in proper selection. Vortex sizing software can be found using the Selection and Sizing tool. The Selection and Sizing tool can be accessed online or downloaded for offline use using this link: www.Emerson.com/FlowSizing.

3.1.2 Wetted material selection

Ensure that the process fluid is compatible with the meter body wetted materials when specifying the Rosemount 8800D. Corrosion will shorten the life of the meter body. Consult recognized sources of corrosion data or contact technical support for more information.

Note

If Positive Material Identification (PMI) is required, perform test on a machined surface.

3.1.3 Orientation

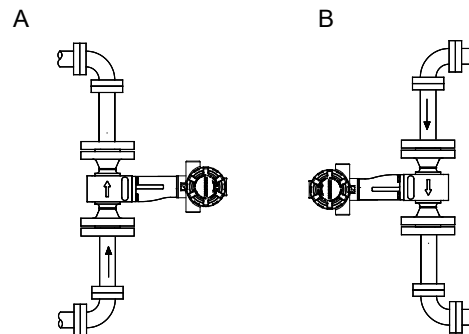
The best orientation for the meter depends on the process fluid, environmental factors, and any other nearby equipment.

Vertical installation

Vertical, upward, installation allows upward process liquid flow and is generally preferred. Upward flow ensures that the meter body always remains full and that any solids in the fluid are evenly distributed.

The meter can be mounted in the vertical down position when measuring gas or steam flows. This type of application is strongly discouraged for liquid flows, although it can be done with proper piping design.

Figure 3-1: Vertical installation



- A. Liquid or gas flow
- B. Gas flow

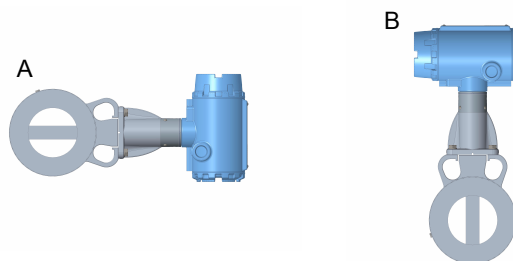
Note

To ensure the meter remains full, avoid downward vertical liquid flows where back pressure is inadequate.

Horizontal installation

For horizontal installation, the preferred orientation is to have the electronics installed to the side of the pipe. In liquid applications, this helps prevent any entrained air or solids from striking the shedder bar and disrupting the shedding frequency. In gas or steam applications, this helps prevent any entrained liquid (such as condensate) or solids from striking the shedder bar and disrupting the shedding frequency.

Figure 3-2: Horizontal installation



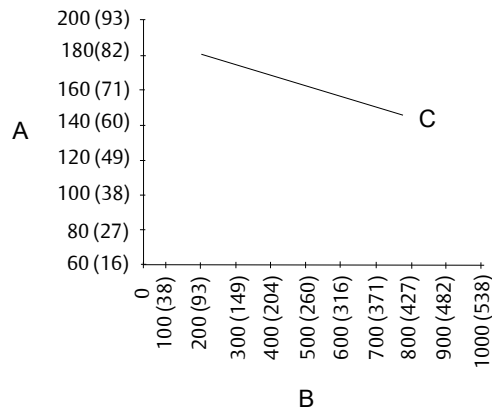
- A. Preferred installation—meter body installed with electronics to side of pipe
- B. Acceptable installation—meter body installed with electronics above pipe

High-temperature installations

The maximum process temperature for integral electronics is dependent on the ambient temperature where the meter is installed. The electronics must not exceed 185 °F (85 °C).

Figure 3-3 shows combinations of ambient and process temperatures needed to maintain a housing temperature of less than 185 °F (85 °C).

Figure 3-3: Ambient/Process temperature limits



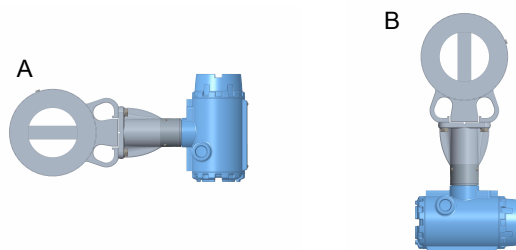
- A. Ambient temperature °F (°C)
- B. Process temperature °F (°C)
- C. 185 °F (85 °C) Housing temperature limit.

Note

The indicated limits are for horizontal pipe and vertical meter position, with meter and pipe insulated with 3 in. (77 mm) of ceramic fiber insulation.

Install the meter body so the electronics are positioned to the side of the pipe or below the pipe as shown in Figure 3-4. Insulation may also be required around the pipe to maintain an electronics temperature below 185 °F (85 °C). See Figure 4-2 for special insulation considerations.

Figure 3-4: Examples of high-temperature installations



- A. Preferred installation—The meter body installed with the electronics to the side of the pipe.
- B. Acceptable installation—The meter body installed with the electronics below the pipe.

3.1.4 Location

Hazardous area

The transmitter has an explosion-proof housing and circuitry suitable for intrinsically safe and non-incendive operation. Individual transmitters are clearly marked with a tag

indicating the certifications they carry. For hazardous location installation, including Explosion-proof, Flameproof, or Intrinsic Safety (I.S.), please consult the Emerson 8800 Approval Document 00825-VA00-0001.

Environmental considerations

Avoid excessive heat and vibration to ensure maximum flow meter life. Typical problem areas include high-vibration lines with integrally mounted electronics, warm-climate installations in direct sunlight, and outdoor installations in cold climates.

Although the signal conditioning functions reduce susceptibility to extraneous noise, some environments are more suitable than others. Avoid placing the flow meter or its wiring close to devices that produce high intensity electromagnetic and electrostatic fields. Such devices include electric welding equipment, large electric motors and transformers, and communication transmitters.

Upstream and downstream piping

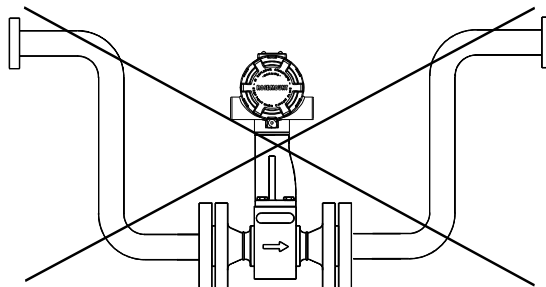
The meter may be installed with a minimum of ten diameters (D) of straight pipe length upstream and five diameters (D) of straight pipe length downstream.

To achieve reference accuracy, straight pipe lengths of 35D upstream and 5D downstream are required. The value of the K-factor may shift up to 0.5% when the upstream straight pipe length is between 10D and 35D. For optional K-factor corrections, see *Rosemount™ 8800 Vortex Installation Effects Technical Data Sheet*. To correct this effect, see [Meter factor](#).

Steam piping

For steam applications, avoid installations such as the one shown in the following figure. Such installations may cause a water-hammer condition at start-up due to trapped condensation. The high force from the water hammer can stress the sensing mechanism and cause permanent damage to the sensor.

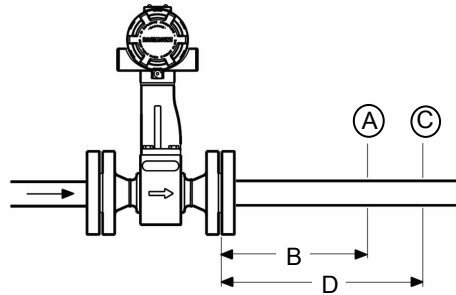
Figure 3-5: Wrong steam pipe installation



Pressure and temperature transmitter location

When using pressure and temperature transmitters in conjunction with the vortex flow meter for compensated mass flows, install the transmitter(s) downstream of the vortex flow meter.

Figure 3-6: Pressure and temperature transmitter location



- A. Pressure transmitter
- B. Four straight pipe diameters downstream
- C. Temperature transmitter
- D. Six straight pipe diameters downstream

3.1.5 Power supply

Analog 4–20 mA Power supply

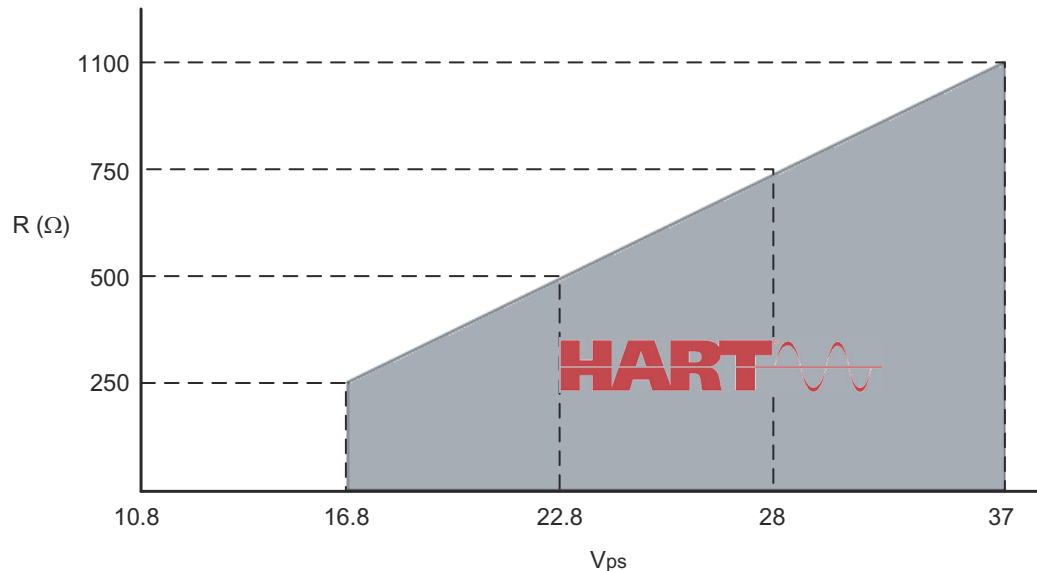
External power supply required. Each transmitter operates on 10.8 VDC to 42 VDC terminal voltage.

Power consumption

One watt maximum per transmitter.

HART communication

Figure 3-7: HART communication voltage/resistance requirement



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

Note that HART Communication requires a minimum loop resistance of 250 ohms up to a maximum of 1100 ohms.

R(Ω) Load resistor value.

V_{ps} Minimum power supply voltage required

$$R(\Omega)_{\max} = 41.7 (V_{ps} - 10.8 \text{ V}).$$

Additional wiring information

- The DC power supply should provide power with less than two percent ripple. The total resistance load is the sum of the resistance of the signal wiring and the load resistance of the controller, indicator, and related pieces. Note that the resistance of intrinsic safety barriers, if used, must be included.
- If a Smart Wireless THUM™ Adapter is being used with the flow meter to exchange information via IEC 62591 (WirelessHART® Protocol) technology, a minimum loop resistance of 250 ohms is required. In addition, a minimum power supply voltage (V_{ps}) of 19.3 volts will be required to output 24 mA.
- If a single power supply is used to power more than one transmitter, the power supply used and circuitry common to the transmitters should not have more than 20 ohms of impedance at 1200 Hz. See [Table 3-1](#).
- Loop resistance must be considered in determining the minimum power supply voltage.

Table 3-1: Resistance based on wire gauge

Gauge number	Ohms per 1,000 ft (305 m) at 68 °F (20 °C) equivalent
14 AWG (2 mm ²)	2.5
16 AWG (1 mm ²)	4.0
18 AWG (0.8mm ²)	6.4
20 AWG (0.5 mm ²)	10
22 AWG (0.3 mm ²)	16
24 AWG (0.2 mm ²)	26

3.2 Commissioning

For proper configuration and operation, commission the meter before putting it into operation. Bench commissioning also enables you to check hardware settings, test the flowmeter electronics, verify flowmeter configuration data, and check output variables. Any problems can be corrected—or configuration settings changed—before going out into the installation environment. To commission on the bench, connect a configuration device to the signal loop in accordance the device instructions.

3.2.1 Alarm and security jumper configuration

Two jumpers on the transmitter specify the alarm and security modes. Set these jumpers during the commissioning stage to avoid exposing the electronics to the plant environment. The two jumpers can be found on the electronics board stack or on the LCD display.

Alarm As part of normal operations, the transmitter continuously runs a self-diagnostic routine. If the routine detects an internal failure in the electronics, flow meter output is driven to a low or high alarm level, depending on the position of the failure mode jumper. The factory sets the jumper according to the Configuration Data Sheet, if applicable, or HI by default.

Security You can protect the configuration data with the security lockout jumper. With the security lockout jumper ON, any configuration changes attempted on the electronics are disallowed. You can still access and review any of the operating parameters and scroll through the available parameters, but no changes can be made. The factory sets the jumper according to the Configuration Data Sheet, if applicable, or OFF by default.

Note

If you will be changing configuration variables frequently, it may be useful to leave the security lockout jumper in the OFF position to avoid exposing the flow meter electronics to the plant environment.

To access the jumpers, remove the transmitter electronics housing or the LCD cover (if equipped) opposite of the terminal block, See [Figure 3-8](#) and [Figure 3-9](#).

Figure 3-8: Alarm and security jumpers (no LCD option)

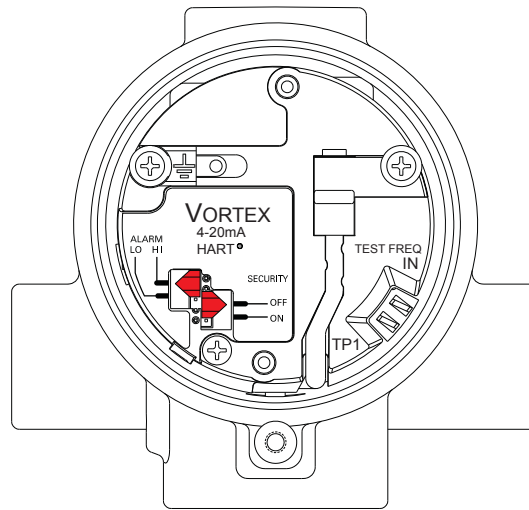
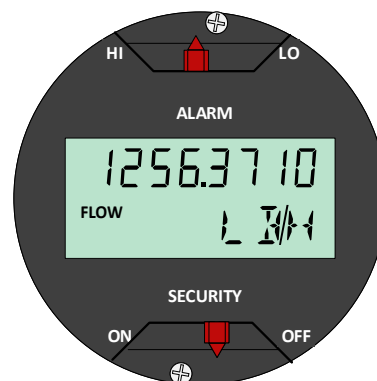


Figure 3-9: Alarm and security jumpers (with LCD option)



Failure mode vs. saturation output values

The failure mode alarm output levels differ from the output values that occur when the operating flow is outside the range points. When the operating flow is outside the range points, the analog output continues to track the operating flow until reaching the saturation value listed below; the output does not exceed the listed saturation value regardless of the operating flow. For example, with standard alarm and saturation levels and flows outside the 4–20 mA range points, the output saturates at 3.9 mA or 20.8 mA. When the transmitter 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. The saturation and alarm levels are software selectable between Rosemount Standard and NAMUR levels.

Table 3-2: Analog output: standard alarm values vs. saturation values

Level	4–20 mA saturation value	4–20 mA alarm value
Low	3.9 mA	≤ 3.75 mA
High	20.8 mA	≥ 21.75 mA

Table 3-3: Analog output: NAMUR-compliant alarm values vs. saturation values

Level	4–20 mA saturation value	4–20 mA alarm value
Low	3.8 mA	≤ 3.6 mA
High	20.5 mA	≥ 22.6 mA

3.2.2 Calibration

The flow meter is wet-calibrated at the factory and needs no further calibration during installation. The calibration factor (K-factor) is indicated on each meter body and is entered into the electronics. Verification can be accomplished with a configuration device.

4 Basic installation

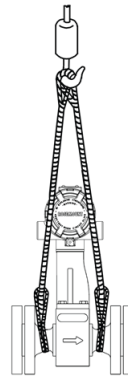
4.1 Handling

Handle all parts carefully to prevent damage. Whenever possible, transport the system to the installation site in the original shipping containers. Keep the shipping plugs in the conduit connections until you are ready to connect and seal them.

NOTICE

To avoid damage to the meter, do not lift the flow meter by the transmitter. Lift the meter by the meter body. Lifting supports can be tied around the meter body as shown.

Figure 4-1: Lifting supports



4.2 Flow direction

The meter can only measure flow in the direction indicated on the meter body. Be sure to mount the meter body so the FORWARD end of the flow arrow points in the direction of the flow in the pipe.

4.3 Gaskets

The flow meter requires gaskets supplied by the user. Be sure to select gasket material that is compatible with the process fluid and pressure ratings of the specific installation.

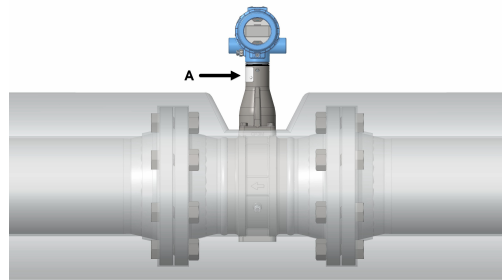
Note

Ensure the inside diameter of the gasket is larger than the inside diameter of the flow meter and adjacent piping. If gasket material extends into the flow stream, it will disturb the flow and cause inaccurate measurements.

4.4 Insulation

Insulation should extend to the end of the bolt on the bottom of the meter body and should leave at least 1-in. (25 mm) of clearance around the electronics bracket. The electronics bracket and electronics housing should not be insulated. See [Figure 4-2](#).

Figure 4-2: Insulation best practice to prevent electronics overheating



A. Support tube

CAUTION

In high temperature installations, to avoid damage to the electronics on integral units or to the remote cable on remote units, only insulate the meter body as shown. Do not insulate the support tube. See also [Orientation](#).

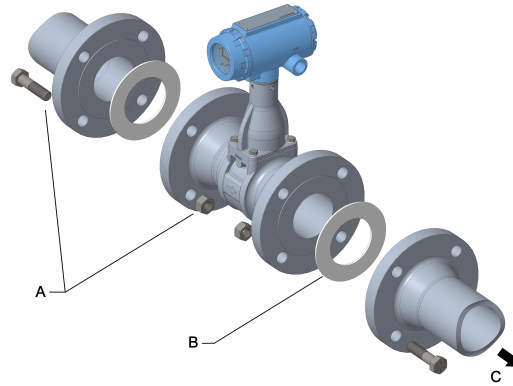
4.5 Flanged-style flow meter mounting

Most vortex flow meters use a flanged-style process connection. Physical mounting of a flanged-style flow meter is similar to installing a typical section of pipe. Conventional tools, equipment, and accessories (such as bolts and gaskets) are required. Tighten the nuts following the sequence shown in [Figure 4-4](#).

Note

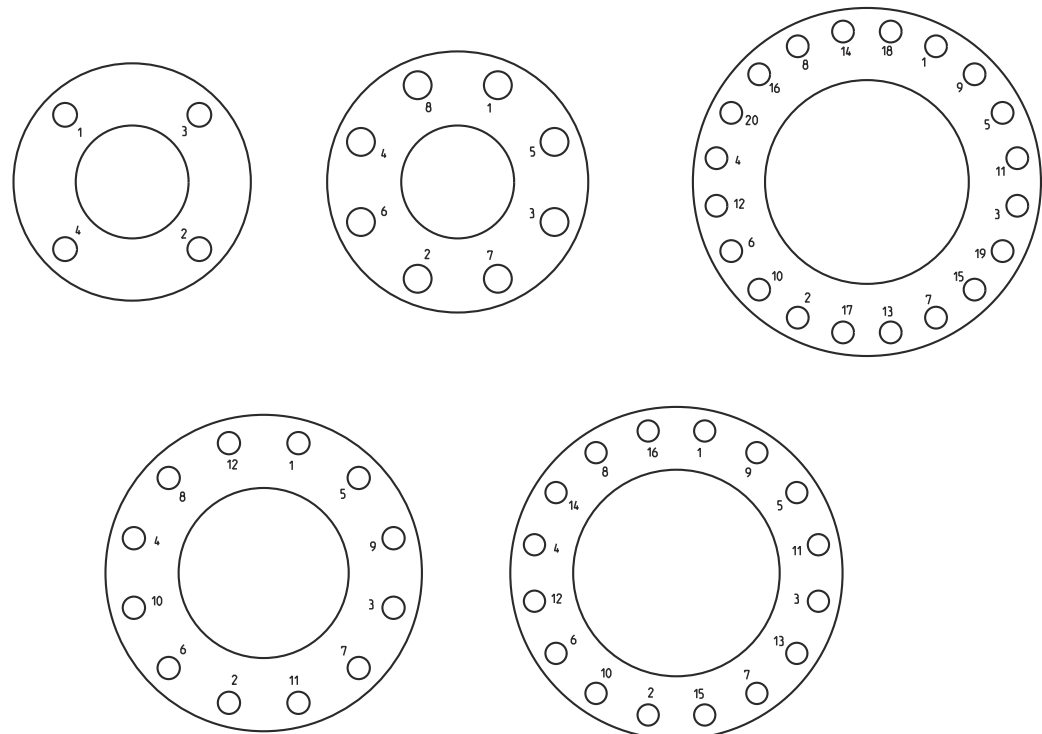
The required bolt load for sealing the gasket joint is affected by several factors, including operating pressure and gasket material, width, and condition. A number of factors also affect the actual bolt load resulting from a measured torque, including condition of bolt threads, friction between the nut head and the flange, and parallelism of the flanges. Due to these application-dependent factors, the required torque for each application may be different. Follow the guidelines outlined in ASME PCC-1 for proper bolt tightening. Make sure the flow meter is centered between flanges of the same nominal size and rating as the flow meter.

Figure 4-3: Flanged-style flow meter installation



- A. Installation studs and nuts (supplied by customer)
- B. Gaskets (supplied by customer)
- C. Flow

Figure 4-4: Flange bolt torquing sequence



4.6 Wafer-style flow meter alignment and mounting

Center the wafer-style meter body inside diameter with respect to the inside diameter of the adjoining upstream and downstream piping. This will ensure the flow meter achieves its specified accuracy. Alignment rings are provided with each wafer-style meter body for centering purposes. Follow these steps to align the meter body for installation. Refer to [Figure 4-5](#).

1. Place the alignment rings over each end of the meter body.
2. Insert the studs for the bottom side of the meter body between the pipe flanges.
3. Place the meter body (with alignment rings) between the flanges.
 - Make sure the alignment rings are properly placed onto the studs.
 - Align the studs with the markings on the ring that correspond to the flange you are using.
 - If a spacer is used, see [Spacers](#).

Note

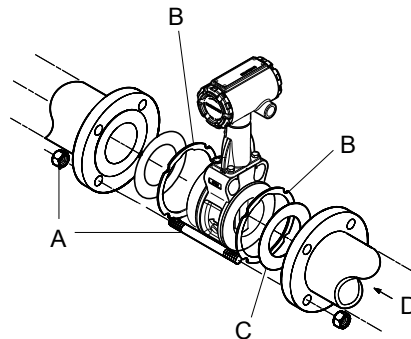
Be sure to align the flow meter so the electronics are accessible, the conduits drain, and the flow meter is not subject to direct heat.

4. Place the remaining studs between the pipe flanges.
5. Tighten the nuts in the sequence shown in [Figure 4-4](#).
6. Check for leaks at the flanges after tightening the flange bolts.

Note

The required bolt load for sealing the gasket joint is affected by several factors, including operating pressure and gasket material, width, and condition. A number of factors also affect the actual bolt load resulting from a measured torque, including condition of bolt threads, friction between the nut head and the flange, and parallelism of the flanges. Due to these application-dependent factors, the required torque for each application may be different. Follow the guidelines outlined in ASME PCC-1 for proper bolt tightening. Make sure the flow meter is centered between flanges of the same nominal size and rating as the flow meter.

Figure 4-5: Wafer-style flow meter installation with alignment rings



- A. Installation studs and nuts (supplied by customer)
- B. Alignment rings
- C. Spacer (for Rosemount 8800D to maintain Rosemount 8800A dimensions)
- D. Flow

Note

See [Spacers](#) for instructions on retrofitting 8800D to 8800A installations.

4.6.1 Stud bolts for wafer-style flow meters

The following tables list the recommended minimum stud bolt lengths for wafer-style meter body size and different flange ratings.

Table 4-1: Stud bolt length for wafer-style flow meters with ASME B16.5 flanges

Line size	Minimum recommended stud bolt lengths (in inches) for each flange rating		
	Class 150	Class 300	Class 600
½-inch	6.00	6.25	6.25
1-inch	6.25	7.00	7.50
1½-inch	7.25	8.50	9.00
2-inch	8.50	8.75	9.50
3-inch	9.00	10.00	10.50
4-inch	9.50	10.75	12.25
6-inch	10.75	11.50	14.00
8-inch	12.75	14.50	16.75

Table 4-2: Stud bolt length for wafer-style flow meters with EN 1092 flanges

Line size	Minimum recommended stud bolt lengths (in mm) for each flange rating			
	PN 16	PN 40	PN 63	PN 100
DN 15	160	160	170	170
DN 25	160	160	200	200
DN 40	200	200	230	230
DN 50	220	220	250	270
DN 80	230	230	260	280
DN 100	240	260	290	310
DN 150	270	300	330	350
DN 200	320	360	400	420

Line size	Minimum recommended stud bolt lengths (in mm) for each flange rating		
	JIS 10k	JIS 16k and 20k	JIS 40k
15mm	150	155	185
25mm	175	175	190
40mm	195	195	225
50mm	210	215	230
80mm	220	245	265
100mm	235	260	295
150mm	270	290	355
200mm	310	335	410

4.7 Cable glands

If you are using cable glands instead of conduit, follow the cable gland manufacturer's instructions for preparation and make the connections in a conventional manner in accordance with local or plant electrical codes. Be sure to properly seal unused ports to prevent moisture or other contamination from entering the terminal block compartment of the electronics housing.

4.8 Flow meter grounding

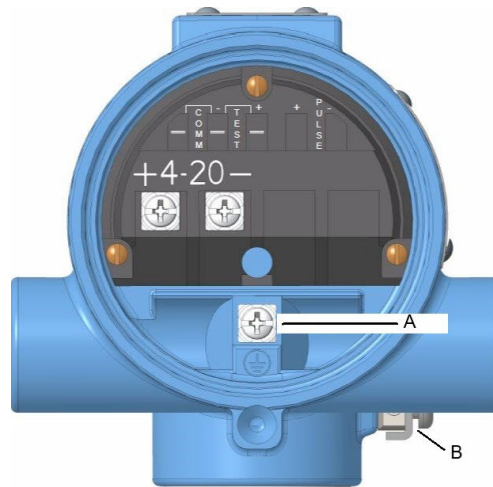
Grounding is not required in typical vortex applications; however, a proper ground will eliminate possible noise pickup by the electronics. Grounding straps may be used to ensure that the meter is grounded to the process piping. If you are using the transient protection option (T1), grounding straps are required to provide a proper low impedance ground.

Note

Properly ground flow meter body and transmitter per the local code.

To use grounding straps, secure one end of the grounding strap to the bolt extending from the side of the meter body and attach the other end of each grounding strap to a suitable ground. See [Figure 4-6](#).

Figure 4-6: Grounding connections



- A. Internal ground connection
 - B. External ground assembly
-

4.9 Grounding the transmitter case

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

Internal Ground Connection

The Internal Ground Connection screw is inside the FIELD TERMINALS side of the electronics housing. This screw is identified by a ground symbol (\perp), and is standard on all Rosemount 8800D transmitters.

External Ground Assembly

This assembly is located on the outside of the electronics housing and is included with the optional transient protection terminal block (Option Code T1). The External Ground Assembly can also be ordered with the transmitter (Option Code V5) and is automatically included with certain hazardous area approvals. See [Figure 4-6](#) for the location of the external ground assembly.

Note

Grounding the transmitter case using the threaded conduit connection may not provide a sufficient ground. The transient protection terminal block (Option Code T1) does not provide transient protection unless the transmitter case is properly grounded. For transient terminal block grounding, see [Transient protection](#). Use the above guidelines to

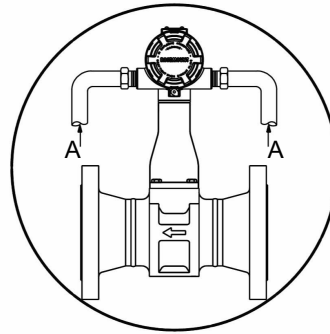
ground the transmitter case. Do not run the transient protection ground wire with signal wiring as the ground wire may carry excessive electric current if a lightning strike occurs.

4.10 Conduit installation

Prevent condensation in any conduit from flowing into the housing by mounting the flowmeter at a high point in the conduit run. If the flowmeter is mounted at a low point in the conduit run, the terminal compartment could fill with fluid.

If the conduit originates above the flowmeter, route conduit below the flowmeter to form a drip loop before entry. In some cases a drain seal may need to be installed.

Figure 4-7: Proper conduit installation



A. Conduit line

4.11 Wiring

The signal terminals are located in a compartment of the electronics housing separate from the flow meter electronics. Connections for a configuration tool and an electric current test connection are above the signal terminals.

Note

A power disconnect is required to remove power from the transmitter for maintenance, removal, and replacement.

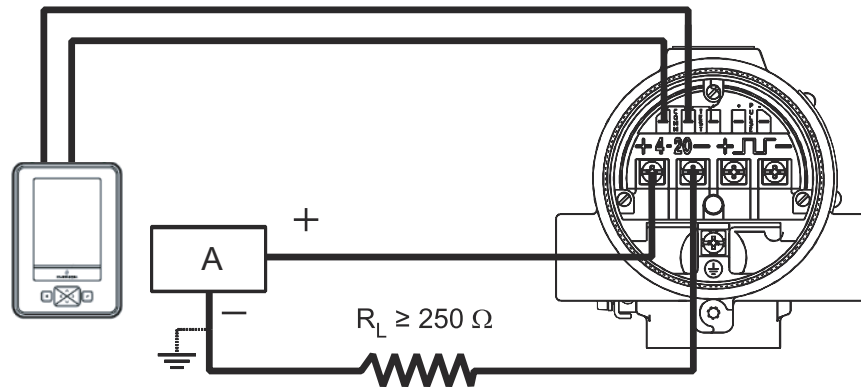
Common wiring practices

Twisted pairs are required to minimize noise pickup in the 4–20 mA signal and digital communication signal. For high EMI/RFI environments, shielded signal wire is required and recommended in all other installations. To ensure communication, wiring should be 24 AWG (0.205 mm²) or larger, and not exceed 5,000 ft (1500 m).

4.11.1 Analog output

The flow meter provides a 4–20 mA dc isolated electric current output, linear with the flow rate or optionally the Process Temperature with the MCA option. To make connections, remove the FIELD TERMINALS side cover of the electronics housing. All power to the electronics is supplied over the 4–20 mA signal wiring. Connect the wires as shown.

Figure 4-8: 4–20 mA wiring



A. Power supply. See [Power supply](#).

4.12 Remote installation

If a remote electronics option (Rxx or Axx) was ordered, the flow meter assembly will be shipped in two parts:

- The meter body with an adapter installed in the support tube and an interconnecting coaxial cable attached to it.
- The electronics housing installed on a mounting bracket.

If an armored remote electronics option (Axx) was ordered, follow the same instructions as for the standard remote cable connection with the exception that the cable may not need to be run through conduit. Both standard and armored cable include cable glands. Information on remote installation can be found in [Cable connections](#).

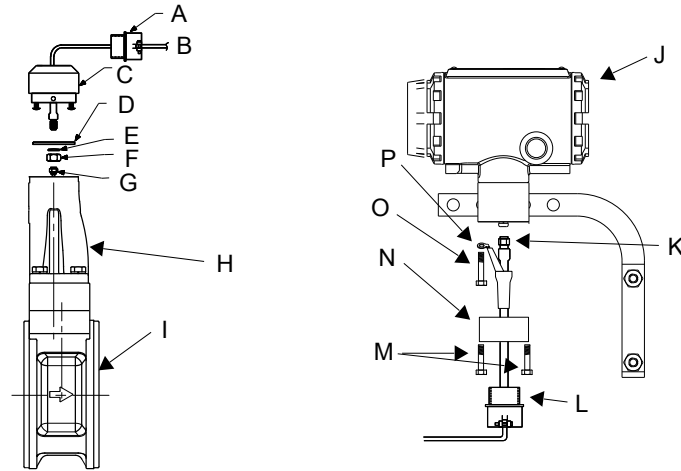
4.12.1 Mounting

Mount the meter body in the process flow line as described earlier in this section. Mount the bracket and electronics housing in the desired location. The housing can be repositioned on the bracket to facilitate field wiring and conduit routing.

4.12.2 Cable connections

Complete these steps for connecting the loose end of the coaxial cable to the electronics housing. If connecting/disconnecting the meter adapter to the meter body, see [Remote electronics procedures](#).

Figure 4-9: Remote installation



- A. $\frac{1}{2}$ NPT conduit adapter or cable gland (supplied by customer for Rxx options)
- B. Coaxial cable
- C. Meter adapter
- D. Union
- E. Washer
- F. Nut
- G. Sensor cable nut
- H. Support tube
- I. Meter body
- J. Electronics housing
- K. Coaxial cable SMA nut
- L. $\frac{1}{2}$ NPT conduit adapter or cable gland (supplied by customer for Rxx options)
- M. Housing adapter screws
- N. Housing adapter
- O. Housing base screw (one of four)
- P. Ground connection

! CAUTION

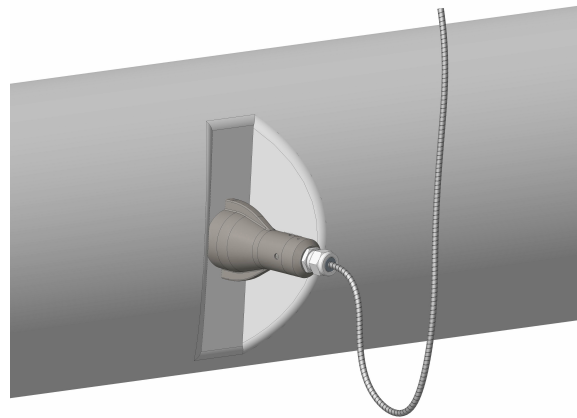
To prevent moisture from entering the coaxial cable connections, install the interconnecting coaxial cable in a single dedicated conduit run or use sealed cable glands at both ends of the cable.

In remote mount configurations when ordered with a hazardous area option code, the remote sensor cable and the interconnecting thermocouple cable are protected by separate intrinsic safety circuits, and must be segregated from each other, other intrinsically safe circuits, and non-intrinsically safe circuits per local and national wiring code.

! CAUTION

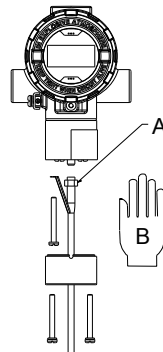
The coaxial remote cable cannot be field terminated or cut to length. Coil any extra coaxial cable with no less than a 2-in. (51 mm) radius.

1. If you plan to run the coaxial cable in conduit, carefully cut the conduit to the desired length to provide for proper assembly at the housing. A junction box may be placed in the conduit run to provide a space for extra coaxial cable length.
2. Slide the conduit adapter or cable gland over the loose end of the coaxial cable and fasten it to the adapter on the meter body support tube. If coaxial remote cable originates or any part of the cable is above the flow meter, route cable below the flow meter to form a drip loop before the meter body support tube.



3. If using conduit, route the coaxial cable through the conduit.
4. Place a conduit adapter or cable gland over the end of the coaxial cable.
5. Remove the housing adapter from the electronics housing.
6. Slide the housing adapter over the coaxial cable.
7. Remove one of the four housing base screws.
8. Attach the coaxial cable ground wire to the housing via the housing base ground screw.
9. Attach and hand tighten the coaxial cable SMA nut to the electronics housing to 7 in-lbs (0.8 N-m).

Figure 4-10: Attaching and tightening SMA nut



- A. SMA nut
- B. Hand tighten

Note

Do not over-tighten the coaxial cable nut to the electronics housing.

10. Align the housing adapter with the housing and attach with two screws.
11. Tighten the conduit adapter or cable gland to the housing adapter.

4.12.3 Housing rotation

The entire electronics housing may be rotated in 90° increments for easy viewing. Use the following steps to change the housing orientation,

1. Loosen the three accessible housing rotation set screws at the base of the electronics housing with a 5/32" hex wrench by turning the screws clockwise (inward) until they clear the support tube.
2. Slowly pull the electronics housing out of the support tube.

CAUTION

Do not pull the housing more than 1.5 in. (40 mm) from the top of the support tube until the sensor cable is disconnected. Damage to the sensor may occur if this sensor cable is stressed.

3. Unscrew the sensor cable from the housing with a 5/16" open end wrench.
4. Rotate the housing to the desired orientation.
5. Hold it in this orientation while you screw the sensor cable onto the base of the housing.

CAUTION

Do not rotate the housing while the sensor cable is attached to the base of the housing. This will stress the cable and may damage the sensor.

6. Place the electronics housing into the top of the support tube.

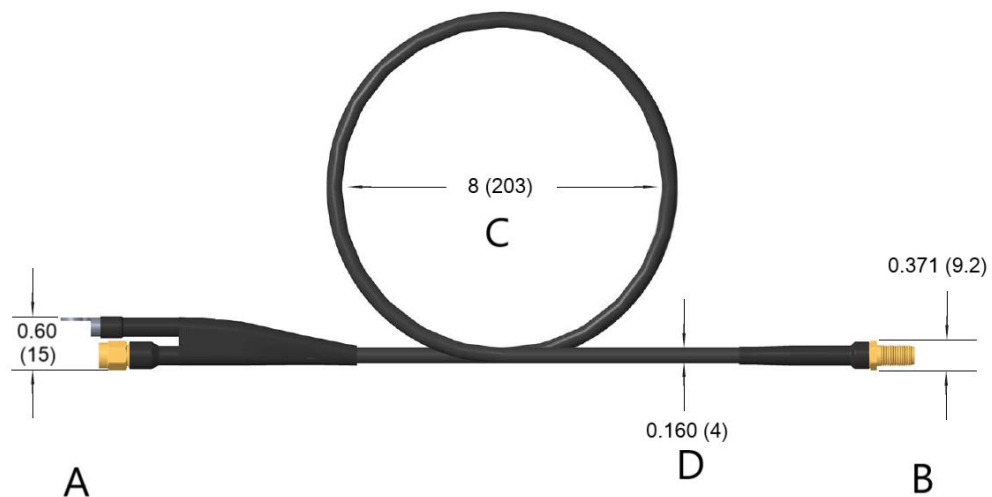
7. Use a hex wrench to turn the three accessible housing rotation screws counter-clockwise (outward) to engage the support tube.

4.12.4 Specifications and requirements for remote sensor cable

If using a Rosemount remote sensor cable, observe these specifications and requirements.

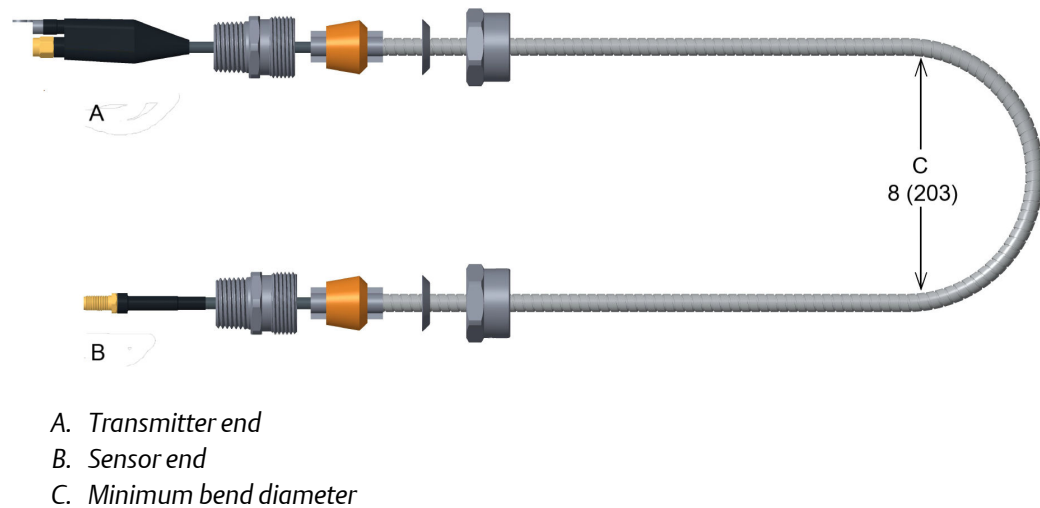
- The remote sensor cable is a proprietary design tri-axial cable
- It is considered a low voltage signal cable
- It is rated for and/or part of intrinsically safe installations
- Non armored version is designed to be run through metal conduit
- Cable is water resistant, but not submersible. As a best practice, exposure to moisture should be avoided if possible
- Rated operating temperature is -58°F to $+392^{\circ}\text{F}$ (-50°C to $+200^{\circ}\text{C}$)
- Flame Resistant in accordance with IEC 60332-3
- Non-armored and armored version minimum bend diameter is 8 inches (203 mm)
- Nominal O.D. of the non-armored version is 0.160 inches (4 mm)
- Nominal O.D. of the armored version is 0.282 inches (7.1 mm)

Figure 4-11: Non-armored cable



- A. Transmitter end*
- B. Sensor end*
- C. Minimum bend diameter*
- D. Nominal O.D.*

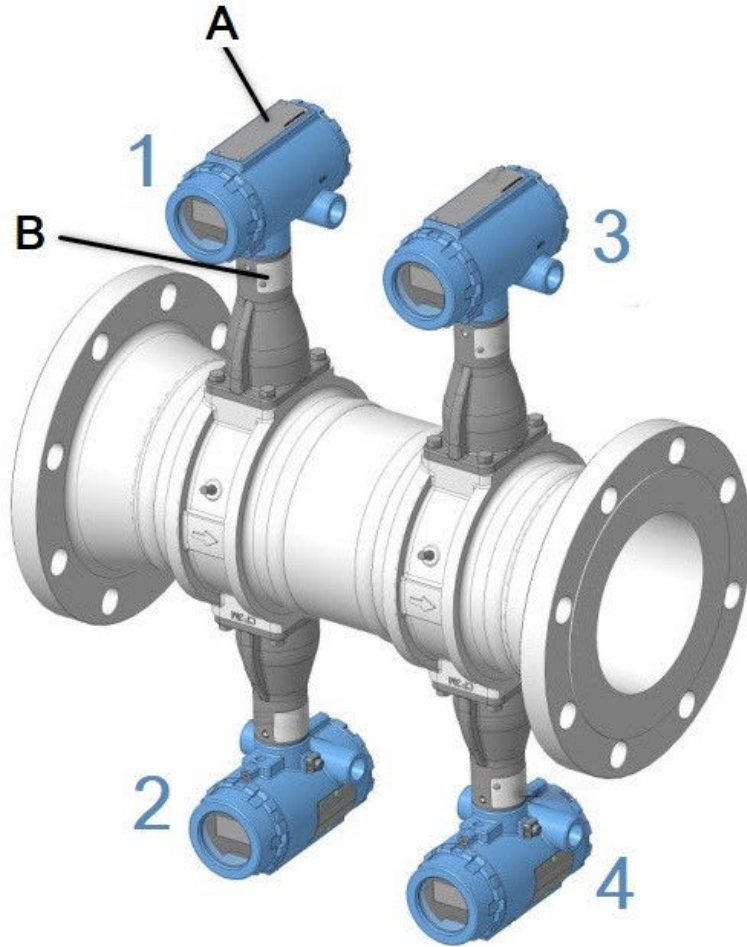
Figure 4-12: Armored cable



4.12.5 Quad transmitter numbering and orientation

When quad vortex flow meters are ordered, for configuration purposes, the transmitters are identified as Transmitter 1, Transmitter 2, Transmitter 3, and Transmitter 4. The transmitter and meter body nameplate of a Quad Vortex flow meter can be used to identify and verify the transmitter number. See [Figure 4-13](#) for Quad transmitter orientation and nameplate locations. See [Figure 4-14](#) and [4-15](#) for Quad transmitter and meter body nameplate number location.

Figure 4-13: Quad transmitter numbering

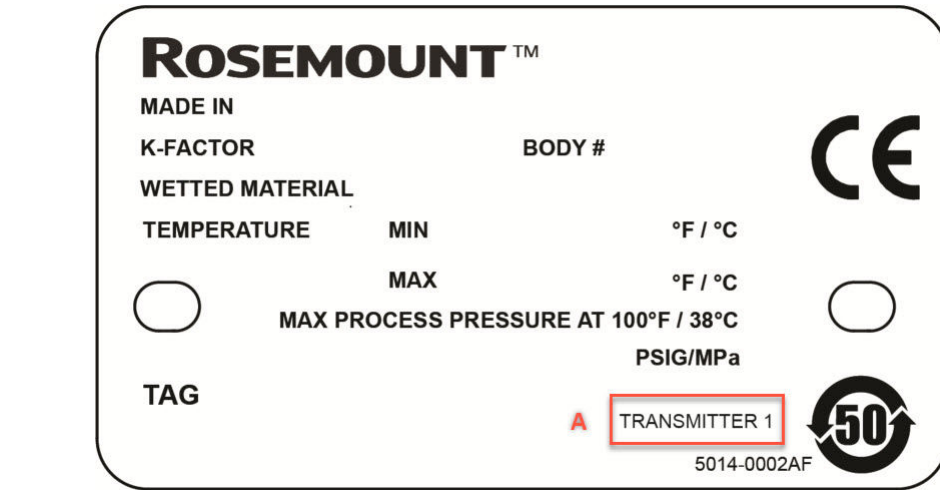


- A. Transmitter nameplate (Transmitter 1)
- B. Meter body nameplate (Transmitter 1)

Figure 4-14: Quad transmitter nameplate



Figure 4-15: Quad meter body nameplate



5 Basic configuration

5.1 About basic configuration

The transmitter must be configured for certain basic variables in order to be operational. In most cases, all of these variables are pre-configured at the factory. Configuration may be required if your transmitter is not configured or if the configuration variables need revision. The basic setup section includes parameters typically required for basic operation.

5.2 Process variables

Process variables define the flow meter output. When commissioning a flow meter, review each process variable, its function and output, and take corrective action if necessary before using the flow meter in a process application.

5.2.1 Primary variable mapping

Allows the user to select which variables the transmitter will output.

ProLink III	Device Tools → Configuration → Communications (HART)
-------------	--

Note

The Primary Variable is also the Analog Output variable.

Flow variables are available as Corrected Volume Flow, Mass Flow, Velocity Flow, Volume Flow or Process Temperature (MTA or MCA option only).

When bench commissioning, the flow values for each variable should be zero and the temperature value should be the ambient temperature.

If the units for the flow or temperature variables are not correct, refer to [Process variable units](#). Use the Process Variable Units function to select the units for your application.

5.2.2 Process variable units

ProLink III	Device Tools → Configuration → Process Measurement → (select type)
-------------	--

Allows for the viewing and configuration of Process Variable Units such as Volume, Velocity, Mass Flow, Electronics Temperature, Process Density, and Corrected Volume units, including corrected volume Special Units configuration.

Volume flow units

Allows the user to select the volumetric flow units from the available list.

Table 5-1: Volume flow units

gallons per second	gallons per minute	gallons per hour
gallons per day	cubic feet per second	cubic feet per minute
cubic feet per hour	cubic feet per day	barrels per second
barrels per minute	barrels per hour	barrels per day
imperial gallons per second	imperial gallons per minute	imperial gallons per hour
imperial gallons per day	liters per second	liters per minute
liters per hour	liters per day	cubic meters per second
cubic meters per minute	cubic meters per hour	cubic meters per day
mega cubic meters per day	special units	

Corrected volumetric flow units

Allows the user to select the corrected volumetric flow units from the available list.

Table 5-2: Corrected volume flow units

gallons per second	gallons per minute	gallons per hour
gallons per day	cubic feet per second	standard cubic feet per minute
standard cubic feet per hour	cubic feet per day	barrels per second
barrels per minute	barrels per hour	barrels per day
imperial gallons per second	imperial gallons per minute	imperial gallons per hour
imperial gallons per day	liters per second	liters per minute
liters per hour	liters per day	normal cubic meters per minute
normal cubic meters per hour	normal cubic meters per day	cubic meters per second
cubic meters per minute	cubic meters per hour	cubic meters per day
special units		

Note

When measuring corrected volumetric flow, a base density and process density must be provided. The base density and process density are used to calculate the density ratio which is a value used to convert actual volume flow to corrected volume flow.

Mass flow units

Allows the user to select the mass flow units from the available list. (1 STon = 2000 lb; 1 MetTon = 1000 kg)

Table 5-3: Mass flow units

grams per hour	grams per minute	grams per second
kilograms per day	kilograms per hour	kilograms per minute
kilograms per second	pounds per minute	pounds per hour

Table 5-3: Mass flow units (continued)

pounds per day	special units	short tons per day
short tons per hour	short tons per minute	pounds per second
tons (metric) per day	tons (metric) per hour	tons (metric) per minute

Note

If you select a Mass Flow Units option, you must enter process density in your configuration.

Velocity flow units

Allows the user to select the Velocity Flow Units from the available list.

- feet per second
- meters per second

Velocity measurement base

Determines if the velocity measurement is based on the mating pipe ID or the meter body ID. This is important for Reducer™ Vortex Applications.

5.3 Tag

ProLink III	Device Tools → Configuration → Informational Parameters → Transmitter
-------------	---

The quickest way to identify and distinguish between flow meters. Flow meters can be tagged according to the requirements of your application. The tag may be up to eight characters long.

5.4 Long Tag

ProLink III	Device Tools → Configuration → Informational Parameters → Transmitter
-------------	---

Available for HART 7 and allows for up to 32 characters.

5.5 Process configuration

ProLink III	Device Tools → Configuration → Device Setup
-------------	---

The flow meter can be used for liquid, gas, or steam applications, but it must be configured specifically for the application. If the flow meter is not configured for the proper process, readings will be inaccurate. Select the appropriate process configuration parameters for your application:

Set process fluid

Select the fluid type - either Liquid, Gas, or Steam.

For more information on pressure and temperature compensation configuration, see [Advanced configuration](#).

Fixed process temperature

Needed for the electronics to compensate for thermal expansion of the flowmeter as the process temperature differs from the reference temperature. Process temperature is the temperature of the process in the line during flowmeter operation.

May also be used as a back-up temperature value in the event of a temperature sensor failure on an MCA meter.

Fixed process density

A Fixed Process Density must be accurately configured if mass flow or corrected volume flow measurements are used. In mass flow it is used to convert volume flow to mass flow. In corrected volume flow it is used with the base process density to derive a density ratio which in turn is used to convert volume flow to corrected volume flow. In temperature compensated fluids the fixed process density is still required as it is used to convert volume flow sensor limits to sensor limits for temperature compensated fluids.

Note

If mass or corrected volume units are chosen, you must enter the density of your process fluid into the software. Be careful to enter the correct density. The mass flow rate and density ratio are calculated using this user-entered density, and unless actual Compensation reads Temperature, Pressure or Pressure and Temperature Compensation. If Actual Compensation reads Temperature, Pressure or Pressure and Temperature Compensation, density is automatically compensated, any error in the user-entered density will result in error in the measurement.

Base process density

The density of the fluid at base conditions. This density is used in corrected volume flow measurement. It is not required for volume flow, mass flow, or velocity flow. The Base Process Density is used with the Process Density to calculate the Density Ratio. In temperature compensated fluids, the Process Density is calculated by the transmitter. In non-temperature compensated fluids the Fixed Process Density is used to calculate a fixed Density Ratio. Density Ratio is used to convert actual volumetric flow to standard volumetric flow rates based on the following equation:

Density ratio = density at actual (flowing) conditions/density at standard (base) conditions

5.6 Reference K-factor

ProLink III	Device Tools → Configuration → Device Setup
-------------	---

A factory calibration number relating the flow through the meter to the shedding frequency measured by the electronics. Every vortex meter manufactured by Emerson is run through a water calibration to determine this value.

5.7 Flange type

ProLink III	Device Tools → Configuration → Device Setup
-------------	---

Enables the user to specify the type of flange on the flow meter for later reference. This variable is preset at the factory but can be changed if necessary.

Table 5-4: Flange types

Wafer	ASME 150	ASME 150 Reducer
ASME 300	ASME 300 Reducer	ASME 600
ASME 600 Reducer	ASME 900	ASME 900 Reducer
ASME 1500	ASME 1500 Reducer	ASME 2500
ASME 2500 Reducer	PN10	PN10 Reducer
PN16	PN16 Reducer	PN25
PN25 Reducer	PN40	PN40 Reducer
PN64	PN64 Reducer	PN100
PN100 Reducer	PN160	PN160 Reducer
JIS 10K	JIS 10K Reducer	JIS 16K/20K
JIS 16K/20K Reducer	JIS 40K	JIS 40K Reducer
Special (Spcl)		

5.8 Pipe I.D.

ProLink III	Device Tools → Configuration → Device Setup
-------------	---

The pipe I.D. (inside diameter) of the pipe adjacent to the flow meter can cause entrance effects that may alter flow meter readings. Configuring the actual mating pipe inside diameter will correct for these effects. Enter the appropriate value for this variable.

Pipe I.D. values for schedule 10, 40, and 80 piping are given in the following table. If the mating pipe I.D. is not listed in the table, confirm it with the manufacturer or measure it yourself.

Table 5-5: Pipe IDs for Schedule 10, 40, and 80 piping

Pipe size inches (mm)	Schedule 10 inches (mm)	Schedule 40 inches (mm)	Schedule 80 inches (mm)
½ (15)	0.674 (17,12)	0.622 (15,80)	0.546 (13,87)
1 (25)	1.097 (27,86)	1.049 (26,64)	0.957 (24,31)
1½ (40)	1.682 (42,72)	1.610 (40,89)	1.500 (38,10)
2 (50)	2.157 (54,79)	2.067 (52,50)	1.939 (49,25)
3 (80)	3.260 (82,80)	3.068 (77,93)	2.900 (73,66)
4 (100)	4.260 (108,2)	4.026 (102,3)	3.826 (97,18)
6 (150)	6.357 (161,5)	6.065 (154,1)	5.761 (146,3)
8 (200)	8.329 (211,6)	7.981 (202,7)	7.625 (193,7)
10 (250)	10.420 (264,67)	10.020 (254,51)	9.562 (242,87)
12 (300)	12.390 (314,71)	12.000 (304,80)	11.374 (288,90)

5.9 Upper and lower range values

ProLink III	Device Tools → Configuration → Outputs → Analog Output
-------------	--

Enables you to set the upper and lower range values in order to maximize the resolution of the analog output. The meter is most accurate when operated within the expected flow ranges for your application. Setting the range to the limits of expected readings will maximize flow meter performance.

The range of expected readings is defined by the Lower Range Value and Upper Range Value. Set the values within the limits of flow meter operation as defined by the line size and process material for your application. Values set outside that range will not be accepted.

Upper Range Value This is the 20 mA set point for the meter.

Lower Range Value This is the 4 mA set point for the meter, and is typically set to 0 when the primary variable is a flow variable.

5.10 Damping

ProLink III	Device Tools → Configuration → Outputs → Analog Output
-------------	--

Damping changes the response time of the flow meter to smooth variations in output readings caused by rapid changes in input. Damping is applied to the Analog Output, Primary Variable, Percent of Range, and Vortex Frequency.

The default damping value is 2.0 seconds. This can be configured to any value between 0.2 to 255 seconds when PV is a flow variable or 0.4 to 32 seconds when PV is Process Temperature. Determine the appropriate damping setting based on the necessary

response time, signal stability, and other requirements of the loop dynamics in your system.

Note

If the vortex shedding frequency is slower than the damping value selected, no damping is applied. Process Temperature damping can be modified when PV is set to Process Temperature.

5.11 Optimize Digital Signal Processing (DSP)

ProLink III	Device Tools → Configuration → Process Measurement → Signal Processing
-------------	--

A function that can be used to optimize the range of the flow meter based on the density of the fluid. The electronics uses process density to calculate the minimum measurable flow rate, while retaining at least a 4:1 signal to the trigger level ratio. This function will also reset all of the filters to optimize the flow meter performance over the new range. If the configuration of the device has changed, this method should be executed to ensure the signal processing parameters are set to their optimum settings. For dynamic process densities, select a density value that is lower than the lowest expected flowing density.

6 Advanced installation

6.1 Insert integral temperature sensor

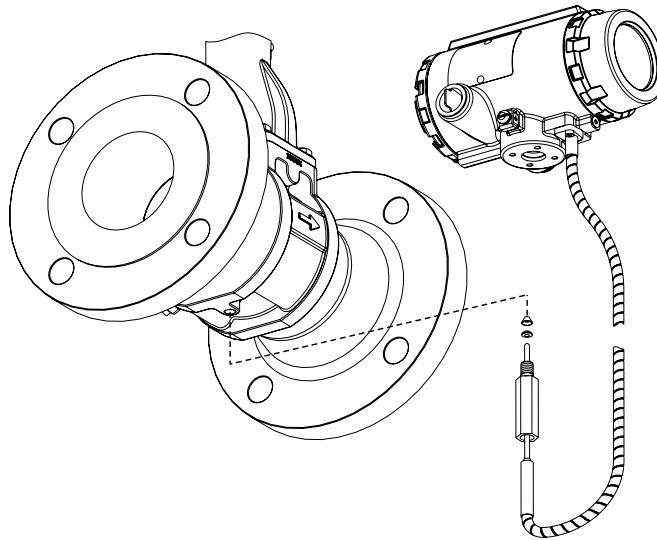
Follow these steps to install the integral temperature sensor, if equipped.

1. The temperature sensor is coiled and attached to the electronics bracket. Remove the Styrofoam around the sensor and insert the temperature sensor into the hole at the bottom of the meter body.

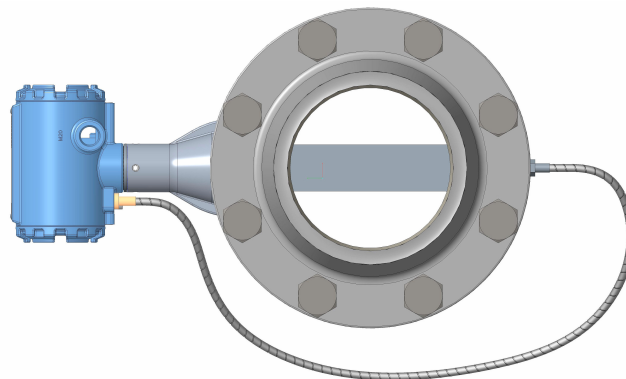
There is no need to remove the opposite end from the electronics.

2. Insert temperature sensor into the hole in the bottom of meter body until it reaches the bottom of the hole.

Figure 6-1: Temperature sensor assembly for inserting into meter body



3. If any part of the temperature sensor cable is above the horizontal plane of where the temperature sensor enters the transmitter, route the sensor cable below the flow meter to form a drip loop.



4. Hold the temperature sensor in place and tighten the bolt with a ½ inch (13 mm) open end wrench until it reaches ¾ turns past finger tight. Do not over-tighten.
5. Verify that the insulation extends to the end of the bolt on the bottom of the meter body. Leave at least 1 inch (25 mm) clearance around the electronics bracket.

The meter body should be insulated to achieve stated temperature accuracy. The electronics bracket and electronics housing should not be insulated. See [Insulation](#).

⚠ CAUTION

Do not loosen or remove the temperature connection at the electronics when the housing integrity needs to be maintained.

6.2 Pulse output

Note

When using the pulse output, all power to the electronics is still supplied over the 4–20 mA signal wiring.

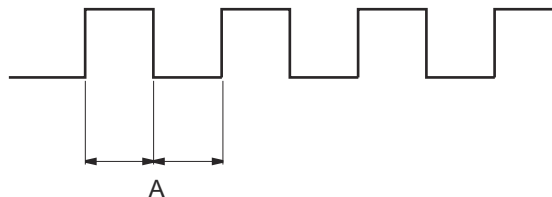
The flowmeter provides an isolated transistor switch-closure frequency output signal proportional to flow, as shown in the following figure. The frequency limits are as follows:

- Maximum frequency = 10000 Hz
- Minimum frequency = 0.0000035 Hz (1 pulse/79 hours)
- Duty cycle = 50%
- External supply voltage (Vs): 5 to 30 V dc
- Load Resistance (RL): 100 Ω to 100 kΩ
- Max switching current = 100 mA \geq VS/RL
- Switch closure: transistor, open collector

The output may drive an externally powered electromechanical or electronic totalizer, or may serve as a direct input to a control element.

In the following example, the pulse output will maintain a 50 percent duty cycle for all frequencies.

Figure 6-2: Example: Pulse output

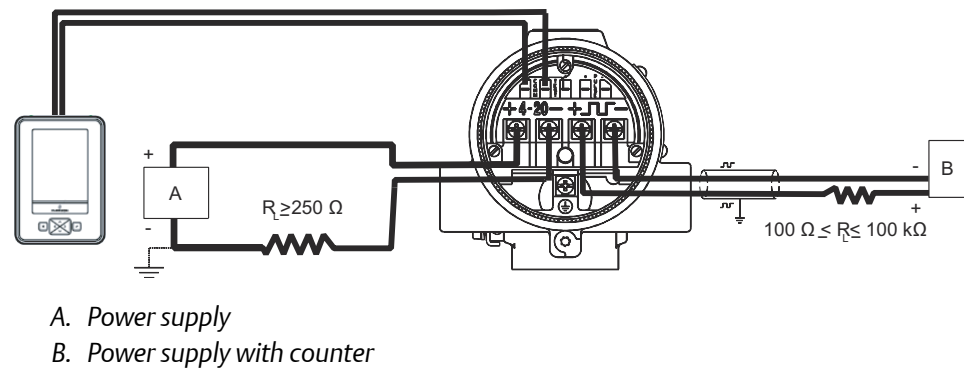


A. 50% duty cycle

6.2.1 Wire the pulse output

- Shielded twisted pair is required when the pulse output and 4–20 mA output are run in the same conduit or cable trays. Shielded wire will also reduce false triggering caused by noise pickup. Wiring should be 24 AWG (0.2 mm²) or larger and not exceed 5,000 ft. (1500 m).
 - Do not connect the powered signal wiring to the test terminals. Power could damage the test diode in the test connection.
 - Do not run signal wiring in conduit or open trays with power wiring, or near heavy electrical equipment. If needed, ground signal wiring at any one point on the signal loop, such as the negative terminal of the power supply. The electronics housing is grounded to the meter body.
 - If the flowmeter is protected by the optional transient protector, you must provide a high-current ground connection from the electronics housing to earth ground. Also, tighten the housing ground screw in the bottom of the terminal block to provide a good ground connection.
 - Plug and seal all unused conduit connections on the electronics housing to avoid moisture accumulation in the terminal side of the housing.
 - If the connections are not sealed, mount the flowmeter with the conduit entry positioned downward for drainage. Install wiring with a drip loop, making sure the bottom of the drip loop is lower than the conduit connections or the electronics housing.
1. To connect the wires, remove the FIELD TERMINALS side cover of the electronics housing.
 2. Connect the wires as shown in the following figure.

Figure 6-3: 4–20 mA and pulse wiring with electronic totalizer/counter



6.3 Transient protection

The optional transient terminal block prevents damage to the flowmeter from transients induced by lightning, welding, heavy electrical equipment, or switch gears. The transient protection electronics are located in the terminal block.

IEEE C62.41 - 2002 Category B

The transient terminal block was verified using the following test waveforms specified in the IEEE C62.41 - 2002 Category B standard:

- 3 kA crest (8 X 20 ms)
- 6 kV crest (1.2 X 50 ms)
- 6 kV/0.5 kA (0.5 ms, 100 kHz, ring wave)

6.3.1 Installing or replacing the transient protection

For flowmeters ordered with the transient protector option (T1), the protector is shipped installed.

The transient protection kit includes the following:

- One transient protection terminal block assembly
- Three captive screws

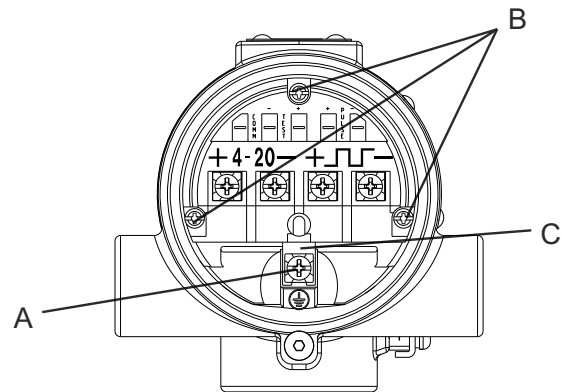
When purchased separately from the transmitter, install the protector using a small instrument screwdriver, a pliers, and the transient protection kit.

1. If the flowmeter is installed in a loop, secure the loop and disconnect power.
2. Remove the field terminal side flowmeter cover.
3. Remove the captive screws.
Refer to the following figure.
4. Remove the housing ground screw.
5. Use pliers to pull the terminal block out of the housing.
6. Inspect the connector pins for straightness.
7. Place the new terminal block in position and carefully press it into place.

The terminal block may have to be moved back and forth to get the connector pins started into the sockets.

8. Tighten the captive screws.
9. Install and tighten the ground screw.
10. Replace the cover.

Figure 6-4: Transient Terminal Block



- A. Housing ground screw
 - B. Captive screws
 - C. Transient terminal block ground tab
-

6.4 Wire a HART pressure transmitter for pressure compensation

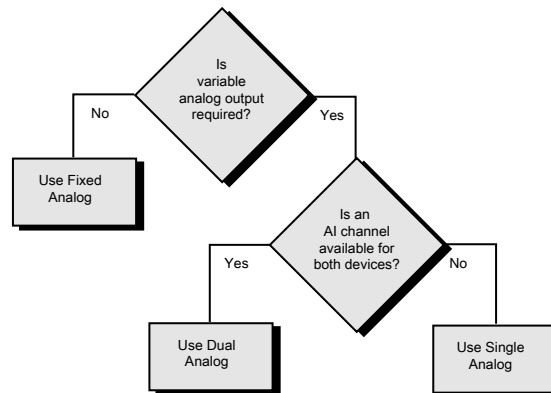
When the vortex meter is ordered with either the MPA or MCA option, the transmitter is capable of catching a pressure input from a HART pressure transmitter and utilizing the pressure input for pressure compensated mass flow.

- The MPA option can be used for pressure compensated mass flow for saturated steam.
- The MCA option can be used for:
 - pressure compensated mass flow for saturated steam, or
 - pressure and temperature compensated mass flow for superheated steam

6.4.1 Wiring configurations

There are multiple wiring possibilities to utilize a pressure input from a pressure transmitter for pressure compensation with the vortex meter. [Figure 6-5](#) is a guide to the appropriate wiring configuration for the application.

Figure 6-5: HART Communication Bridge wiring decision tree



See [Dual and Single Analog Wiring Configuration with the HART Communication Bridge](#) for Dual and Single analog wiring information.

Fixed analog

Fixed-analog wiring configuration provides the capability for the vortex meter to receive the pressure input from a HART pressure transmitter by wiring multiple devices in parallel. This is a great solution when a variable analog output is not required from either device, analog output is not used for control, low power remote, or totalizing applications.

Note

A HART communication bridge is NOT required with this wiring configuration.

Follow these steps to properly wire the flow meter and pressure transmitter:

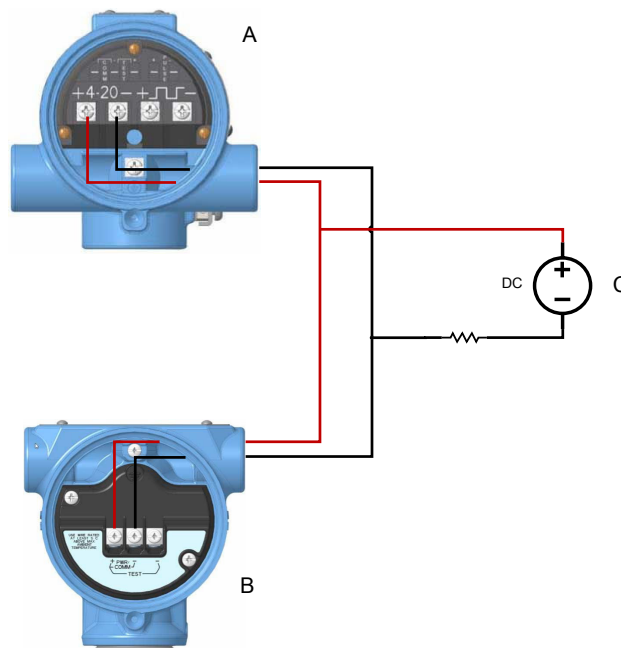
1. Configure both devices with different non-zero HART addresses.

Note

Configuring a HART 5 device with a non-zero HART address will result in a fixed output of 4 mA; Configuring a HART 7 device with a non-zero HART address may permit a choice between a fixed output and loop current varying with the Primary Variable.

2. Configure the pressure transmitter to burst its Primary Variable.
 3. Connect the devices as shown in [Figure 6-6](#).
-

Figure 6-6: Fixed analog flow and pressure wiring



- A. Vortex transmitter
 - B. Pressure transmitter
 - C. Power supply
-

Note

Use a common 250 to 1k ohm resistor for HART communication

Note

The flow meter cannot be in burst mode. Two bursting transmitters in a parallel wiring will result in collisions on the HART segment and prevent the flow meter from receiving the pressure value.

Please refer to [Mass compensation](#) for more information on Optimizing HART systems for pressure compensation

7 Advanced configuration

Advanced configuration options are used to configure the flow meter for a wider range of applications and special situations.

7.1 LCD display

ProLink III	Device Tools → Configuration → Display Variables
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The LCD display (option M5) provides local indication of the output and abbreviated diagnostic messages governing operation of the flow meter. You can select any of the following variables to be displayed, where at least one must be selected:

- Primary Variable
- Percent of Range
- Loop Current
- Totalizer Value
- Shedding Frequency
- Mass Flow
- Velocity Flow
- Volume Flow
- Process Temperature (MCA option with Temperature Mode enabled)
- Calculated Process Density (MCA option with Temperature Mode enabled)
- Process Pressure (Pressure Mode enabled)
- Pulse Frequency
- Shedding Frequency
- Electronics Temperature
- Signal Strength
- Corrected Volume Flow
- Elapsed Time Meter (meters with ETM option)

7.2 Compensated K-factor

ProLink III	Device Tools → Configuration → Device Setup
-------------	---

The compensated K-factor is based on the reference K-factor as compensated for the given process temperature, wetted materials, body number, and pipe ID. Compensated K-factor is an informational variable that is calculated by the electronics of the flow meter.

The reference K-factor is factory set and is displayed on the support tube label. The reference K-factor should only be re-configured in the device in the event of transmitter replacement. Contact technical support for details.

7.3 Meter body

ProLink III	Device Tools → Configuration → Informational Parameters → Meter Body
-------------	--

Meter body parameters are factory-set configuration variables that indicate the physical and manufacturing properties of the flow meter. These parameters need not be changed unless the transmitter is being configured in the field for use with a different meter body than originally configured.

Wetted Material	The meter body material that is in contact with the process.
Flange Type	The sensor flange type and rating.
Meter Body Serial Number	The manufacturer's unique identification number for the sensor.
Body Number Suffix	A number + letter or a number with no letter on the right side of the meter body tag indicating the construction of the meter.
	Number + letter "A" or number only Welded meter construction
	Number + letter "B" Cast meter construction

7.4 Meter factor

Compensates the flowmeter for installation effects such as those caused by less than ideal straight run piping. See the reference graphs in the *Technical Data Sheet (00816-0100-3250) on Installation Effects* for the percent of K-factor shift based on entrance effects of upstream disturbances. This value is entered as a flow multiplication factor of the range of 0.8 to 1.2.

7.5 Variable mapping

Allows the user to select which variables the transmitter will output.

ProLink III	Device Tools → Configuration → Communications (HART)
-------------	--

Primary Variable

Note

The Primary Variable is also the Analog Output variable.

The Primary Variable can be either Corrected Volume Flow, Mass Flow, Velocity Flow, or Volume Flow or Process Temperature. When bench commissioning, the flow values for each variable should be zero and the temperature value should be the ambient temperature.

If the units for the flow or temperature variables are not correct, refer to [Process variable units](#). Use the Process Variable Units function to select the units for your application.

Secondary Variable

Selections for the secondary variable can be set to any of the following:

- Cold Junction Temperature (MCA option with Temperature Mode enabled)
- Totalizer Value
- Shedding Frequency
- Mass Flow
- Velocity Flow
- Volume Flow
- Process Temperature (MCA option with Temperature Mode enabled)
- Calculated Process Density (MCA option with Temperature Mode enabled or Pressure Mode enabled)
- Process Pressure (Pressure Mode enabled)
- Pulse Frequency
- Electronics Temperature
- Signal Strength
- Corrected Volume Flow
- Elapsed Time Meter (meters with ETM option)

Third variable

Selections for the Third Variable are identical to those of the Secondary Variable.

Fourth variable

Selections for the Fourth Variable are identical to those of the Secondary Variable.

7.6 Alarm/saturation levels

ProLink III	Device Tools → Configuration → Alarm/Saturation Levels
-------------	--

Alarm Direction	This is a read only parameter that indicates the Alarm Direction jumper setting. See Alarm and security jumper configuration .
Alarm Level	Specifies whether the Analog Output alarm values conform to NAMUR or Rosemount standards. See Failure mode alarm levels . The High Alarm, High Saturation, Low Saturation, and Low Alarm configuration read only parameters reflect the Alarm Level selection.

Table 7-1: Analog output: standard alarm values vs. saturation values

Level	4–20 mA saturation value	4–20 mA alarm value
Low	3.9 mA	≤ 3.75 mA
High	20.8 mA	≥ 21.75 mA

Table 7-2: Analog output: NAMUR-compliant alarm values vs. saturation values

Level	4–20 mA saturation value	4–20 mA alarm value
Low	3.8 mA	≤ 3.6 mA
High	20.5 mA	≥ 22.6 mA

7.7 Pulse output

ProLink III	Device Tools → Configuration → Outputs → Pulse Output
-------------	---

Pulse output can be configured using the configuration tool guided setups.

Note

Configuration of the pulse features is allowed even if the pulse option (Option P) was not ordered.

The flow meter comes with an optional pulse output option (P). This enables it to output the pulse rate to an external control system, totalizer, or other device. If the flow meter was ordered with the pulse mode option, it may be configured for either pulse scaling (based on rate or unit) or shedding frequency output.

There are several options for configuring the pulse output:

- Off
- Direct (Shedding Frequency)
- Scaled Volume
- Scaled Velocity
- Scaled Mass
- Scaled Corrected Volumetric

Note

In order to totalize in compensated mass flow, set pulse output to Scaled Mass even if the pulse output was not ordered or will not be used.

Direct (shedding)

This mode provides the vortex shedding frequency as output. In this mode, the software does not compensate the K-factor for effects such as thermal expansion or differing mating pipe inside diameters. Scaled pulse mode must be used to compensate the K-factor for thermal expansion and mating pipe effects.

Scaled volumetric

This mode allows for configuration of the pulse output based on a volumetric flow rate. For example, set 100 gallons per minute = 10,000 Hz. (The user enterable parameters are flow rate and frequency.)

Scaled corrected volumetric

This mode allows for configuration of the pulse output based on a corrected volumetric flow rate.

Scaled velocity

This mode allows for configuration of the pulse output based on a velocity flow rate.

Scaled mass

This mode allows for configuration of the pulse output based on a mass flow rate if Actual Mass Compensation is Temperature Compensation.

When one of the scaled outputs is selected, choose one of two options:

Pulse scaling based on flow rate	Allows the user to set a certain flow rate to a desired frequency. For example: 1000 lbs/hr = 1000HZ <ul style="list-style-type: none">• Enter a flow rate of 1000 lbs/hr.• Enter a frequency of 1000Hz.
Pulse scaling based on flow unit	Allows the user to set one pulse equal to a desired volume, mass, corrected volume, or distance. For example: 1 pulse = 1000lbs. <ul style="list-style-type: none">• Enter 1000 for the mass.

7.7.1 Pulse Loop Test

Pulse Loop Test is a fixed frequency mode test that checks the integrity of the pulse loop. It tests that all connections are good and that pulse output is running on the loop.

Note

The Pulse Loop Test will not check for valid pulse scaling configuration. It will set a frequency without consideration of the pulse scaling configuration.

7.8 Mass compensation

The transmitter can dynamically compensate for changes in fluid density to provide accurate compensated mass flow measurement. Depending on how the flow meter is ordered and/or licensed, it can measure mass flow using temperature and/or pressure compensation with the following options.

Temperature Compensation

The flow meter ordered with the MCA option code is equipped with a built in temperature sensor that communicates directly to the transmitter electronics. It can be used for saturated steam, water, or other liquids with known densities at given temperatures.

To use temperature compensation, set **Desired Compensation** to **Temperature Compensation**.

Saturated Steam To compensate for changes of density based on temperature in saturated steam applications, Set **Fluid Type** to **Steam**. This enables dynamic density compensation while measuring mass flow or corrected volumetric flow using built-in steam tables.

Water To compensate for changes of density based on temperature in water applications:

- Set **Fluid Type** to **Liquid**
- Set **Temperature Compensated Liquid** to **Water**
- Set **Fixed Process Pressure** to the approximate value of the process pressure

Entering fixed process pressure enables dynamic density compensation while measuring mass flow or corrected volumetric flow using the built-in water density calculations per IAPWS-IF97.

User defined liquid To compensate for changes of density based on temperature in liquid applications other than water:

- Set **Fluid Type** to **Liquid**
- Set **Temperature Compensated Liquid** to **User Defined**
- Enter between 2 and 5 temperature and density points of ascending temperature. The temperature and density points enable dynamic density compensation while measuring mass flow or corrected volumetric flow for a user defined liquid.

Note

The lower and upper limit of the temperature points is -40°F (-40°C) and 842°F (450°C).

Gas Temperature compensation is not available for gas fluid types.

The transmitter will use the internal measured temperature measurement from the integrated temperature sensor for density calculations. If the temperature sensor fails, the transmitter can continue to provide a compensated mass flow measurement using a fixed temperature value. See [Thermocouple Failure](#) for more information.

Pressure compensation

The flow meter can receive a pressure input from a HART-based pressure transmitter and use it for a pressure compensated mass flow measurement. This can be used for saturated steam applications. To use pressure compensation, ensure that **Desired Compensation** is set to **Pressure**.

Saturated Steam To compensate for changes of density based on pressure in saturated steam applications, Set **Fluid Type** to **Steam**. This enables dynamic density compensation.

Liquid or Gas Pressure compensation is not available for liquid and gas fluid types.

The transmitter will use the pressure value received from an external HART pressure transmitter for density calculations. If communication or the pressure sensor fails, the transmitter can continue to provide a compensated mass flow measurement using a fixed pressure value. See [External Pressure Failure Mode](#) for more information.

Pressure and temperature compensation

The flow meter ordered with the MCA option code can compensate for pressure and temperature. The flow meter is equipped with a temperature sensor and can receive a pressure input from a HART pressure transmitter. With pressure and temperature compensation, it is possible to measure mass flow in superheated steam applications. To utilize pressure and temperature compensation, set **Desired Compensation** to **Pressure and Temperature Compensation**.

Superheated Steam To compensate for changes of density based on pressure and temperature in superheated steam applications, set **Fluid Type** to **Steam**. This enables dynamic density compensation while measuring mass flow or corrected volumetric flow by using built-in steam tables.

Liquid or Gas Pressure and temperature compensation is not available for liquid and gas fluid types.

The transmitter will use the pressure value received from an external HART pressure transmitter and the internal measured temperature measurement from the integrated temperature sensor for density calculations.

The transmitter will use the internal measured temperature measurement from the integrated temperature sensor for density calculations. If the temperature sensor fails, the transmitter can continue to provide a compensated mass flow measurement using a fixed temperature value. See [Thermocouple Failure](#) for more information.

If communication or the pressure sensor fails, the transmitter can continue to provide a compensated mass flow measurement using a fixed pressure value. See [External Pressure Failure Mode](#) for more information.

If the temperature measurement is lower than the saturated temperature based on the external pressure measurement value, the transmitter will use the density based on the external pressure and saturated temperature value to provide a compensated mass flow rate and provide an alert. When process temperature is higher than the saturated temperature based on the external pressure measurement value, the transmitter will revert to using process temperature for density calculations and the alert will be cleared.

7.8.1 Temperature settings

Temperature Mode

When **Enable** is selected, the process temperature is measured. The temperature value obtained from the temperature sensor, can be used as the primary variable and/or temperature compensation for mass or corrected volumetric mass flow when Actual Compensation is Temperature Compensated or Pressure and Temperature Compensated is shown. When **Disable** is selected, the temperature sensor, if equipped, will be ignored.

Fixed Process Temperature and Fixed Process Temperature Units

Specify the approximate process temperature and units. This value is used primarily to compensate for thermal expansion of the meter body, even if temperature compensation is not being used. It can also be used for temperature compensation, if specified in the Measurement Compensation settings, in the event of a temperature sensor or input failure.

Electronics Temperature Units and Electronics Temperature Units

Electronics Temperature is a read-only informational/diagnostic value for which you can specify the preferred unit of measurement.

Temperature Damping

Increasing Temperature Damping setting effectively slows the response time to the temperature measurement. The default value is 2 seconds.

Thermocouple Failure

Choose what the transmitter should do in the event of a thermocouple failure. Selecting **Go To Alarm** will send the unit into Alarm mode. Selecting **Use Fixed Process Temperature** will allow the use of the value of **Fixed Process Temperature** to be used as the temperature input. The meter will also output a HART alert.

7.8.2 Pressure settings

Note

Pressure settings are only available for meters ordered with the MPA or MCA option.

Pressure Mode

Selecting **External** will enable the capability for the transmitter to obtain a process pressure reading from a pressure transmitter via HART communication. The pressure value obtained via HART can be used as the second, third or fourth variable. It can also be used for pressure compensation for mass or corrected volumetric flow when Actual Compensation is Pressure Compensated or Pressure and Temperature Compensated is shown. When **Disable** is selected, the ability to obtain a pressure input is turned off.

Pressure Input Source

Selecting **Catch** will enable pressure compensation mass flow through the use of an external HART pressure transmitted for a pressure input. Selecting **None** will disable the ability to use a pressure input for a pressure compensated mass flow measurement.

External Pressure

Digital value that represents the pressure measurement that is received through an external HART pressure device. This a read-only variable.

Stale Data Detection

Specify the number of seconds that are allowed to pass between pressure readings from the pressure transmitter before they are deemed stale. If the time between pressure readings exceed the number of seconds specified, **External Pressure Failure Mode will be enabled**.

Pressure Measurement Type

Choose **Absolute** or **Gauge** pressure according to the type of pressure measurement being taken by the pressure transmitter. If Gauge pressure is selected, **Atmospheric Pressure** and **Atmospheric Reference Pressure Units** must be specified.

Fixed Process Pressure

Specify the approximate process pressure value. This value is used for pressure compensation when the time between pressure readings exceeds the number of seconds specified in Stale Data Detection and External Pressure Failure Mode is set to Use Fixed Process Pressure.

External Pressure Failure Mode

This mode defines the behavior when the time in between pressure readings have exceeded the value for **Stale Data Detection**. Selecting **Go To Alarm** will send the unit into Alarm mode. Selecting **Use Fixed Process Pressure** will allow the use of the value of **Fixed Process Pressure** to be used as the pressure input. The meter will also output a HART alert.

7.8.3 Mass compensation general settings

The Mass Compensation general settings should be the starting place for configuring any mass flow compensation because they affect availability of other settings.

Process Fluid

Choose between liquid or steam.

Desired Compensation	The user selection for <i>Desired Compensation</i> is validated by the transmitter according to the current temperature and pressure compensation settings and licensing, as configured. If the desired compensation method is valid.
Actual Compensation	<i>Actual Compensation</i> , which is read-only, will reflect the same compensation type. If the Actual Compensation shows something different from the Desired Compensation, one or more of the temperature, pressure, process fluid, or licensing settings needs to be corrected for the Desired Compensation to be valid.

Example Desired and Actual Compensation selections

Saturated Steam with Tcomp	Temperature mode - Enabled Pressure mode - N/A Desired Compensation - Temp comp Actual Compensation - Temp comp
Superheated Steam with P+T comp	Temperature Mode - Enabled Pressure Mode - Enabled Desired Compensation - Pressure and Temperature compensation Actual Compensation - Pressure and Temperature compensation

7.8.4 Superheat diagnostics

Note

Superheat diagnostics applies only to meters ordered with the MCA option code.

ProLink III	Device Tools → Configuration → Process Measurement → Signal Processing
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Superheat Diagnostics allows for an alert and/or alarm to activate when the difference of the measured process temperature and the saturated temperature at the process pressure value drops below the Superheat Threshold value.

Superheat Diagnostics is available if the flow meter is equipped with the MCA option code, Fluid Type is Steam, both Pressure and Temperature Modes have been enabled and Actual Compensation is Pressure and Temperature Compensation.

The limit range for the Superheat Threshold is 9 °F to 180 °F (5 °C to 100 °C). The default value is 9 °F (5 °C).

7.9 Configure HART pressure transmitter

When using a pressure transmitter for compensated mass flow measurement, ensure that the HART PV is set to pressure.

Note

See [Wire a HART pressure transmitter for pressure compensation](#) for more information.

7.10 SMART fluid diagnostic

ProLink III	Device Tools → Configuration → Process Measurement → Signal Processing
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CAUTION

Due to unpredictable flow conditions and multiple potential failure modes in a process piping system, the SMART Fluid Diagnostic should not be used as a fail-safe alert when the transition from liquid to gas represents a safety hazard.

Alerts users when the fluid flow changes from liquid flow to gas flow. This is useful in oil and gas separator applications where stuck dump valves may allow gas to pass through the water leg and eventually into storage tanks. The diagnostic will alert users when gas begins flowing through the water leg. Additionally, the diagnostic can be used in blow down cycles where air, nitrogen, or steam are used to clear pipes. Once the liquid has been cleared, the meter will detect gas flow and the user can use that alert to properly time blow down cycles.

The SMART Fluid Diagnostic uses several application specific parameters to allow users to fine-tune functionality to their installation. Additionally, the diagnostic is available as a trial for 30 days on all equipped transmitters.

Control

Enables user to turn the SMART Fluid Diagnostic Functionality ON or OFF. Default is OFF unless configured for SMART Fluid Diagnostic from the factory.

Alarm Type

Enables user to select the alarm type. The alarm types are Analog, Pulse, Analog and Pulse, and Neither Analog or Pulse. This is the output that the transmitter will use to send the alarm when the meter detects a change from liquid to gas flow. In order to use the pulse output alarm, the transmitter must be equipped with the pulse output option. The default setting is Neither Analog or Pulse.

Analog Alarm

If the output type selected includes Analog, then the output level chosen here will be used for the alarm. The valid range is 3.5–22.65 mA. Default is 21.75 mA.

Pulse Alarm

If the output type selected includes pulse, then the output frequency you choose here will be used for the alarm. The valid range is 1–10,000 Hz. Default is 1 Hz.

Alarm Latch

Dictates the behavior of the alarm once gas flow is detected. If Alarm Latch is Enabled, the alarm will continue until the user resets the alarm manually (using a HART communication device such as AMS Device Manager, or a handheld communicator). When Disabled, the alarm will stop once liquid flow is detected by the transmitter, at which time the meter will continue normal operation. The default is Disabled.

Optimize Gas Detection Filters

Once the gas density has been determined, optimize the gas detection filters. This consists of two parts. The first is setting the gas density and second is setting the gas detection window.

The gas density value must be selected from a list of densities. This will be used to set the detection filters for the gas flow. Choose the value from the drop down that is the closest to the process gas density without exceeding it. Default value is 0.15 lb/cu ft. After filter optimization, it is best practice to verify that your gas detection low flow cutoff is above your highest expected liquid flow rate frequency.

The **Gas Detection** window specifies how long the meter will look for a gas flow event after the meter stops detecting liquid flow. Under typical conditions, the transition takes place quickly; however, if the transition is slow, then a longer window may be required. The acceptable range of values is 1 to 9 seconds and the default value is 1 second.

SMART Fluid Diagnostic Trial

The SMART Fluid Diagnostic can be used on a trial basis for 30 days following activation of the trial. The trial period can be activated by entering 8800 in the license field. To permanently activate the diagnostic following the trial, contact an Emerson representative (see back page) to obtain an activation code.

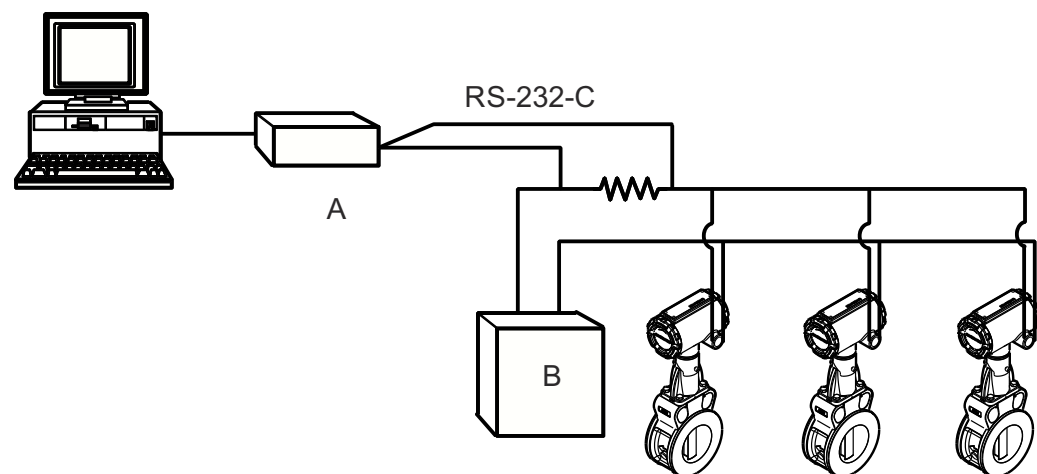
7.11 HART multidrop communication

Multidropping refers to the connection of several transmitters to a single communication transmission line. Communication occurs digitally between a HART-based communicator or control system and the devices. Multidrop mode automatically deactivates the analog output of the transmitters. Using the HART communication protocol, up to 15 transmitters can be connected on a single twisted pair of wires or over leased phone lines.

The use of a multidrop installation requires consideration of the update rate necessary from each device, the combination of device models, and the length of the transmission line. Multidrop installations are not recommended where intrinsic safety is a requirement. Communication with the devices can be accomplished with commercially available Bell 202 modems and a host implementing the HART protocol. Each device is identified by a unique address (0–15 for HART version 5 or 0–63 for HART version 7) and responds to the commands defined in the HART protocol.

The following figure shows a typical multidrop network. This figure is not intended as an installation diagram. Contact Emerson with specific requirements for multidrop applications.

Figure 7-1: Typical multidrop network



- A. Bell 202 Modem
- B. Power Supply

Note

The vortex transmitter is set to poll address zero at the factory, allowing it to operate in the standard point-to-point manner with a 4–20 mA output signal. To activate multidrop communication, the transmitter poll address must be changed to a number between 1 and 15. This change deactivates the 4–20 mA analog output, setting it to 4 mA, and disables the failure mode alert signal.

Poll address

Enables configuration of the poll address for a multidropped meter. The poll address is used to identify each meter on the multidrop line. Follow the on-screen instructions to set

the address at a number from 0 to 15. HART 7 allows an address range of 0 to 63. To set or change its address, establish communication with the selected flow meter in the loop.

Auto poll

When a HART-based communicator is powered up and auto polling is on, the communicator automatically polls the flow meter addresses to which it is connected. If the address is 0, the HART-based communicator enters its normal Online mode. If it detects an address other than 0, the communicator finds each device in the loop and lists them by poll address and tag. Scroll through the list and select the meter with which you need to communicate.

If **Auto Poll** is off, the flow meter must have the poll address set to 0 or the flow meter will not be found. Additionally, if a single connected device has an address other than zero and auto polling is off, the device will not be found.

7.12 Burst mode

ProLink III	Device Tools → Configuration → Communications (HART)
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Burst Mode configuration

The transmitter supports HART burst mode, which broadcasts the primary variable or all dynamic variables approximately three to four times a second. HART version 7 devices offer enhanced burst mode capabilities including the ability to broadcast variable status, the ability to broadcast up to 8 variables, and the ability to trigger messages based on variable events or at defined values.

Note

Only one device on a HART segment can be in Burst mode. For example, if pressure compensation (via the MPA or MCA option) is used with a pressure transmitter in Burst mode the vortex flow meter transmitter must not use Burst mode.

The Burst Mode variable enables you to set the burst mode to the needs of your application. Options for the burst mode setting include:

- Off** Turns off the burst mode so that no data are broadcast on the loop.
- On** Turns burst mode on so that the data selected under Burst Option are broadcast over the loop.

Additional command options may appear that are reserved and do not apply to the Rosemount 8800D.

Burst option

The burst option selects the variables to broadcast over the loop:

- PV** Selects the primary variable for broadcast over the loop.
- Percent Range/
Current** Selects the primary variable as percent of range and analog output current for broadcast over the loop.
- Process vars/crnt** Selects the primary variables and analog output current for broadcast over the loop.

Dynamic Vars	Burst all dynamic variables in the transmitter.
Xmtr Vars	Allows the user to define custom burst variables.

7.13 Optimizing HART systems for pressure compensation

After the flow meter is completely set up and running, you can try turning off Burst Mode to determine whether the system is actively reading the pressure process variable using Command 1 frequently enough to avoid Stale Data Detection.

7.14 Signal processing

ProLink III	Device Tools → Configuration → Process Measurement
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The transmitter can filter out noise and other frequencies from the vortex signal. The four user-alterable parameters associated with the digital signal processing include low-pass filter corner frequency, low-flow cutoff, trigger level, and damping. These four signal conditioning functions are configured at the factory for optimum filtering over the range of flow for a given line size, service type (liquid or gas), and process density. For most applications, leave these parameters at the factory settings. Some applications may require adjustment of the signal processing parameters.

Use signal processing only when recommended in the troubleshooting section of this manual. Some of the problems that may require signal processing include:

- High output (output saturation)
- Erratic output with or without flow present
- Incorrect output (with known flow rate)
- No output or low output with flow present
- Low total (missing pulses)
- High total (extra pulses)

If one or more of these conditions exist, and you have checked other potential sources (K-factor, service type, lower and upper range values, 4–20 mA trim, pulse scaling factor, process temperature, pipe ID), refer to [Troubleshooting](#). If problems persist after signal processing adjustments, contact an Emerson representative (see back page).

Optimize DSP (Digital Signal Processing)

Used to optimize the range of the flow meter based on the density of the fluid. The electronics uses process density to calculate the minimum measurable flow rate, while retaining at least a 4:1 signal to the trigger level ratio. This function will also reset all of the filters to optimize the flow meter performance over the new range. For a stronger signal, select a density value that is lower than the actual flowing density. For dynamic process densities, select a density value that is lower than the lowest expected flowing density.

Signal strength

Variable that indicates the flow signal strength to trigger level ratio. This ratio indicates if there is enough flow signal strength for the meter to work properly. For accurate flow measurement, the value should be greater than 4. Values greater than 4 will allow increased filtering for noisy applications. For values greater than 4, with sufficient density, the Optimize DSP function can be utilized to optimize the measurable range of the flow meter.

Values less than 4 may indicate applications with very low densities and/or applications with excessive filtering.

Manual filter adjust

Allows for manual adjustment of the following settings: Low Flow Cutoff, Low Flow Cutoff Response, Low Pass Corner Frequency, and Trigger Level, while monitoring flow and or signal strength.

Low flow cutoff

Enables the adjustment of the filter for noise at no flow. It is set at the factory to handle most applications, but certain applications may require adjustment either to expand measurability or to reduce noise.

- Low Flow Cutoff offers two modes for adjustment:
- Decrease Low Flow Cutoff
- Increase Low Flow Cutoff

It also includes a dead band such that once flow goes below the cutoff value, output does not return to the normal flow range until flow goes above the dead band. The dead band extends to approximately 20 percent above the low flow cutoff value. The dead band prevents the output from bouncing between 4 mA and normal flow range if the flow rate is near the low flow cutoff value.

LFC response

Defines how the output of the Vortex meter will behave entering into and coming out of the Low Flow Cutoff. Options are stepped or damped. (See [Technical Note 00840-0200-4004](#) for more information regarding Low Flow Measurement).

Low pass corner frequency

Sets the low-pass filter corner frequency to minimize the effects of high frequency noise. It is factory set based on line size and service type. Adjustments may be required only if you are experiencing problems. See [Troubleshooting](#).

The Low Pass Filter corner frequency variable offers two modes for adjustment:

- Decrease Low Pass Corner Frequency
- Increase Low Pass Corner Frequency

Note

Do not adjust this parameter unless directed to do so by an Emerson representative.

Trigger level

Configured to reject noise within the flow range while allowing normal amplitude variation of the vortex signal. Signals of amplitude lower than the Trigger Level setting are filtered out. The factory setting optimizes noise rejection in most applications. Trigger Level offers two modes for adjustment:

- Increase Trigger Level
- Decrease Trigger Level

Note

Do not adjust this parameter unless directed to do so by an Emerson representative.

Restore default filter

Restores all of the signal conditioning variables to default values. Default values for signal conditioning variables will be set automatically depending on fluid type using the Optimize DSP function with a density setting of 40 lb/ft³ (640 kg/m³) for liquid or 0.15 lb/ft³ (2.4 kg/m³) for gas.

Flow damping

The default damping value is 2.0 seconds. Flow Damping can be reset to any value between 0.2 and 255 seconds.

Temperature damping

The default damping value is 2.0 seconds. Temperature Damping can be reset to any value between 0.4 and 32 seconds. Temperature Damping can only be configured if Temperature is assigned to be PV.

7.15 Device information

ProLink III	Device Tools → Device Information
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Used for identification of flow meters in the field and to store information that may be useful in service situations. Information variables have no effect on flow meter output or process variables.

See also [Tag](#) and [Long Tag](#).

Descriptor

Longer user-defined variable to assist with more specific identification of the particular flowmeter. It is usually used in multi-flowmeter environments and provides 16 characters.

Message

Provides an even longer user-defined variable for identification and other purposes. It provides 32 characters of information and is stored with the other configuration data.

Date

User-defined variable that provides a place to save a date, typically used to store the last date that the transmitter configuration was changed.

Write Protect

Read-only informational variable that reflects the setting of the hardware security switch. If Write Protect is ON, configuration data are protected and cannot be changed from a HART-based communicator or control system. If Write Protect is OFF, configuration data may be changed using the communicator or control system. For HART 7 devices, a software lock is also available.

Revision Numbers

Fixed informational variables that provide the revision number for different elements of your equipment. These revision numbers may be required when calling . Revision numbers can only be changed at the factory and are provided for the following elements:

Universal Revision	Designates the HART Universal Command specification to which the flow meter is designed to conform.
Transmitter Revision	Designates the revision for vortex flow meter specific command identification for HART compatibility.
Software Revision	Designates the internal software revision level for the flow meter.
Hardware Revision	Designates the revision level for the vortex flow meter hardware.
DD Revision	Factory-defined unique identifier for device descriptor revision identification in the software.

7.16 Change HART revisions

On enabled devices, change between HART revision 5 and 7. Configuration will be saved while switching between revisions.

7.17 Special process variable units

ProLink III	Device Tools → Configuration → Process Measurement → Flow → Special Units
-------------	---

Allows the user to create flow rate units that are not among the standard options. Configuration of a special unit involves entry of these values: base flow unit, base time unit, user defined unit and conversion number. For example, the following settings would be used to display flow in beer barrels per minute instead of gallons per minute, with one beer barrel equal to 31 gallons:

- Base volume unit: gal
- Base time unit: min
- User defined unit: br
- Conversion number: 1/31.0

Base flow unit

The unit from which the conversion is made.

Table 7-3: Base flow unit

Volumetric flow	Mass flow	Corrected volume flow
U.S. gallon	gram	U.S. gallon
liter	kilogram	liter
imperial gallon	metric ton	imperial gallon
cubic meter	pound	barrel
barrel	short ton	standard cubic foot
cubic foot		normal cubic foot

Base time unit

Provides the time unit from which to calculate the special units. For example, if the special unit is a volume per minute, select minutes. Choose from the following units:

- Seconds (s)
- Minutes (min)
- Hours (h)
- Days (d)

Special flow unit

A user created custom flow unit. The special unit is limited to four characters. The LCD display will display the actual four character user defined special unit.

Conversion number

Used to relate base units to special units. For a straight conversion of volume units from one to another, the conversion number is the number of base units in the new unit.

For example, if it is desired to convert from gallons to beer barrels there are 31 gallons in a beer barrel. The conversion equation is as follows (where beer barrels is the new volume unit):

$$1 \text{ gallon} = 0.032258 \text{ bbl.}$$

7.18 Elapsed Time Meter

ProLink III	Device Tools → Totalizer Control → Totalizers
-------------	---

When enabled, Elapsed Time Meter provides an accurate measurement of the time the transmitter is powered. This can be useful as a diagnostic tool if a power interruption is suspected. Use **Reset** to restart the timer at zero.

7.19 Flow totalizer

ProLink III	Device Tools → Totalizer Control → Totalizers
-------------	---

The flow totalizer keeps a running total of the flow that has run through the meter in the user-selected flow variable (Corrected Volume Flow, Mass Flow, Velocity Flow, or Volume Flow). It can run continuously or be controlled using the **Start**, **Stop**, and **Reset** (to zero) commands.

Totalizer control

Allows the totalizer to be started, stopped, or reset.

Start Starts the totalizer counting from its current value.

Stop Interrupts the totalizer count until it is restarted again. This feature is often used during pipe cleaning or other maintenance operations.

Reset Returns the totalizer value to zero. If the totalizer was running, it will continue to run starting at zero.

Totalizer configuration

Used to configure the flow parameter (volume, mass, velocity, or corrected volume flow) that will be totaled.

Note

The totalizer value is saved in the non-volatile memory of the electronics every three seconds. Should power to the transmitter be interrupted, the totalizer value will start at the last saved value when the power is re-applied.

Note

Changes that affect the density, density ratio, or compensated K-Factor will affect the totalizer value being calculated. These changes will not cause the existing totalizer value to be recalculated.

Note

In order to totalize in compensated mass flow, set pulse output to Scaled Mass even if the pulse output was not ordered or will not be used. Please refer to section 7.9 for pulse output configuration.

7.20 Locate device

For HART 7 devices with LCD displays, enabling Locate Device displays the characters 0-0-0-0 on the LCD display. This allows for easy field identification of the device during commissioning or service.

8 Troubleshooting

8.1 Communication problem with HART-based communicator

Recommended actions

1. Check for a minimum of 10.8 VDC at the transmitter terminals.
2. If possible, visually verify transmitter is powered by viewing the LCD display.
3. Check for loop resistor (250 to 1000 ohms).
4. Measure the loop resistor value (R_{loop}) and the source power supply voltage (V_{ps}). Check that $[V_{ps} - (R_{loop} \times 0.024)] > 10.8$ VDC.
5. Check for the transmitter in multidrop mode by setting communicator to search all HART addresses.
6. Check for the transmitter in burst mode. It may help to turn off burst mode for HART communication.
7. Remove the pulse connection if you have a three-wire pulse installation.
8. Cycle power and try again.
9. Replace the electronics.

8.2 Incorrect 4–20 mA output

Recommended actions

1. Check for a minimum 10.8 VDC at the transmitter terminals.
2. If the output current is outside the range of 4–20 mA, check for diagnostic information and correct as appropriate.
3. Check the URV, LRV, Density, Special Units, LFC. Compare these inputs with the sizing program results. Correct the configuration.
4. Perform a 4–20 mA loop test, and if necessary, perform a 4-20mA trim.
5. Connect a milliammeter across the "TEST" clips on the terminal block and confirm measured current matches loop test value. If the system measured current does not match current measured by the milliammeter, check loop wiring and terminations.
6. Check for corrosion on the terminal block.
7. Refer to [Advanced troubleshooting](#)
8. For the electronics verification procedure, see [Electronics verification](#).
9. Replace the electronics if necessary.

8.3 Incorrect pulse output

Recommended actions

1. Check that the 4–20 mA output is correct.
2. Confirm the wiring polarity as well as pulse power supply and resistance are within specifications. See [Pulse output](#).
3. Check the pulse mode and the scaling factor. Make sure the scaling factor is not inverted.
4. Perform a pulse test.
5. Select the pulse scaling so that the pulse output is less than 10,000Hz at URV.

8.4 Error messages on a HART-based communicator

Recommended actions

See [Diagnostic messages](#).

8.5 Flow in Pipe, No Output

Recommended actions for basic problems

1. Check sizing. Make sure the flow is within measurable flow limits. Use the online Emerson Size and Selection tool for best sizing results.
2. Check to make sure the meter is installed with the arrow in the direction of process flow.
3. For installations with transmitter mounted remotely from the meter, confirm remote cable connections.
4. Perform basic checks for [Incorrect 4–20 mA output](#).
5. Check and correct the configuration parameters in this order:
 - a. Process fluid
 - b. Process density
 - c. Base density
 - d. Reference K-factor
 - e. Variable mapping
 - f. PV unit
 - g. Range values - (URV, LRV)
 - h. Optimize signal processing
 - i. Pulse mode
 - j. Scaling (if used)

6. For the electronics verification procedure, see [Electronics verification](#).

Recommended actions for electronics problems

1. Check for Diagnostic messages. See [Diagnostic messages](#) for more information about the messages.
2. Run a self test with a HART-based interface tool.
3. Using a sensor simulator, apply a test signal.
4. Check the configuration, LFC, trigger level, and STD vs. actual flow units.
5. Replace the electronics.

Recommended actions for application problems

1. Check sizing. Make sure the flow is within measurable flow limits. Use the online Emerson Size and Selection tool for best sizing results.
2. Calculate the expected frequency. If the actual frequency is the same, check the configuration.
3. Check that the application meets viscosity and density requirements for the line size.
4. Recalculate the back pressure requirement. If it is necessary and possible, increase the back pressure, flow rate, or operating pressure.

Recommended actions for sensor problems

1. Inspect sensor lead wire and sensor connection for damage. Replace if necessary.
2. Check tightness of SMA connector.
The SMA nut should be gently secured to the nut with a 5/16 inch wrench to 7 in-lbs (0.8 N-m) to the electronics housing. Avoid over-tightening the coaxial sensor cable to the electronics housing.
3. Check that the sensor impedance at process temperature is > 1 Mega- Ohm. Replace the sensor if necessary. See [Replacing the sensor](#).
4. Check the torque on the sensor nut and make sure it is at 32 ft lbf (43.4 N m). For a 1-8 inch (2.54-20.32 cm) meter body with ANSI 1500 flanges, the torque on the sensor nut should be 50 ft lbf (67.8 N m).

8.6 No flow, output

Recommended actions for basic problems

1. Check basic configuration and ADSP filter settings.
2. Check for excessive pipe vibration by monitoring Signal Strength and Shedding Frequency. Typically pipe vibration would be less than 30 Hz. Please refer to the product spec section for more information on vibration spec.
3. Check the shedding frequency to see if it is locked to 50/60 Hz for AC line noise. Remote installations are more susceptible.
4. Verify line is blocked or fully shut down

5. Check to make sure the meter is installed with the arrow in the direction of process flow.

8.7 Diagnostic messages

When a diagnostic event occurs, the transmitter posts information to the communication tools and the LCD. The following tables list the messages and descriptions as they appear in ProLink or AMS, as well as their associated display/communication tool messages.

Table 8-1: Faults

Display	ProLink III	Description
FAULT^^^ ELECT	Electronics Failure	This is a summary fault condition indicating a failure in the transmitter electronics. <ul style="list-style-type: none"> • Cycling power may resolve the problem. • Replace the electronics if the problem persists.
FAULT^^^ SFTWR	Software Detected Error	One of the software task stacks has overflowed. Resetting the transmitter will clear the faults. <ul style="list-style-type: none"> • Cycling power may resolve the problem. • Report the problem to the factory. • Replace the electronics if the problem persists.
FAULT^^^ COPHW	Output Board Electronics Failure	The coprocessor built in Self Test has detected a fault, or the coprocessor has detected a math or instruction fault. <ul style="list-style-type: none"> • Cycling power may resolve the problem. • Replace the electronics if the problem persists.
FAULT^^^ ^ASIC	Digital Filter Error	The digital filter in the transmitter electronics is not reporting. The transmitter will remain in ALARM until the digital signal processor resumes reporting flow data. <ul style="list-style-type: none"> • Cycling power may resolve the problem. • Replace the electronics if the problem persists.
FAULT^^^ ^COEFF	Coprocessor Coefficient Error	The area of non-volatile memory used to store the curve fit coefficients for the coprocessor calculations does not contain valid data. This data can only be loaded at the factory. <ul style="list-style-type: none"> • Cycling power may resolve the problem. • Replace the electronics if the problem persists.
FAULT^^^ NVMEM	Non-Volatile Memory Error	At least one segment of non-volatile memory has failed a checksum verification. If the 'Factory Non-Volatile Memory Error' is NOT also active this problem may be fixed by reconfiguring all transmitter parameters. The transmitter will remain in ALARM until the EEPROM checksum test passes. <ul style="list-style-type: none"> • Reconfigure all transmitter parameters. • Replace the electronics if the problem persists.

Table 8-1: Faults (continued)

Display	ProLink III	Description
FAULT^^^ ^^ROM	ROM Checksum Error	The microprocessor ROM has failed a checksum test. This test is run at start-up and in the background. <ul style="list-style-type: none"> Cycling power may resolve the problem Replace the electronics if the problem persists
ALERT^^^ or FAULT^^^ T/C	Thermocouple Failure	<p>Note This message is a fault when Temperature Sensor Failure Mode is set to Go to Alarm. It is an alert when Temperature Sensor Failure Mode is set to Use Fixed Process Pressure.</p> <p>The thermocouple used to measure process temperature has failed.</p> <ul style="list-style-type: none"> Check the thermocouple connections to the transmitter. Replace the thermocouple if the problem persists.
FAULT^^^ SDCOM	Internal Communications Fault	After several attempts the microprocessor has failed in communicating with an ASIC used in the conversion of the flow sensor signal. <ul style="list-style-type: none"> Cycling power may resolve the problem. Check the connector between electronics boards. Replace the electronics if the problem persists.
FAULT^^^ SDPLS	Internal Signal Fault	The flow data from an ASIC used in the conversion of the flow sensor signal has been lost. <ul style="list-style-type: none"> Cycling power may resolve the problem. Check the connector between electronics boards. Replace the electronics if the problem persists.
FAULT^^^ NVMEM	Factory Non-Volatile Memory Error	A segment of non-volatile memory that is written only at the factory has failed a checksum verification. This fault cannot be fixed by reconfiguring transmitter parameters. Replace the electronics.
FAULT^^^ PT HW	Process Temperature Electronics Failure	The electronics circuitry that supports the measurement of the Process Temperature has failed. The transmitter can still be used in a conventional volume flow mode. Replace the electronics if Process Temperature measurement is required.

Table 8-2: Maintenance

Display	ProLink III	Description
	Trigger Overrange	The Trigger Level configuration of the Digital Filters is out of range. <ul style="list-style-type: none"> Re-enter the Trigger Level configuration.
	Low-Pass Filter Overrange	The Low-pass Filter configuration of the Digital Filters is out of range. <ul style="list-style-type: none"> Reconfigure the Low-pass Filter.

Table 8-2: Maintenance (continued)

Display	ProLink III	Description
	Low Flow Cutoff Out of Range	The Low Flow Cutoff configuration of the Digital Filters is out of range. <ul style="list-style-type: none"> Reconfigure the Low Flow Cutoff.
	Electronics Temperature Out of Limits	The temperature of the electronics is too high or too low. <ul style="list-style-type: none"> Adjust the ambient conditions of the transmitter. Consider remotely mounting the electronics.
FAULT^^^ CONFIG	Invalid Configuration	Parameters critical to the operation of the transmitter are not properly configured. Refer to the Configuration Status to determine which parameters should be reconfigured. The valid configuration of some parameters is dependent on the current configuration of other parameters. Consult the manual for assistance. <ul style="list-style-type: none"> Re-enter the invalid configuration parameter.
FAULT^^^ LOOPV	Low Loop Voltage	The voltage at the transmitter terminals has dropped to a level that is causing internal power supplies to drop, reducing the capability of the transmitter to accurately measure a flow signal. <ul style="list-style-type: none"> Check the voltage at the transmitter terminals. Either increase power supply or reduce loop resistance.
PT^^^ FIXED	Fixed Process Temperature Active	The Fixed Process Temperature value is being used for density calculations. The thermocouple used to measure process temperature has failed. <ul style="list-style-type: none"> Check the thermocouple connections to the transmitter. Replace the thermocouple if the problem persists.

Table 8-3: Advisory

Display	ProLink III	Description
	Smart Fluid Alarm Active	A Smart Fluid alarm has been triggered. The Smart Fluid diagnostic is enabled and has detected a transition from liquid to gas flow. <ul style="list-style-type: none"> Acknowledge the Smart Fluid Alarm if it is latched. The alarm will remain active as long as there is gas flow detected.
SIGnAL^^ SIMUL	Flow Simulation Mode	The flow signal is being produced from a signal generator internal to the Vortex transmitter. The flow value reported by the transmitter is NOT the process flow value. <ul style="list-style-type: none"> This is informational only.
SEnSOR^^ OFFLN	Flow Signal Injection	The flow signal is being injected into the transmitter from an external signal generator. The flow value reported by the transmitter is NOT the process flow value. <ul style="list-style-type: none"> This is informational only.

Table 8-3: Advisory (continued)

Display	ProLink III	Description
ALert ^^^ PTOSL	Process Temperature Out of Range	<p>The Process Temperature is beyond the defined sensor limits of –58 °F to +842 °F (–50 °C to +450 °C).</p> <ul style="list-style-type: none"> This is informational only.
ALert ^^^ PT>UL	Process Temperature Above Density Calculation Limits	<p>The Process Temperature is above the high limit for Saturated and Superheated Steam or Liquid density calculations. This status only occurs when:</p> <ul style="list-style-type: none"> Process Fluid is Steam and Actual Compensation is Temperature, or Pressure and Temperature Process Fluid is Liquid, Temperature Compensated Liquid is Water or User Defined, and Actual Compensation in Temperature <p>Steam The density calculation will use a process temperature of 695.408 °F (368.56 °C) when Actual Compensation in Temperature Compensation or 842 °F (450 °C) when Actual Compensation in Pressure and Temperature Compensation while this condition is active.</p> <p>Liquids</p> <p>Water The density calculation will use a process temperature of 600.8°F (316 °C) when Temperature Compensated Liquid is Water and Actual Compensation in Temperature Compensation while this condition is active.</p> <p>User Defined The density calculation will use a process temperature of the last custom temperature point while this condition is active.</p> <ul style="list-style-type: none"> This is informational only.

Table 8-3: Advisory (continued)

Display	ProLink III	Description
ALert^^ PT<LL	Process Temperature Below Density Calculation Limits	<p>The Process Temperature is below the low limit for Saturated and Superheated Steam or Liquid density calculations. This status only occurs when:</p> <ul style="list-style-type: none"> Process Fluid is Steam and Actual Compensation is Temperature, or Pressure and Temperature Process Fluid is Liquid, Temperature Compensated Liquid is Water or User Defined, and Actual Compensation in Temperature <p>Steam The density calculation will use a process temperature of 176 °F (80 °C) while this condition is active.</p> <p>Liquids</p> <p>Water The density calculation will use a process temperature of 32 °F (0 °C) while this condition is active.</p> <p>User Defined The density calculation will use a process temperature of the first custom temperature point while this condition is active.</p> <ul style="list-style-type: none"> This is informational only.
(freq.) PULSE	Pulse Output Fixed	<p>The transmitter has been commanded to output a fixed pulse output frequency. The pulse output does not reflect the process flow.</p> <ul style="list-style-type: none"> Exit the Pulse Loop test.
PP^^^ FIXED	Fixed Process Pressure is Active	<p>The Fixed Process Pressure value is being used for density calculations.</p> <p>The MV Vortex Transmitter has been configured to substitute 'Fixed Process pressure' for density calculations when external pressure has been lost.</p> <ul style="list-style-type: none"> Check communications connection with external pressure device. Increase the minimum Stale Data Detection parameter.
ALert^^ PT<ST	Process Temperature is below the saturation curve for the Density Calculation Limits	<p>Density Calculations are out of range:</p> <ol style="list-style-type: none"> Process Temperature is below the saturation curve but within temperature process limits. Process Pressure is in-range for the density calculations. <p>Density calculation uses the process pressure value and saturated temperature based on the pressure value.</p> <ul style="list-style-type: none"> Check process conditions. This alert is informational only.

Table 8-3: Advisory (continued)

Display	ProLink III	Description
ALert^^ PP>UL	Process Pressure is Above the Density Calculation Limits	Process Pressure is greater than the maximum process pressure limit. <ul style="list-style-type: none"> Check process conditions. This alert is informational only.
ALert^^ SH LO	Process Temperature is below the Superheat Threshold	Process temperature is below the User Defined Superheat limit. <ul style="list-style-type: none"> Check process conditions This alert is informational only.
ALert^^ PP<LL	Process Pressure is below the Density Calculation Limits (Pressure and Temperature compensation Superheated/ Saturated Steam)	<ol style="list-style-type: none"> Process Pressure is less than the minimum process pressure limit Process Temperature is greater than the saturation temperature at 6.88 psia. <ul style="list-style-type: none"> Check process conditions. This alert is informational only.
ALert^^ PP<LL	Process Pressure is below the Density Calculation Limits (Pressure compensation only Saturated Steam)	Process Pressure is less than the minimum process pressure limit. <ul style="list-style-type: none"> Check process conditions. This alert is informational only.
ALert^^ PP<LL	Process Density is below calculated limit (Pressure and Temperature compensation Superheated/ Saturated Steam)	Caught Process Pressure value is less than the minimum process pressure limit and Process temperature is below the saturation limit for the minimum pressure limit. This alert is informational only. Note ALert^^ PT<LL will also display.
FAULt ^PP or ALert ^PP	Process Pressure Unavailable	Note This message is a fault when Loss of Pressure is set to Go to Alarm. It is an alert when Loss of Pressure is set to Use Fixed Process Pressure. Process Pressure has not been updated within the period defined by the minimum Stale Data Detection parameter. <ul style="list-style-type: none"> Check communications connection with external pressure device. Increase the minimum Stale Data Detection parameter.

8.8 Temperature and pressure compensation troubleshooting

Mass flow measurement with temperature and pressure compensation requires the correct combination of measurement devices, physical configuration, wiring, and software configuration to be successful. The vortex transmitter software is designed to

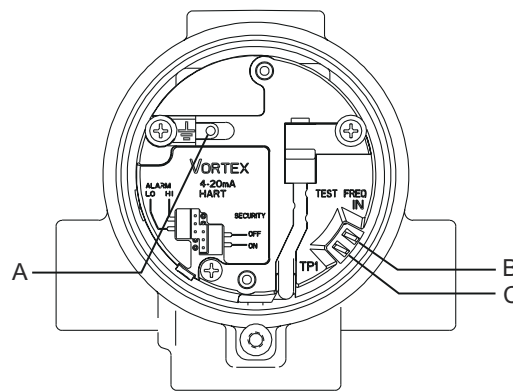
identify configuration problems and communicate them to users on the local display or through the configuration tools.

Use the information in [Diagnostic messages](#) to determine where problems may have originated, and then modify the installation details or configuration accordingly. See also [Mass compensation](#) and [Advanced installation](#).

8.9 Electronics test points

As shown in the following figure, there are several test points located on the electronics.

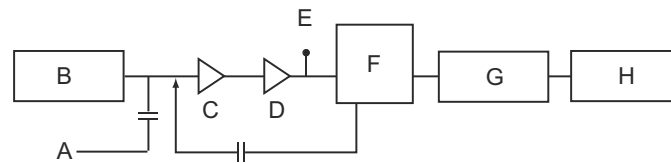
Figure 8-1: Electronics test points



- A. Ground
- B. Test frequency input
- C. Test point 1

The electronics are capable of internally generating a flow signal that can be used to simulate a sensor signal to perform electronics verification with a handheld communicator or AMS Device Manager interface. The simulated signal amplitude is based on the transmitter required minimum process density. The signal being simulated can be one of several profiles – a simulated signal of constant frequency or a simulated signal representative of a ramping flow rate. The electronics verification procedure is described in [Electronics verification](#). To verify the electronics, you can input a frequency on the TEST FREQ IN and GROUND pins to simulate flow via an external signal source such as a frequency generator. To analyze and/or troubleshoot the electronics, an oscilloscope (set for AC coupling) and a handheld communicator or AMS Device Manager interface are required. The following figure is a block diagram of the signal as it flows from the sensor to the microprocessor in the electronics.

Figure 8-2: Signal flow



- A. External test frequency input
- B. Sensor
- C. Charge amplifier
- D. Amplifier/Low pass filter
- E. TP1
- F. A-to-D converter/internal frequency generator
- G. Digital filter
- H. Microprocessor

TP1—Test point 1

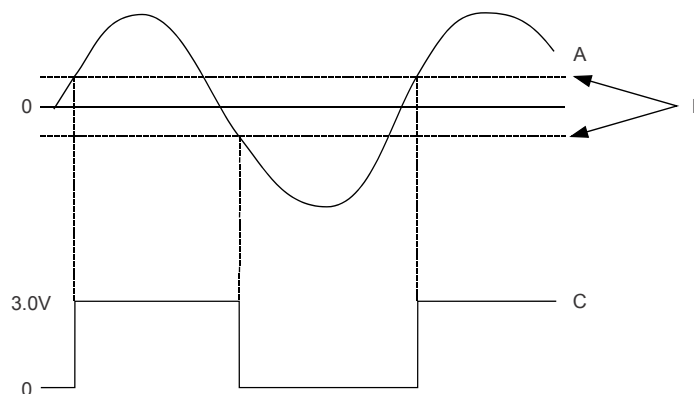
TP1 is the vortex shedding signal after it has gone through the charge amplifier and low pass filter stages and into the input of the sigma delta A-to-D converter ASIC in the electronics. The signal strength at this point will be in the mV to Volt range.

TP1 is easily measured with standard equipment.

Example: Correct waveform

Figure 8-3 shows an ideal (clean) waveform. Consult technical support if the waveform you detect is not similar in principle to this figure.

Figure 8-3: Clean signals

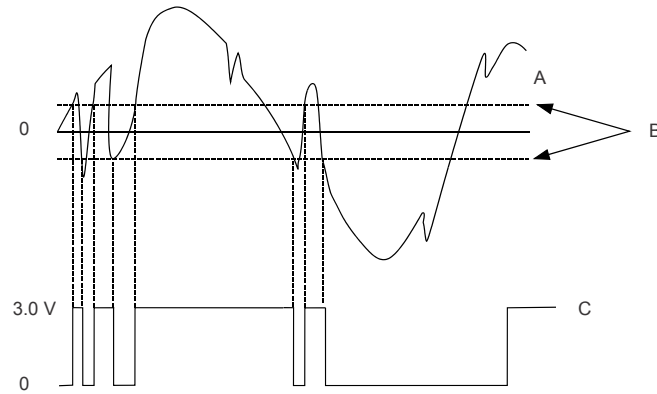


- A. Vortex signal (TP1)
- B. Trigger level
- C. Shedding frequency output

Examples: Wrong waveforms

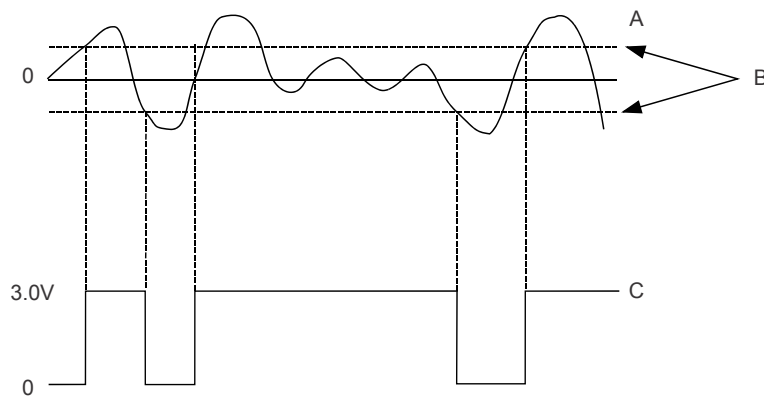
Figure 8-4 and Figure 8-5 show waveforms that may cause the output to be inaccurate.

Figure 8-4: Noisy signals



- A. Vortex signal (TP1)
- B. Trigger level
- C. Shedding frequency output

Figure 8-5: Improper Sizing/Filtering



- A. Vortex signal (TP1)
- B. Trigger level
- C. Shedding frequency output

9 Maintenance

9.1 Transient protection

The optional transient terminal block prevents damage to the flowmeter from transients induced by lightning, welding, heavy electrical equipment, or switch gears. The transient protection electronics are located in the terminal block.

IEEE C62.41 - 2002 Category B

The transient terminal block was verified using the following test waveforms specified in the IEEE C62.41 - 2002 Category B standard:

- 3 kA crest (8 X 20 ms)
- 6 kV crest (1.2 X 50 ms)
- 6 kV/0.5 kA (0.5 ms, 100 kHz, ring wave)

9.1.1 Installing or replacing the transient protection

For flowmeters ordered with the transient protector option (T1), the protector is shipped installed.

The transient protection kit includes the following:

- One transient protection terminal block assembly
- Three captive screws

When purchased separately from the transmitter, install the protector using a small instrument screwdriver, a pliers, and the transient protection kit.

1. If the flowmeter is installed in a loop, secure the loop and disconnect power.
2. Remove the field terminal side flowmeter cover.
3. Remove the captive screws.

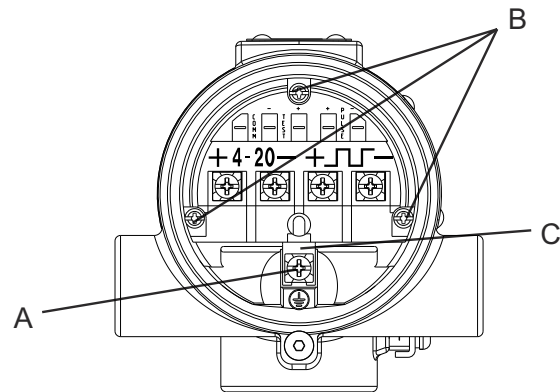
Refer to the following figure.

4. Remove the housing ground screw.
5. Use pliers to pull the terminal block out of the housing.
6. Inspect the connector pins for straightness.
7. Place the new terminal block in position and carefully press it into place.

The terminal block may have to be moved back and forth to get the connector pins started into the sockets.

8. Tighten the captive screws.
9. Install and tighten the ground screw.
10. Replace the cover.

Figure 9-1: Transient Terminal Block



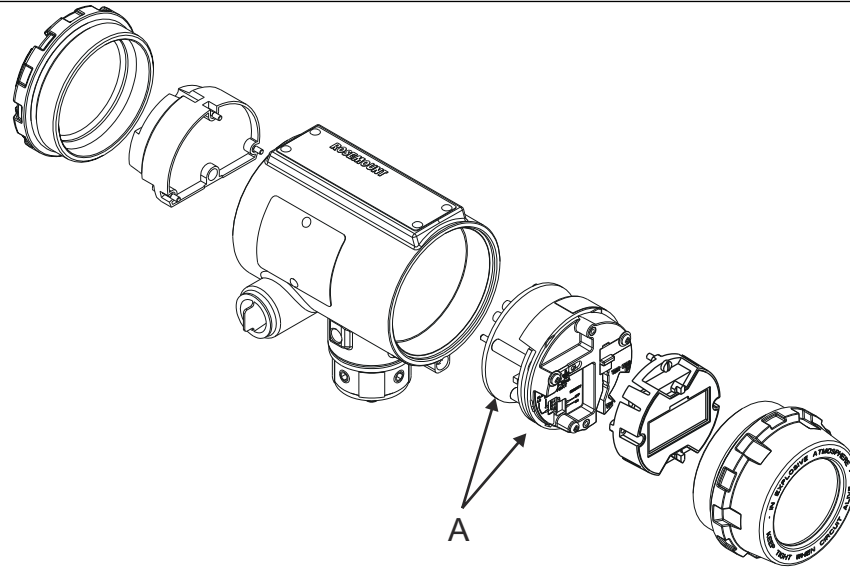
- A. Housing ground screw
- B. Captive screws
- C. Transient terminal block ground tab

9.2 Installing the LCD indicator

For flowmeters ordered with the LCD indicator, the indicator is shipped installed. When purchased separately from the Rosemount 8800D, you must install the indicator using a small instrument screwdriver and the indicator kit. The indicator kit includes:

- One LCD indicator assembly
- One extended cover with o-ring installed
- One connector
- Two mounting screws
- Two jumpers

Refer to the following figure when using these steps to install the LCD indicator:



A. *Electronics board*

1. If the flowmeter is installed in a loop, secure the loop and disconnect the power.
2. Remove the flowmeter cover on the electronics side.

Note

The circuit board is electrostatically sensitive. Be sure to observe handling precautions for static-sensitive components.

3. Insert the mounting screws into the LCD indicator.
4. Remove the two jumpers on the circuit board that coincide with the Alarm and the Security settings.
5. Insert the connector into the Alarm/Security junction.
6. Gently slide the LCD indicator onto the connector and tighten the screws into place.
7. Insert jumpers into ALARM and SECURITY positions on the face of the LCD indicator.
8. Attach the extended cover and tighten at least one-third turn past O-ring contact.

Note

The indicator may be installed in 90-degree increments for easy viewing. Mounting screws may need to be installed in the alternative holes based on LCD display orientation. One of the four connectors on the back of the indicator assembly must be positioned to fit into the 10-pin connector on the electronic board stack.

Note the following LCD display temperature limits:

- Operating: -4 to 185 °F (-20 to 85 °C)
- Storage: -50 to 185 °F (-46 to 85 °C)

9.3 Hardware replacement

The following procedures will help you disassemble and assemble the Rosemount 8800D hardware if you have followed the troubleshooting guide earlier in this section of the manual and determined that hardware components need to be replaced.

Note

Use only the procedures and new parts specifically referenced in this manual. Unauthorized procedures or parts can affect product performance and the output signal used to control a process, and may render the instrument dangerous.

⚠ CAUTION

Process should be vented before the meter body is removed from service for disassembly. Flowmeters should not be left in service once they have been determined to be inoperable.

9.3.1 Replacing the terminal block in the housing

To replace the field terminal block in the housing, you will need a small screwdriver. Use the following procedure to replace the terminal block in the housing.

Remove the terminal block

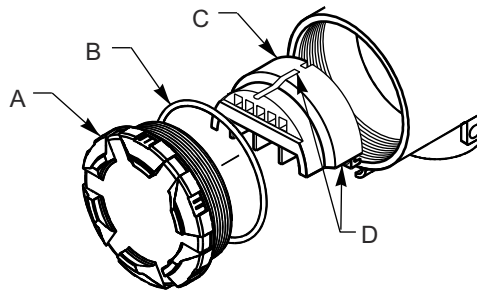
⚠ WARNING

For complete warning information, see [Safety messages](#).

1. **⚠ CAUTION**
Remove power before removing the electronics cover.

Turn off the power to the Rosemount 8800D.
2. Unscrew the cover. Refer to the following figure.

Figure 9-2: Terminal block assembly



- A. Cover
- B. O-ring
- C. Terminal block
- D. Captive screws (3x)

3. Disconnect the wires from the field terminals. Be sure to secure them out of the way.
4. Remove the ground screw if transient protection (Option T1) is installed.
5. Loosen the three captive screws.
6. Pull outward on the terminal block to remove it from the housing.

Install the terminal block

1. Align the socketed holes on the back side of the terminal block over the pins protruding from the bottom of the housing cavity in the terminal block side of the electronics housing.
2. Slowly press the terminal block into place. Do not force the block into the housing. Check the alignment if it does not glide into place.
3. Tighten the three captive screws to anchor the terminal block.
4. Connect the wires to the appropriate field terminals.
5. Reinstall and tighten the transient ground screw if you have the transient option (Option T1).
6. Screw on and tighten the cover.

9.3.2 Replacing the electronics boards

The Rosemount 8800D electronics boards may need to be replaced if they have been damaged or otherwise become dysfunctional. Use the following procedures to replace electronics boards in the Rosemount 8800D. You will need a small Phillips head screwdriver and pliers.

Note

The electronics boards are electrostatically sensitive. Be sure to observe handling precautions for static-sensitive components.



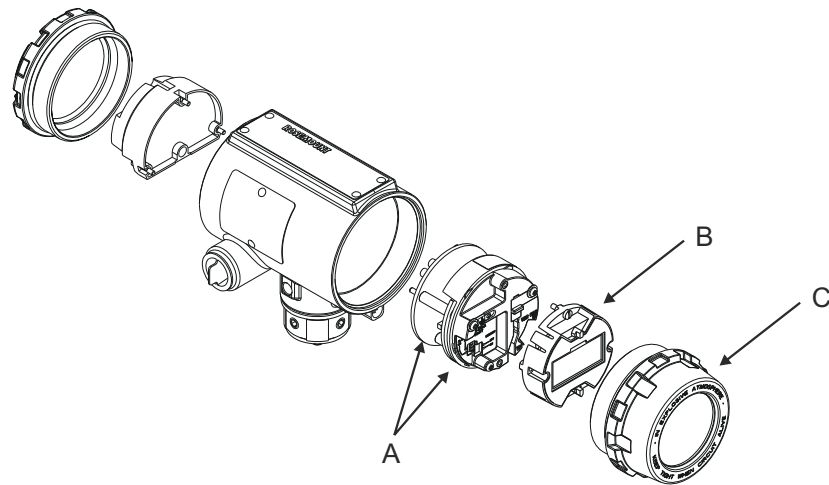
CAUTION

Remove power before removing the electronics cover.

Remove the electronics boards

1. Turn off the power to the Rosemount 8800D.
2. Unscrew and remove the electronics board compartment cover. (Unscrew and remove the LCD display cover if you have the LCD display option).

Figure 9-3: Electronics Boards Assembly



- A. Electronics boards
- B. LCD display
- C. LCD display cover

3. If the meter has the LCD display option, loosen the two screws.
4. Remove the LCD display and the connector from the electronics board.
5. Loosen the three captive screws that anchor the electronics.
6. Use pliers or a flat head screwdriver to carefully remove the sensor cable clip from the electronics.
7. Remove thermocouple if applicable.
8. Use the handle molded into the black plastic cover to slowly pull the electronics boards out of the housing.

Install the electronics boards

1. Verify that power to the Rosemount 8800D is off.
2. Align the sockets on the bottom of the two electronics boards over the pins protruding from the bottom of the housing cavity.
3. Carefully guide the sensor cable through the notches on the edge of the circuit boards.
4. Slowly press the boards into place. Do not force the boards down. Check the alignment if they do not glide into place. Carefully insert sensor cable clip into electronics board.
5. Tighten the three captive screws to anchor the two electronics boards. Ensure that the SST washer is under the screw in the 2 o'clock position.
6. Reinsert the alarm and security jumpers into the correct location.
7. Re-install the thermocouple if applicable.
8. If the meter has LCD display option, insert the connector header into the LCD display board.

- a) Remove jumpers from the electronics board.
 - b) Put the connector through the bezel on the electronics board.
 - c) Carefully press the LCD display onto the electronics board.
 - d) Tighten the two screws that retain the LCD display.
 - e) Insert the alarm and security jumpers in the correct location.
9. Replace the electronics board compartment cover.

9.3.3 Replacing the electronics housing

The Rosemount 8800D electronics housing can be replaced easily when necessary. Use the following procedure:

Tools needed

- 5/32 inch (4 mm) hex wrench
- 5/16 inch (8 mm) open end wrench
- Screwdriver to disconnect wires
- Tools to disconnect conduit

Note

Remove power before removing the electronics housing.

Remove the electronics housing

1. Turn off the power to the Rosemount 8800D.
2. Remove the terminal block side cover.
3. Disconnect the wires and conduit from the housing.
4. Use a 5/32 inch (4 mm) hex wrench to loosen the housing rotation screws (at the base of the electronics housing) by turning screws clockwise (inward) until they clear the bracket.
5. Slowly pull the electronics housing no more than 1.5 inch (40 mm) from the top of the support tube.
6. Loosen the sensor cable nut from the housing with a 5/16 inch (8 mm) open end wrench.

Note

Lift the electronics housing until the sensor cable nut is exposed. Do not pull the housing more than 1.5 inch (40 mm) from the top of the support tube. Damage to the sensor may occur if this sensor cable is stressed.

Install the electronics housing

1. Verify that power to the Rosemount 8800D is off.
2. Screw the sensor cable nut onto the base of the housing.
3. Tighten the sensor cable nut with a 5/16 inch (8 mm) open end wrench.

4. Place the electronics housing into the top of the support tube.
5. Use a hex wrench to turn the three hex socket screws counterclockwise (outward) to engage support tube.
6. Place the access cover on the support tube (if applicable).
7. Tighten the screw on the access cover.
8. Connect conduit and wires.
9. Replace the terminal block cover.
10. Apply power.

9.3.4 Replacing the sensor

The sensor for the Rosemount 8800D is a sensitive instrument that should not be removed unless there is a problem with it. If you must replace the sensor, follow these procedures closely. Consult technical support before removing the sensor.

Note

Be sure to fully check all other troubleshooting possibilities before removing the sensor.

Do not remove the sensor unless it is determined that a problem exists with the sensor itself. The sensor may not fit on the post if it is removed and replaced more than two or three times, or replaced incorrectly.

Also, please note that the sensor is a complete assembly and cannot be further disassembled.

Tools needed

- 5/32 inch (4 mm) hex wrench
- 5/16 inch (8 mm) open end wrench
- 7/16 inch (11 mm) open end wrench
- ¾ inch (19 mm) open end wrench — for 3 inch (80 mm) and 4 inch (100 mm) SST wafers
- 1-1/8 inch (28 mm) open end wrench (for all other models)
- Suction or compressed air device
- Small, soft bristle brush
- Cotton swabs
- Appropriate cleaning liquid: water or cleaning agent

Removing the sensor

The following procedure applies to flowmeters equipped with a removable support tube.

Note

Sensor cavity could contain line pressure if an abnormal failure has occurred inside the meter body. For complete warning information, see [Safety messages](#).

1. If the meter body is not a CriticalProcess™ Vortex (CPA Option) proceed to [Step 6](#).

2. Welded onto the side of the meter body is a valve. Move any nearby equipment from the line of sight of the valve tube, if possible. Protect other equipment with shielding, cover, or other type of protection.
3. Position all personnel away from the line of sight of the valve tube.

Note

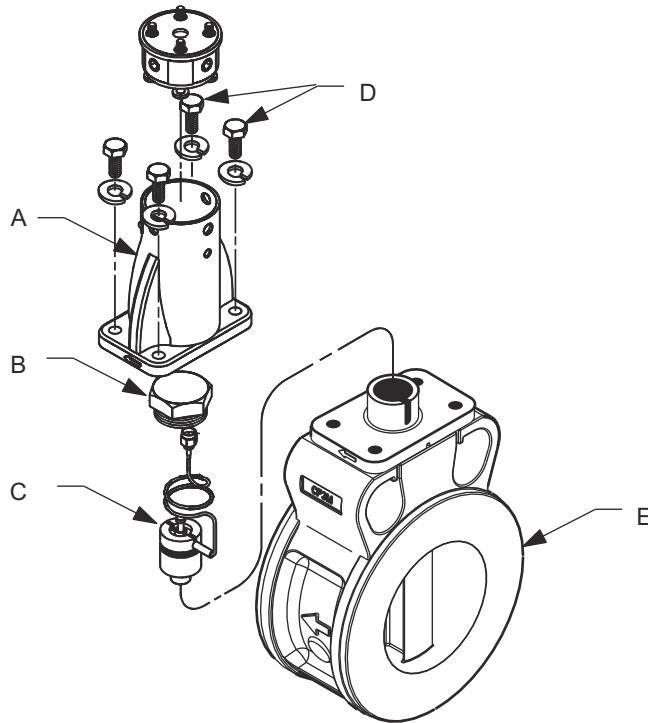
There are numerous tube fittings that could connect to the tube if there is a need to drain away process material. The tube on the valve has a 0.188 in (4.8 mm) OD with a 0.035 in (0.9 mm) wall thickness.

4. Using a 7/16 in (11 mm) open end wrench, slowly loosen the valve nut. Back out the nut until it stops. There is a set screw which prevents the nut from being completely removed.
5. Process fluid venting from the valve tube indicates that there is process fluid in the sensor cavity.

Option	Description
If there is no process fluid in the sensor cavity	Continue to Step 7 .
If there is process fluid in the sensor cavity	Immediately re-tighten the valve nut until process fluid stops venting. Do not tighten any further. Stop and contact your technical support. The meter body may need to be replaced.

6. De-pressurize the flow line.
7. Remove the electronics housing (see [Replacing the electronics housing](#)).
8. Loosen the four support tube anchor bolts with a 7/16 in (11 mm) open end wrench.

Figure 9-4: Removable support tube assembly



- A. Removable support tube
- B. Sensor nut
- C. Sensor
- D. Anchor bolts
- E. Meter body

9. Remove the support tube.
10. Loosen and remove the sensor nut from the sensor cavity with a 1-1/8 in (28 mm) open end wrench.
Use a 3/4 in (19 mm) open end wrench for 3 in (80 mm) and 4 in (100 mm) SST wafers.
11. Lift the sensor from the sensor cavity. Be very careful to lift the sensor straight up. Do not rock, twist, or tilt the sensor during removal; this will damage the engagement diaphragm.
12. If Critical Process (CPA option) is present, tighten the valve to insure it is closed after the new Vortex sensor is installed. It is recommended that the nut be torqued to 50 in-lbs (5.7 N-m). Over tightening the valve nut could compromise its ability to seal.

Clean the sealing surface

Before installing a sensor in the meter body, clean the sealing surface by completing the following procedure.

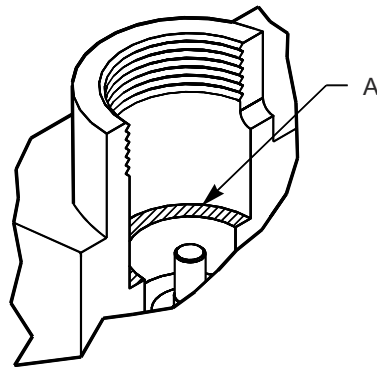
The metal o-ring on the sensor is used to seal the sensor cavity in the event that process fluid should corrode through the meter body and enter the sensor cavity. Be sure not to

scratch or otherwise damage any part of the sensor, sensor cavity, or sensor nut threads. Damage to these parts may require replacement of the sensor or meter body, or may render the flowmeter dangerous.

Note

If you are installing a sensor that has been used before, clean the metal o-ring on the sensor using the procedure below. If you are installing a newly purchased sensor, cleaning the o-ring is not necessary.

Figure 9-5: O-Ring Sealing Surface in Sensor Cavity



A. Sealing surface

1. Use a suction or compressed air device to remove any loose particles from the sealing surface and other adjacent areas in the sensor cavity. See [Figure 9-5](#).

Note

Do not scratch or deform any part of the sensor, sensor cavity, or sensor nut threads.

2. Carefully brush the sealing surface clean with a soft bristle brush.
3. Moisten a cotton swab with an appropriate cleaning liquid.
4. Wipe the sealing surface. Repeat several times if necessary with a clean cotton swab until there is minimal dirt residue picked up by the cotton swab.

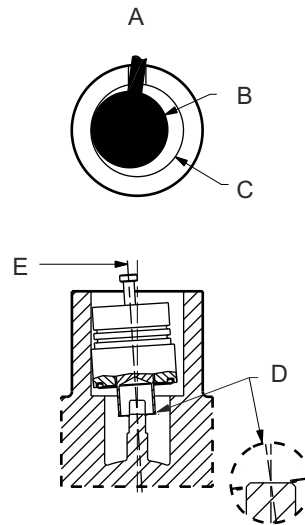
Install the sensor

1. Carefully place sensor over the post in the sensor cavity.
2. Ensure that the sensor is centered on the post. See [Figure 9-6](#) and [Figure 9-7](#).

Note

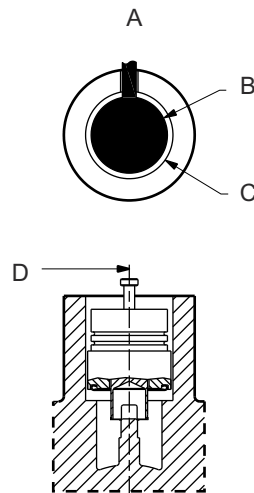
If the sensor is installed in a high temperature application place the sensor in the sensor cavity and wait for it to come up to temperature before seating the sensor on the post.

Figure 9-6: Sensor installation – improper alignment (before seating)



- A. Top view of flowmeter
- B. Sensor
- C. Sensor cavity in flowmeter
- D. Sensor not properly aligned
- E. Sensor center line is not aligned with flowmeter center line. Damage to sensor will occur.

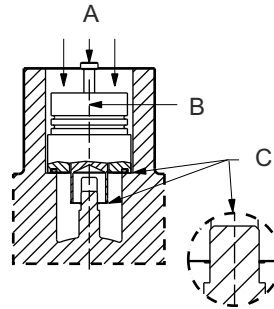
Figure 9-7: Sensor installation – proper alignment (before seating)



- A. Top view of flowmeter
- B. Sensor
- C. Sensor cavity in flowmeter
- D. Sensor center line must be aligned with flowmeter center line.

3. Sensor should remain as close to vertical as possible when applying force to seat. See [Figure 9-8](#).

Figure 9-8: Sensor installation – applying force



- A. Pressure
- B. Sensor center line must be aligned with flowmeter center line
- C. Sensor properly seated

4. Manually push down on the sensor by applying equal pressure for engagement onto the post.
5. Screw the sensor nut into the sensor cavity. Tighten the nut with a 1-1/8 inch (28 mm) open end torque wrench to 32 ft-lbs (43.4 N-m) (50 ft-lbs [67.8 N-m] for ANSI 1500 meter body).
Use a 3/4 inch (19 mm) open end wrench for 3 inch (80 mm) and 4 inch (100 mm) SST wafers. Do not over-tighten the sensor nut.
6. Replace the support tube.
7. Tighten the four bolts that anchor the support tube in place with a 7/16 inch (11 mm) open end wrench.
8. Install the flowmeter electronics housing. See [Replacing the electronics housing](#).

9.3.5 Remote electronics procedures

If the Rosemount 8800D electronics housing is mounted remotely, some replacement procedures are different than for the flowmeter with integral electronics. The following procedures are identical:

- [Replacing the terminal block in the housing](#).
- [Replacing the electronics boards](#).
- [Replacing the sensor](#).

Disconnect the coaxial cable at the meter

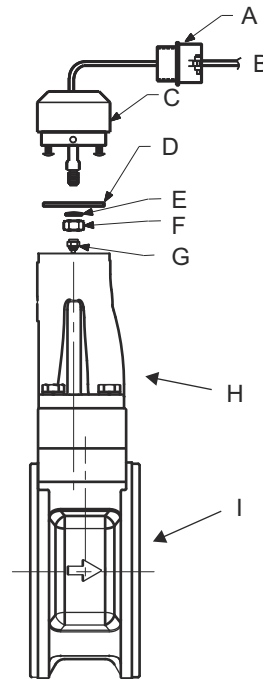
1. Remove the access cover on the meter body support tube if present.
2. Loosen the three housing rotation screws at the base of the meter adapter with a 5/32 inch (4 mm) hex wrench by turning the screws clockwise (inward) until they clear the bracket.

3. Slowly pull the meter adapter no more than 1.5 inch (40 mm) from the top of the support tube.
4. Loosen and disconnect the sensor cable nut from the union using a 5/16 inch (8 mm) open end wrench.

Note

Do not pull the adapter more than 1.5 inch (40 mm) from the top of the support tube. Damage to the sensor may occur if the sensor cable is stressed.

Figure 9-9: Coaxial Cable Connections



- A. 1/2 NPT conduit adapter or cable gland (supplied by customer)
 - B. Coaxial cable
 - C. Meter adapter
 - D. Union
 - E. Washer
 - F. Nut
 - G. Sensor cable nut
 - H. Support tube
 - I. Meter body
-

Detach the meter adapter

Use the following steps if it is necessary to remove the coaxial cable.

1. Loosen and remove the two screws that hold the union onto the meter adapter and pull the union away from the adapter.
2. Loosen and remove the sensor cable nut from the other end of the union.

3. Loosen and disconnect the conduit adapter or cable gland from the meter adapter.

Attach the meter adapter

1. If you are using a conduit adapter or cable gland, slide it over the plain end of the coaxial cable (the end without a ground wire).
2. Slide the meter adapter over the coaxial cable end.
3. Use a 5/16 inch (8 mm) open end wrench to securely tighten the sensor cable nut onto one end of the union.
4. Place the union onto the two screws extending out of the meter adapter and tighten the two screws.

Connect the coaxial cable at the meter body

1. Pull the sensor cable out of the support tube slightly and securely tighten the sensor cable nut onto the union.

Note

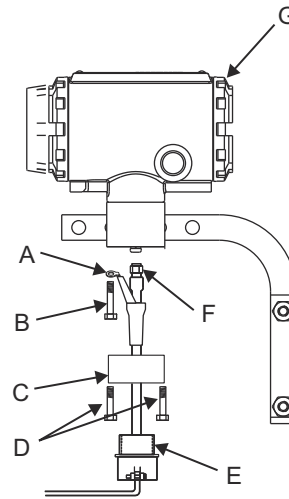
Do not stretch the sensor cable over 1.5 inch (40 mm) beyond the top of the support tube. Damage to the sensor may occur if the sensor cable is stressed.

2. Place the meter adapter into the top of the support tube and line up the screw holes.
3. Use a hex wrench to turn the three adapter screws counterclockwise (outward) to engage the support tube.
4. Replace the access cover on the support tube — 6 inch (152.4 mm) to 8 inch (203.2 mm) wafer style only.
5. Tighten the conduit adapter or cable gland into the meter adapter.

Remove the coaxial cable from the electronics housing

1. Loosen the two housing screws from the housing adapter.
2. Remove the housing adapter from the housing.
3. Loosen and remove the coaxial cable nut from the base of the electronics housing.
4. Remove the coaxial cable ground connection from the housing base by loosening the housing base screw that is connecting it to the housing base.
5. Loosen the conduit adapter (or cable gland) from the housing adapter.

Figure 9-10: Remote electronics exploded view



- A. Ground connection
- B. Housing base screw
- C. Housing adapter
- D. Housing adapter screws
- E. Conduit adapter (optional—supplied by customer)
- F. Coaxial cable nut
- G. Electronics housing

Attach the coaxial cable

1. Route the coaxial cable through the conduit (if you are using conduit).
2. Place a conduit adapter over the end of the coaxial cable.
3. Remove the housing adapter from the electronics housing (if attached).
4. Slide the housing adapter over the coaxial cable.
5. Remove one of the four housing base screws that is in closest proximity to the ground connection.
6. Re-install the housing base screw by passing it through the ground connection.
7. Attach and securely tighten the coaxial cable nut to the connection on the electronics housing.
8. Align the housing adapter with the housing base and attach with the two housing adapter screws.
9. Tighten the conduit adapter to the housing adapter.

9.3.6 Changing the housing orientation

The entire electronics housing may be rotated in 90 degree increments for better wiring access or improved viewing of the display.

1. Loosen the screw on the access cover on the support tube (if present) and remove the cover.
2. Loosen the three accessible housing rotation set screws at the base of the electronics housing with a 5/32 inch (4 mm) hex wrench by turning the screws clockwise (inward) until they clear the support tube.
3. Slowly pull the electronics housing out of the support tube.
If the electronics housing is rotated more than 90 degrees and a thermocouple is present, remove the thermocouple from the transmitter housing. See [Temperature sensor replacement](#) for more information.
4. Unscrew the sensor cable from the housing with a 5/16 inch (8 mm) open end wrench.

Note

Do not pull the housing more than 1.5 inch (40 mm) from the top of the support tube until the sensor cable is disconnected. Damage to the sensor may occur if this sensor cable is stressed.

5. Rotate the housing to the desired orientation.
6. Hold it in this orientation while you screw the sensor cable onto the base of the housing.

Note

Do not rotate the housing while the sensor cable is attached to the base of the housing. This will stress the cable and may damage the sensor.

7. If applicable, re-install the thermocouple to the transmitter housing. See [Temperature sensor replacement](#).
8. Place the electronics housing into the top of the support tube.
9. Use a hex wrench to turn the three accessible housing rotation screws counterclockwise to engage the support tube.
10. Replace the access cover on the support tube (if present).
11. Tighten the screw on the access cover (if present).

9.3.7 Temperature sensor replacement

Replacement of the temperature sensor should only be necessary in the event of a failure. Use the following procedure for replacement.

Note

Disconnect power before replacing temperature sensor.

1. Turn off power to the meter.
2. Remove temperature sensor from meter body by using a 1/2 inch (13 mm) open end wrench.

Note

Use plant approved procedure for removing a temperature sensor from a thermowell.

3. Remove temperature sensor from electronics by using a 2.5 mm hex wrench to remove hex socket screw from electronics.
4. Gently pull temperature sensor from electronics.

Note

This will expose the electronics to the atmosphere.

5. Insert new temperature sensor into electronics housing using care to align pin and cap head screw to align connector pins.
6. Tightening cap head screw with 2.5 mm hex wrench.
7. Slide bolt and ferrule assembly onto temperature sensor and hold into place.
8. Insert temperature sensor into hole in bottom of meter body until it reaches the bottom of the hole. Hold it in place and tighten bolt with ½ inch (13 mm) open end wrench until ¾ turns past finger tight to seat ferrule.
9. Reapply power to the Rosemount 8800D.

9.4 Return of material

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

The center will ask for product model and serial numbers, and will provide a Return Material Authorization (RMA) number. The center will also ask for the name of the process material to which the product was last exposed.



CAUTION

People who handle products exposed to a hazardous substance can avoid injury if they are informed and understand the hazard. If the product being returned was exposed to a hazardous substance as defined by OSHA, a copy of the required Material Safety Data Sheet (MSDS) for each hazardous substance identified must be included with the returned goods.

The Rosemount North American Response Center will detail the additional information and procedures necessary to return goods exposed to hazardous substances.

Toll-free assistance numbers

Within the United States, Emerson Process Management has two toll-free assistance numbers:

Technical support, quoting, and order-related questions:

1-800-522-6277 (7:00 am to 7:00 pm CST)

North American Response Center—Equipment service needs:

1-800-654-7768 (24 hours—includes Canada)

Outside of the United States, contact your local an Emerson Flow Sales Representative .

A Product Specifications

A.1 Physical specifications

Rosemount vortex flow meters are designed to the standards defined in ASME B31.3. This standard is used as the basis for all of our other pressure vessel certifications such as CRN and PED.

Process fluids

Liquid, Gas, and Steam applications. Fluids must be homogeneous and single-phase.

Flow calibration

Every Emerson Vortex flowmeter is water calibrated and given a unique calibration number called a reference K-factor. Emerson flow labs use traceable calibrations that reference internationally recognized standards such as NIST in the United States and Mexico, National Institute of Standards in China, and ISO 10725 in Europe.

Theoretical and experimental data have shown that the K-factor is independent of fluid density and viscosity, proving the K-factor is applicable in all types of fluid—liquid, gas and steam. The K-factor is a function of the shedder bar and meter geometry.

Line sizes and pipe schedules

Table A-1: Line sizes by process connection type

Line size		Process connection type (✓ indicates availability)							
Inch	DIN	Flanged				Wafer	Weld-end	Threaded	
		Standard	Dual	Reducer	Quad			Standard	Reducer
0.5	15	✓	✓			✓	✓	✓	
1	25	✓	✓	✓		✓	✓	✓	✓
1.5	40	✓	✓	✓		✓	✓	✓	✓
2	50	✓	✓	✓	✓	✓	✓	✓	✓
3	80	✓	✓	✓	✓	✓	✓		
4	100	✓	✓	✓	✓	✓	✓		
6	150	✓	✓	✓	✓	✓	✓		
8	200	✓	✓	✓	✓	✓	✓		
10	250	✓	✓	✓	✓		✓		
12	300	✓	✓	✓	✓		✓		
14	350			✓					

Process pipe schedules

Meters will be shipped from the factory at the Schedule 40 default value unless otherwise specified. The value can be changed in the field if necessary.

For a weld-end style meter, see [Table A-5](#).

Pressure limits

Table A-2: Flanged/Dual/Quad style meter

ASME 16.5	EN1092-1	JIS
Class 150	PN 10	10K
Class 300	PN 16	20K
Class 600	PN 25	40K
Class 900	PN 40	
Class 1500	PN 63	
	PN 100	
	PN 160	

Table A-3: Reducer style meter

ASME 16.5	EN1092-1
Class 150	PN 10
Class 300	PN 16
Class 600	PN 25
Class 900	PN 40
Class 1500	PN 63
	PN 100
	PN 160

Table A-4: Wafer style meter

ASME 16.5	EN1092-1	JIS
Class 150	PN 10	10K
Class 300	PN 16	20K
Class 600	PN 25	40K
	PN 40	
	PN 63	
	PN 100	

Table A-5: Weld-end/Threaded-end style meter

	W1	W4	W8/T8	W9/T9
Mating pipe schedule:	Schedule 10	Schedule 40	Schedule 80	Schedule 160

Table A-5: Weld-end/Threaded-end style meter (continued)

	W1	W4	W8/T8	W9/T9
Pressure rating for 1 inch to 4 inch sizes:	720 psig (4.96 MPa-g)	1,440 psig (9.93 MPa-g)	2,160 psig (14.9 MPa-g)	3,600 psig (24.8 MPa-g)
Pressure rating for 6 inch to 12 inch sizes:	N/A	720 psig (4.96 MPa-g)	1,440 psig (9.93 MPa-g)	2,160 psig (14.9 MPa-g)

Temperature limits

Table A-6: Vortex sensor temperature limits

Vortex sensor	Temperature limit
Standard	-40 °F to +450 °F (-40 °C to +232 °C)
Extended	-330 °F to +800 °F (-201 °C to +427 °C)
Severe ⁽¹⁾	-330 °F to +800 °F (-201 °C to +427 °C)

(1) The meter body and sensor, in remote mount configurations, is functionally rated to +842 °F process temperature. Process temperature may be further restricted depending on hazardous area options and PED certificates. Consult applicable certificates for particular installation limits.
-320 °F to 800 °F (-196 to +427 °C) for European Pressure Equipment Directive (PED), Contact an Emerson Flow representative (see back page).
The Super Duplex material of construction is limited to use in applications with process temperatures from -40 to +450 °F (-40 to +232 °C). Contact an Emerson Flow representative (see back page).

Table A-7: Temperature sensor temperature limits

Temperature sensor	Temperature limit
Type N thermocouple	-40 °F to +842 °F (-40 °C to +450 °C) ⁽¹⁾

(1) Meets ASTM E230/E230M-17 Special Tolerance Standard.

Table A-8: Electronics temperature limits (remotely-mounted transmitter)

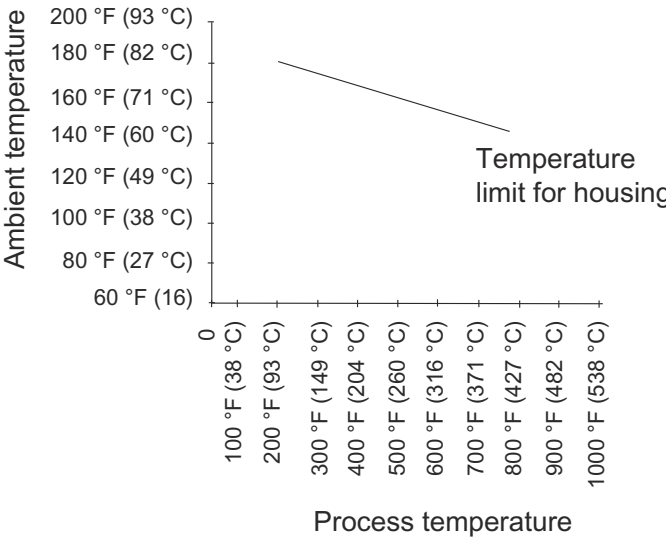
Ambient operating temperature range	-58 °F to +185 °F (-50 °C to +85 °C)
Ambient operating temperature range with LCD—Local Indicator ⁽¹⁾	-40 °F to +185 °F (-40 °C to +85 °C)
Storage temperature range	-58 °F to +250 °F (-50 °C to +121 °C)
Storage temperature range with LCD	-50 °F to +185 °F (-46 °C to +85 °C)

(1) LCD contrast may be affected below -4 °F (-20 °C).

Table A-9: Electronics temperature limits (integrally-mounted transmitter)

Operating and storage temperature range, with and without LCD	Same as remotely-mounted transmitter. See Table A-8. However, high process temperature lowers the maximum allowable ambient temperature. See Figure A-1.
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Table A-9: Electronics temperature limits (integrally-mounted transmitter)
(continued)

<p>Maximum process temperature</p>	<p>Interdependent with ambient temperature. Figure A-1 indicates the combined ambient and process temperature limits under which the electronics temperature can be maintained below the maximum +185 °F (+85 °C).</p> <hr/> <p>Note The indicated limit is with the integral transmitter directly above a horizontal pipe, and the pipe insulated with three inches of ceramic fiber. Other configurations may affect the actual electronics temperature.</p> <hr/> <p>Figure A-1: Maximum ambient/process temperature limit</p>  <p>The graph shows a linear relationship between ambient and process temperatures. The y-axis (Ambient temperature) has major ticks at 60 °F (16 °C), 80 °F (27 °C), 100 °F (38 °C), 120 °F (49 °C), 140 °F (60 °C), 160 °F (71 °C), 180 °F (82 °C), and 200 °F (93 °C). The x-axis (Process temperature) has major ticks at 0 °F (38 °C), 100 °F (93 °C), 200 °F (149 °C), 300 °F (204 °C), 400 °F (260 °C), 500 °F (316 °C), 600 °F (371 °C), 700 °F (427 °C), 800 °F (482 °C), 900 °F (538 °C), and 1000 °F (594 °C). A line labeled 'Temperature limit for housing' starts at approximately (100 °F, 185 °F) and ends at (1000 °F, 140 °F).</p>
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EMI/RFI effect

- Meets EMC requirements to Directive 2014/30/EU.
- Output error less than ±0.025% of span with twisted pair from 80–1000 MHz for radiated field strength of 10 V/m.
- 1.4–2.0 GHz for radiated field strength of 3 V/m.
- 2.0–2.7 GHz for radiated field strength of 1 V/m.
- No affect on the values that are being given if using HART digital signal.
- Tested per EN61326.

Humidity limits

Operates in 0–95% relative humidity under noncondensing conditions (tested to IEC 60770, Section 6.2.11).

Remote transmitter mounting hardware and cables

- Mounting hardware is provided.
- The transmitter and meter body are interconnected by a standard or armored signal cable assembly.
 - Cable length is specified when ordered (see [Ordering Information - Single/Dual Transmitter](#) or [Ordering information – Quad transmitter](#)), and it cannot be altered in the field.
 - Standard cable is non-armored and is intended to be run through rigid metal conduit.
 - Armored cable includes glands/adapters to connect the cable to the meter body and transmitter.
 - Both types of cable are flame resistant in accordance with IEC 60322-3.

Tagging

- Standard tags are stainless steel.
- The standard tag is permanently attached to the flowmeter.
- Character height is 1/16 inch (1,6 mm).
- A wired-on tag is available on request.
- Character height on the wire-on tag is 0.236 inch (6 mm).
- Wire on tags can contain five lines with an average of 19 characters per line at standard character height.

A.2 Performance specifications

The following performance specifications are for all Rosemount models except where noted. Digital performance specifications applicable to both Digital HART and FOUNDATION Fieldbus output. Unless stated otherwise, all accuracy specifications include linearity, hysteresis, and repeatability.

Volume flow accuracy

Table A-10: Volume flow accuracy

Process fluid	Digital and pulse output
Liquids with Reynolds number over 20,000	±0.65% of rate ⁽¹⁾⁽²⁾⁽³⁾⁽⁴⁾
Gas and steam with Reynolds number over 15,000	±1.0% of rate ⁽⁵⁾⁽²⁾
For all process fluids from stated limit to a Reynolds number of 10,000	From process limit specification to ±2% linear increase
For Reynolds numbers less than 10,000 to 5,000	±2% to ±6%, linear

(1) 6 inch to 12 inch reducer (150 mm to 300 mm) ±1.0% of rate.

(2) Analog ±0.025% of span

(3) 4 inch (100 mm) Quad, ±0.65% for velocities greater than 5.0 ft/sec (1.5 m/sec), ±1.00% of rate for velocities less than 5.0 ft/sec (1.5 m/sec)

- (4) 6 inch (150 mm) Quad, $\pm 1.00\%$ of rate.
- (5) 6 inch to 12 inch reducer (150 mm to 300 mm): $\pm 1.35\%$ of rate.

Accuracy limitations for gas and steam:

- For ½ inch and 1 inch (DN 15 and DN 25); max velocity of 220 ft/s (67.06 m/s)
- For all dual shedder bar design meters: max velocity of 100 ft/s (30.5 m/s)
- For dual shedder bar design meters above 100 ft/s (30.5 m/s) contact an Emerson Flow representative (see back page).

Volume flow repeatability

± 0.1 percent of actual flow rate.

Stability

$\pm 0.1\%$ of rate over one year

Process temperature accuracy

Table A-11: Process temperature accuracy by installation type

Installation type	Process temperature accuracy
Integral mount	2.2 °F (1.2 °C) or 0.4% of reading, whichever is greater
Remote mount	Add ± 0.018 °F/ft (± 0.03 °C/m) of uncertainty to measurement

Temperature sensor accuracy meets ASTM E230/E230M-17 Special Tolerance Standard.

Mass flow accuracy

Table A-12: Mass flow accuracy by process fluid type

Process fluid type	MV option code	Compensation type	Accuracy
Steam	MTA or MCA	Temperature compensation ⁽¹⁾	$\pm 2.0\%$ of rate (typical)
	MPA and MCA	Pressure compensation ⁽¹⁾⁽²⁾⁽³⁾	$\pm 1.3\%$ of rate at 30 psia through 2,000 psia
	MCA	Pressure and Temperature Compensation ⁽¹⁾⁽²⁾⁽³⁾	$\pm 1.2\%$ of rate at 150 psia $\pm 1.3\%$ of rate at 300 psia $\pm 1.6\%$ of rate at 800 psia $\pm 2.5\%$ of rate at 2,000 psia
Liquid (water)	MTA and MCA	Temperature Compensation	$\pm 0.70\%$ of rate up to 500 °F (260 °C) ⁽⁴⁾
Liquid (user-defined)	MTA and MCA	Temperature Compensation	Dependent on user input

- (1) Temperature range +176 °F to +842 °F (+80 °C to +450 °C)
- (2) Pressure measurement accuracy is $\pm 0.1\%$ of span.
- (3) Consult factory accuracy for < 30 psia and > 2,000 psia.
- (4) $\pm 0.85\%$ of rate between +500 °F to +600 °F (+260 °C to +316 °C)

Process temperature effect on K-factor

The compensated K-factor is based on the reference K-factor as compensated for the given fixed process temperature and wetted materials. Compensated K-factor is calculated by the electronics.

The percentage change in K-factor for all materials is no greater than ± 0.3 per 100 °F (56 °C).

Table A-13: Ambient temperature effect

Output type	Ambient temperature effect
Digital and pulse output	No effect
Analog output	$\pm 0.1\%$ of span from -58 °F to 185 °F (-50 to 85 °C)

Measurable flow rates

Capable of processing signals from flow applications which meet the Reynolds number and velocity limitations listed in [Table A-14](#), [Table A-15](#), and [Table A-16](#).

Table A-14: Minimum Measurable Meter Reynolds Numbers

Meter sizes	Reynolds number limitations
$\frac{1}{2}$ – 4 inch (DN 15 – DN100)	5000 minimum
6 – 12 inch (DN150 – DN300)	

Table A-15: Minimum measurable meter velocities

Process	Feet per second ⁽¹⁾	Meters per second ⁽¹⁾
Liquids ⁽²⁾	$\sqrt{36/\rho}$	$\sqrt{54/\rho}$
Gases ⁽²⁾	$\sqrt{36/\rho}$	$\sqrt{54/\rho}$

ρ is the process fluid density at flowing conditions in lb/ft³ for ft/s and kg/m³ for m/s.

(1) Referenced to schedule 40 pipe.

(2) This minimum measurable meter velocity is based on default filter settings.

Table A-16: Maximum Measurable Meter Velocities (use the smaller of the two values)

Process	Feet per second ⁽¹⁾		Meters per second ⁽¹⁾	
Liquids	$\sqrt{90,000/\rho}$	or 25	$\sqrt{134,000/\rho}$	or 7.6
Gases ⁽²⁾	$\sqrt{90,000/\rho}$	or 300	$\sqrt{134,000/\rho}$	or 91.4

ρ is the process fluid density at flowing conditions in lb/ft³ for ft/s and kg/m³ for m/s.

(1) Referenced to schedule 40 pipe.

(2) Accuracy limitations for gas and steam for dual-style meters ($\frac{1}{2}$ to 4 inch): max velocity of 100 ft/s (30.5 m/s).

Note

Sizing calculations are required to select the proper flow meter size. These calculations provide pressure loss, accuracy, minimum and maximum flow rate data to guide in proper selection. Vortex sizing software can be found using the Selection and Sizing tool. The Selection and Sizing tool can be accessed online or downloaded for offline use using this link:

www.Emerson.com/FlowSizing

Permanent pressure loss

The approximate permanent pressure loss (PPL) from the flowmeter is calculated for each application in the Vortex sizing software. Go to the [Rosemount 8800D Product Page](#), and select **Size** for detailed sizing on most applications, or complete a [Configuration Data Sheet](#) and contact an Emerson Flow representative (see back page).

The PPL is determined using the equation:

$PPL = \frac{A \times \rho_f \times Q^2}{D^4}$	<p>PPL Permanent pressure loss (psi or kPa)</p> <p>ρ_f Density at operating conditions (lb/ft³ or kg/m³)</p> <p>Q Actual volumetric flow rate (Gas = ft³/min or m³/hr; Liquid = gal/min or l/min)</p> <p>D Flowmeter bore diameter (in. or mm)</p> <p>A Constant depending on meter style, fluid type, and flow units. Determined per :</p>																													
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2" style="text-align: left;">Meter style</th> <th colspan="2" style="text-align: center;">English units</th> <th colspan="2" style="text-align: center;">SI units</th> </tr> <tr> <th style="text-align: center;">A_{liquid}</th> <th style="text-align: center;">A_{gas}</th> <th style="text-align: center;">A_{liquid}</th> <th style="text-align: center;">A_{gas}</th> </tr> </thead> <tbody> <tr> <td style="text-align: left;">8800DF/W</td> <td style="text-align: center;">3.4 × 10⁻⁵</td> <td style="text-align: center;">1.9 × 10⁻³</td> <td style="text-align: center;">0.425</td> <td style="text-align: center;">118</td> </tr> <tr> <td style="text-align: left;">8800DR</td> <td style="text-align: center;">3.91 × 10⁻⁵</td> <td style="text-align: center;">2.19 × 10⁻³</td> <td style="text-align: center;">0.489</td> <td style="text-align: center;">136</td> </tr> <tr> <td style="text-align: left;">8800DD</td> <td style="text-align: center;">6.12 × 10⁻⁵</td> <td style="text-align: center;">3.42 × 10⁻³</td> <td style="text-align: center;">0.765</td> <td style="text-align: center;">212</td> </tr> <tr> <td style="text-align: left;">8800DQ</td> <td style="text-align: center;">6.12 × 10⁻⁵</td> <td style="text-align: center;">3.42 × 10⁻³</td> <td style="text-align: center;">0.765</td> <td style="text-align: center;">212</td> </tr> </tbody> </table>		Meter style	English units		SI units		A _{liquid}	A _{gas}	A _{liquid}	A _{gas}	8800DF/W	3.4 × 10 ⁻⁵	1.9 × 10 ⁻³	0.425	118	8800DR	3.91 × 10 ⁻⁵	2.19 × 10 ⁻³	0.489	136	8800DD	6.12 × 10 ⁻⁵	3.42 × 10 ⁻³	0.765	212	8800DQ	6.12 × 10 ⁻⁵	3.42 × 10 ⁻³	0.765	212
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Minimum upstream pressure (liquids)

Flow metering conditions that would allow cavitation, the release of vapor from a liquid, should be avoided. This flow condition can be avoided by remaining within the proper flow range of the meter and by following appropriate system design.

For some liquid applications, incorporation of a back pressure valve should be considered. To prevent cavitation, the minimum upstream pressure should be the smaller result of these two equations:

- 2.9 × ΔP + 1.3 × p_v
- 2.9 × ΔP + p_v + 0.5 psia (3.45 kPa)

Where:

- P** Line pressure five pipe diameters downstream of the meter (psia or kPa abs)
- ΔP** Pressure loss across the meter (psi or kPa)
- p_v** Liquid vapor pressure at operating conditions (psia or kPa abs)

Vibration effect

High vibration may cause a false flow measurement when there is no flow. The meter design will minimize this effect, and the factory settings for signal processing are selected to eliminate these errors for most applications. If an output error at zero flow is still detected, it can be eliminated by adjusting the low flow cutoff, trigger level, or low-pass filter. As the process begins to flow through the meter, most vibration effects are quickly overcome by the flow signal.

Vibration specifications

- Integral aluminum housings, remote aluminum housings, and remote SST housings: At or near the minimum liquid flow rate in a normal pipe mounted installation, the maximum vibration should be 0.087 inch (2,21 mm) double amplitude displacement or 1 g acceleration, whichever is smaller. At or near the minimum gas flow rate in a normal pipe mounted installation, the maximum vibration should be 0.043 inch (1,09 mm) double amplitude displacement or ½ g acceleration, whichever is smaller.
- Integral SST housing: At or near the minimum liquid flow rate in a normal pipe mounted installation, the maximum vibration should be 0.044 inch (1,11 mm) double amplitude displacement or ⅓ g acceleration, whichever is smaller. At or near the minimum gas flow rate in a normal pipe mounted installation, the maximum vibration should be 0.022 inch (0,55 mm) double amplitude displacement or ⅙ g acceleration, whichever is smaller.

Mounting position effect

Meter will meet accuracy specifications when mounted in horizontal, vertical, or inclined pipelines. Best practice for mounting in a horizontal pipe is to orient the shedder bar in the horizontal plane. This will prevent solids in liquid applications and liquid in gas/steam applications from disrupting the shedding frequency.

Pipe length requirements

Rated accuracy is based on the number of pipe diameters from an upstream disturbance. No K-factor correction is required if the meter is installed with 35D upstream and 5D downstream. The value of the K-factor may shift up to 0.5% when the upstream straight pipe length is reduced down to the minimum recommended 10D. Refer to the Rosemount 8800 Vortex Installation Effects Technical Data Sheet for detailed information on K-factor correction.

Flow calibration information

Flowmeter calibration and configuration information is provided with every flowmeter. For a certified copy of flow calibration data, the Q4 option code must be ordered in the model number.

Transient protection

The optional transient terminal block prevents damage to the flowmeter from transients induced by lightning, welding, heavy electrical equipment, or switch gears. The transient protection electronics are located in the terminal block.

The transient terminal block meets the following specifications:

- IEEE C62.41 - 2002 Category B
- 3 kA crest (8 × 20 ms)
- 6 kV crest (1.2 × 50 ms)
- 6 kV/0.5 kA (0.5 ms, 100 kHz, ring wave)

A.3 Typical flow rates

This section provides typical flow ranges for some common process fluids with default filter settings. Consult an Emerson representative (see back page) to obtain a computer sizing program that describes in greater detail the flow range for an application.

Table A-17 is a reference of pipe velocities that can be measured for the standard Rosemount 8800D and the reducer Rosemount 8800DR Vortex Meters. It does not consider density limitations, as described in Table A-14 and Table A-15. Velocities are referenced in schedule 40 pipe.

Table A-17: Typical pipe velocity ranges for Rosemount 8800D and 8800DR

Process line size (inches/ DN)	Vortex meter ⁽¹⁾	Liquid velocity ranges		Gas velocity ranges	
		(ft/s)	(m/s)	(ft/s)	(m/s)
0.5/ 15	8800DF005	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
1/ 25	8800DF010	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR010	0.25 to 8.8	0.08 to 2.7	2.29 to 87.9	0.70 to 26.8
1.5/ 40	8800DF015	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR015	0.30 to 10.6	0.09 to 3.2	2.76 to 106.1	0.84 to 32.3
2/ 50	8800DF020	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR020	0.42 to 15.2	0.13 to 4.6	3.94 to 151.7	1.20 to 46.2
3/ 80	8800DF030	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR030	0.32 to 11.3	0.10 to 3.5	2.95 to 113.5	0.90 to 34.6
4/ 100	8800DF040	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR040	0.41 to 14.5	0.12 to 4.4	3.77 to 145.2	1.15 to 44.3
6/ 150	8800DF060	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR060	0.31 to 11.0	0.09 to 3.4	2.86 to 110.2	0.87 to 33.6
8/ 200	8800DF080	0.70 to 25.0	0.21 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR080	0.40 to 14.4	0.12 to 4.4	3.75 to 144.4	1.14 to 44.0
10/ 250	8800DF100	0.90 to 25.0	0.27 to 7.6	6.50 to 250.0	1.98 to 76.2

Table A-17: Typical pipe velocity ranges for Rosemount 8800D and 8800DR (continued)

Process line size (inches/ DN)	Vortex meter ⁽¹⁾	Liquid velocity ranges		Gas velocity ranges	
		(ft/s)	(m/s)	(ft/s)	(m/s)
	8800DR100	0.44 to 15.9	0.13 to 4.8	4.12 to 158.6	1.26 to 48.3
12/ 300	8800DF120	1.10 to 25.0	0.34 to 7.6	6.50 to 250.0	1.98 to 76.2
	8800DR120	0.63 to 17.6	0.19 to 5.4	4.58 to 176.1	1.40 to 53.7

(1) Velocity range of the Rosemount 8800DW is the same as Rosemount 8800DF.

Note

Table A-18 is a reference of flow rates that can be measured for the standard Rosemount 8800D and the reducer 8800DR Vortex Meters. It does not consider density limitations, as described in Table A-14 and Table A-15.

Table A-18: Water flow rate limits for the Rosemount 8800D and 8800DR

Process line size (inches/ DN)	Vortex meter ⁽¹⁾	Minimum and maximum measurable water flow rates ⁽²⁾	
		Gallons/minute	Cubic meters/hour
0.5/ 15	8800DF005	1.76 to 23.7	0.40 to 5.4
1/ 25	8800DF010	2.96 to 67.3	0.67 to 15.3
	8800DR010	1.76 to 23.7	0.40 to 5.4
1.5/ 40	8800DF015	4.83 to 158	1.10 to 35.9
	8800DR015	2.96 to 67.3	0.67 to 15.3
2/ 50	8800DF020	7.96 to 261	1.81 to 59.4
	8800DR020	4.83 to 158.0	1.10 to 35.9
3/ 80	8800DF030	17.5 to 576	4.00 to 130
	8800DR030	7.96 to 261.0	1.81 to 59.3
4/ 100	8800DF040	30.2 to 992	6.86 to 225
	8800DR040	17.5 to 576	4.00 to 130
6/ 150	8800DF060	68.5 to 2251	15.6 to 511
	8800DR060	30.2 to 992	6.86 to 225
8/ 200	8800DF080	119 to 3898	27.0 to 885
	8800DR080	68.5 to 2251	15.6 to 511
10/ 250	8800DF100	231 to 6144	52.2 to 1395
	8800DR100	119 to 3898	27.0 to 885
12/ 300	8800DF120	391 to 8813	88.8 to 2002
	8800DR120	231 to 6144	52.2 to 1395

(1) Velocity range of the 8800DW is the same as 8800DF.

(2) Conditions: 77 °F (25 °C) and 14.7 psia (1.01 bar absolute)

Table A-19: Air flow rate limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and maximum air flow rates for line sizes 1/2-in./DN 15 through 1-in./DN 25							
		1/2-in./DN 15				1-in./DN 25			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	27.9	47.3	Not Available	Not Available	79.2	134	27.9	47.3
	min	4.62	7.84	Available	Available	9.71	16.5	4.62	7.84
50 psig (3,45 bar G)	max	27.9	47.3	Not Available	Not Available	79.2	134	27.9	47.3
	min	1.31	2.22	Available	Available	3.72	6.32	1.31	2.22
100 psig (6,89 bar G)	max	27.9	47.3	Not Available	Not Available	79.2	134	27.9	47.3
	min	0.98	1.66	Available	Available	2.80	4.75	0.98	1.66
150 psig (10,3 bar G)	max	27.9	47.3	Not Available	Not Available	79.2	134	27.9	47.3
	min	0.82	1.41	Available	Available	2.34	3.98	0.82	1.41
200 psig (13,8 bar G)	max	27.9	47.3	Not Available	Not Available	79.2	134	27.9	47.3
	min	0.82	1.41	Available	Available	2.34	3.98	0.82	1.41
300 psig (20,7 bar G)	max	27.9	47.3	Not Available	Not Available	79.2	134	27.9	47.3
	min	0.82	1.41	Available	Available	2.34	3.98	0.82	1.41
400 psig (27,6 bar G)	max	25.7	43.9	Not Available	Not Available	73.0	124	25.7	43.9
	min	0.82	1.41	Available	Available	2.34	3.98	0.82	1.41
500 psig (34,5 bar G)	max	23.0	39.4	Not Available	Not Available	66.0	112	23.0	39.4
	min	0.82	1.41	Available	Available	2.34	3.98	0.82	1.41

Table A-20: Air flow rate limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and maximum air Flow rates for line sizes 1 1/2-in./DN 40 through 2-in./DN 50							
		1 1/2-in./DN 40				2-in./DN 50			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	212	360	79.2	134	349	593	212	360
	min	18.4	31.2	9.71	16.5	30.3	51.5	18.4	31.2
50 psig (3,45 bar G)	max	212	360	79.2	134	349	593	212	360
	min	8.76	14.9	3.72	6.32	14.5	24.6	8.76	14.9
100 psig (6,89 bar G)	max	212	360	79.2	134	349	593	212	360
	min	6.58	11.2	2.80	4.75	10.8	18.3	6.58	11.2
150 psig (10,3 bar G)	max	212	360	79.2	134	349	593	212	360
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36

Table A-20: Air flow rate limits at 59 °F (15 °C) (continued)

Process pressure	Flow rate limits	Minimum and maximum air flow rates for line sizes 1 1/2-in./DN 40 through 2-in./DN 50							
		1 1/2-in./DN 40				2-in./DN 50			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
200 psig (13,8 bar G)	max	212	360	79.2	134	349	593	212	360
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36
300 psig (20,7 bar G)	max	198	337	79.2	134	326	554	198	337
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36
400 psig (27,6 bar G)	max	172	293	73.0	124	284	483	172	293
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36
500 psig (34,5 bar G)	max	154	262	66.0	112	254	432	154	262
	min	5.51	9.36	2.34	3.98	9.09	15.4	5.51	9.36

Table A-21: Air flow rate limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and maximum air flow rates for line sizes 3-in./DN 80 through 4-in./DN 100							
		3-in./DN 80				4-in./DN 100			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	66.8	114	30.3	51.5	115	195	66.8	114
50 psig (3,45 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	31.8	54.1	14.5	24.6	54.8	93.2	31.8	54.1
100 psig (6,89 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	23.9	40.6	10.8	18.3	41.1	69.8	23.9	40.6
150 psig (10,3 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0
200 psig (13,8 bar G)	max	770	1308	349	593	1326	2253	770	1308
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0
300 psig (20,7 bar G)	max	718	1220	326	554	1237	2102	718	1220
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0
400 psig (27,6 bar G)	max	625	1062	284	483	1076	1828	625	1062
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0
500 psig (34,5 bar G)	max	560	951	254	432	964	1638	560	951
	min	20.0	34.0	9.09	15.4	34.5	58.6	20.0	34.0

Table A-22: Air flow rate limits at 59 °F (15 °C)

Process pressure	Flow rate limits	Minimum and maximum air flow rates for line sizes 6-in./DN 150 through 8-in./DN 200							
		6-in./DN 150				8-in./DN 200			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		ACFM	ACMH	ACFM	ACMH	ACFM	ACMH	ACFM	ACMH
0 psig (0 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	261	443	115	195	452	768	261	443
50 psig (3,45 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	124	211	54.8	93.2	215	365	124	211
100 psig (6,89 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	93.3	159	41.1	69.8	162	276	93.3	159
150 psig (10,3 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	78.2	133	34.5	58.6	135	229	78.2	133
200 psig (13,8 bar G)	max	3009	5112	1326	2253	5211	8853	3009	5112
	min	78.2	133	34.5	58.6	135	229	78.2	133
300 psig (20,7 bar G)	max	2807	4769	1237	2102	4862	8260	2807	4769
	min	78.2	133	34.5	58.6	135	229	78.2	133
400 psig (27,6 bar G)	max	2442	4149	1076	1828	4228	7183	2442	4149
	min	78.2	133	34.5	58.6	136	229	78.2	133
500 psig (34,5 bar G)	max	2188	3717	964	1638	3789	6437	2188	3717
	min	78.2	133	34.5	58.6	136	229	78.2	133

Table A-23: Saturated steam flow rate limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 1/2-in./DN 15 through 1-in./DN 25							
		1/2-in./DN 15				1-in./DN 25			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	120	54.6	Not Available	Not Available	342	155	120	54.6
	min	12.8	5.81	Not Available	Not Available	34.8	15.8	12.8	5.81
25 psig (1,72 bar G)	max	158	71.7	Not Available	Not Available	449	203	158	71.7
	min	14.0	6.35	Not Available	Not Available	39.9	18.1	14.0	6.35
50 psig (3,45 bar G)	max	250	113	Not Available	Not Available	711	322	250	113
	min	17.6	8.00	Not Available	Not Available	50.1	22.7	17.6	8.00
100 psig (6,89 bar G)	max	429	194	Not Available	Not Available	1221	554	429	194
	min	23.1	10.5	Not Available	Not Available	65.7	29.8	23.1	10.5

Table A-23: Saturated steam flow rate limits (assumes steam quality is 100%) (continued)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 1/2-in./DN 15 through 1-in./DN 25							
		1/2-in./DN 15				1-in./DN 25			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
150 psig (10,3 bar G)	max	606	275	Not Available	Not Available	1724	782	606	275
	min	27.4	12.5	Available	Available	78.1	35.4	27.4	12.5
200 psig (13,8 bar G)	max	782	354	Not Available	Not Available	2225	1009	782	354
	min	31.2	14.1	Available	Available	88.7	40.2	31.2	14.1
300 psig (20,7 bar G)	max	1135	515	Not Available	Not Available	3229	1464	1135	515
	min	37.6	17.0	Available	Available	107	48.5	37.6	17.0
400 psig (27,6 bar G)	max	1492	676	Not Available	Not Available	4244	1925	1492	676
	min	44.1	20.0	Available	Available	125	56.7	44.1	20.0
500 psig (34,5 bar G)	max	1855	841	Not Available	Not Available	5277	2393	1855	841
	min	54.8	24.9	Available	Available	156	70.7	54.8	24.9

Note

The Rosemount 8800D measures the volumetric flow under operating conditions (i.e. the actual volume at the operating pressure and temperature—acfm or acmh), as shown above. However, gas volumes are strongly dependent on pressure and temperature. Therefore, gas quantities are typically stated in standard or normal conditions (e.g. SCFM or NCMH). (Standard conditions are typically 59 °F and 14.7 psia. Normal conditions are typically 0 °C and 1.01 bar abs.)

The flow rate limits in standard conditions are found using the equations below:

$$\text{Standard Flow Rate} = \text{Actual Flow Rate} \times \text{Density Ratio}$$

$$\text{Density Ratio} = \text{Density at Actual (Operating) Conditions} / \text{Density at Standard Conditions}$$

Table A-24: Saturated steam flow rate limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 1/2-in./DN 15 through 1-in./DN 25							
		1 1/2-in./DN 40				2-in./DN 50			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	917	416	342	155	1511	685	917	416
	min	82.0	37.2	34.8	15.8	135	61.2	82.0	37.2
25 psig (1,72 bar G)	max	1204	546	449	203	1983	899	1204	546
	min	93.9	42.6	39.9	18.1	155	70.2	93.9	42.6
50 psig (3,45 bar G)	max	1904	864	711	322	3138	1423	1904	864
	min	118	53.4	50.1	22.7	195	88.3	118	53.4

Table A-24: Saturated steam flow rate limits (assumes steam quality is 100%) (continued)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 1/2-in./DN 15 through 1-in./DN 25							
		1 1/2-in./DN 40				2-in./DN 50			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
100 psig (6,89 bar G)	max	3270	1483	1221	554	5389	2444	3270	1483
	min	155	70.1	65.7	29.8	255	116	155	70.1
150 psig (10,3 bar G)	max	4616	2094	1724	782	7609	3451	4616	2094
	min	184	83.2	78.1	35.4	303	137	184	83.2
200 psig (13,8 bar G)	max	5956	2702	2225	1009	9818	4453	5956	2702
	min	209	94.5	88.7	40.2	344	156	209	94.5
300 psig (20,7 bar G)	max	8644	3921	3229	1464	14248	6463	8644	3921
	min	252	114	107	48.5	415	189	252	114
400 psig (27,6 bar G)	max	11362	5154	4244	1925	18727	8494	11362	5154
	min	295	134	125	56.7	487	221	295	134
500 psig (34,5 bar G)	max	14126	6407	5277	2393	23284	10561	14126	6407
	min	367	167	156	70.7	605	274	367	167

Table A-25: Saturated steam flow rate limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 3-in./DN 80 through 4-in./DN 100							
		3-in./DN 80				4-in./DN 100			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	3330	1510	1511	685	5734	2601	3330	1510
	min	298	135	135	61.2	513	233	298	135
25 psig (1,72 bar G)	max	4370	1982	1983	899	7526	3414	4370	1982
	min	341	155	155	70.2	587	267	341	155
50 psig (3,45 bar G)	max	6914	3136	3138	1423	11905	5400	6914	3136
	min	429	195	195	88.3	739	335	429	195
100 psig (6,89 bar G)	max	11874	5386	5389	2444	20448	9275	11874	5386
	min	562	255	255	116	968	439	562	255
150 psig (10,3 bar G)	max	16763	7603	7609	3451	28866	13093	16763	7603
	min	668	303	303	137	1150	522	668	303
200 psig (13,8 bar G)	max	21630	9811	9818	4453	37247	16895	21630	9811
	min	759	344	344	156	1307	593	759	344

Table A-25: Saturated steam flow rate limits (assumes steam quality is 100%) (continued)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 3-in./DN 80 through 4-in./DN 100							
		3-in./DN 80				4-in./DN 100			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
300 psig (20,7 bar G)	max	31389	14237	14248	6463	54052	24517	31389	14237
	min	914	415	415	189	1574	714	914	415
400 psig (27,6 bar G)	max	41258	18714	18727	8494	71047	32226	41258	18714
	min	1073	487	487	221	1847	838	1073	487
500 psig (34,5 bar G)	max	51297	23267	23284	10561	88334	40068	51297	23267
	min	1334	605	605	274	2297	1042	1334	605

Table A-26: Saturated steam flow rate limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 6-in./DN 150 through 8-in./DN 200							
		6-in./DN 150				8-in./DN 200			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	13013	5903	5734	2601	22534	10221	13013	5903
	min	1163	528	513	233	2015	914	1163	528
25 psig (1,72 bar G)	max	17080	7747	7526	3414	29575	13415	17080	7747
	min	1333	605	587	267	2308	1047	1333	605
50 psig (3,45 bar G)	max	27019	12255	11905	5400	46787	21222	27019	12255
	min	1676	760	739	335	2903	1317	1676	760
100 psig (6,89 bar G)	max	46405	21049	20448	9275	80356	36449	46405	21049
	min	2197	996	968	439	3804	1725	2197	996
150 psig (10,3 bar G)	max	65611	29761	28866	13093	113440	51455	65611	29761
	min	2610	1184	1150	522	4520	2050	2610	1184
200 psig (13,8 bar G)	max	84530	38342	37247	16895	146375	66395	84530	38342
	min	2965	1345	1307	593	5134	2329	2965	1345
300 psig (20,7 bar G)	max	122666	55640	54052	24517	212411	96348	122666	55640
	min	3572	1620	1574	714	6185	2805	3572	1620
400 psig (27,6 bar G)	max	161236	73135	71047	32226	279200	126643	161236	73135
	min	4192	1901	1847	838	7259	3293	4192	1901
500 psig (34,5 bar G)	max	200468	90931	88334	40068	347134	157457	200468	90931
	min	5212	2364	2297	1042	9025	4094	5212	2364

Table A-27: Saturated steam flow rate limits (assumes steam quality is 100%)

Process pressure	Flow rate limits	Minimum and maximum saturated steam flow rates for line sizes 10-in./DN 250 through 12-in./DN 300							
		10-in./DN 250				12-in./DN 300			
		Rosemount 8800D		Rosemount 8800DR		Rosemount 8800D		Rosemount 8800DR	
		lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr	lb/hr	kg/hr
15 psig (1,03 bar G)	max	35519	16111	22534	10221	50994	23130	35519	16111
	min	3175	1440	2015	914	4554	2066	3175	1440
25 psig (1,72 bar G)	max	46618	21146	29575	13415	66862	30328	46618	21146
	min	4570	2073	2308	1047	5218	2367	4570	2073
50 psig (3,45 bar G)	max	73748	33452	46787	21222	105774	47978	73748	33452
	min	4575	2075	2903	1317	6562	2976	4575	2075
100 psig (6,89 bar G)	max	126660	57452	80356	36449	181663	82401	126660	57452
	min	5996	2720	3804	1725	8600	3901	5996	2720
150 psig (10,3 bar G)	max	178808	81106	113440	51455	256457	116327	178808	81106
	min	7125	3232	4520	2050	10218	4635	7125	3232
200 psig (13,8 bar G)	max	230722	104654	146375	66395	330915	150101	230722	104654
	min	8092	3670	5134	2329	11607	5265	8092	3670
300 psig (20,7 bar G)	max	334810	151867	212411	96348	480203	217816	334810	151867
	min	9749	4422	6185	2805	13983	6343	9749	4422
400 psig (27,6 bar G)	max	440085	199619	279200	126643	631195	286305	440085	199619
	min	11442	5190	7259	3293	16411	7444	11442	5190
500 psig (34,5 bar G)	max	547165	248190	347134	157457	784775	355968	547165	248190
	min	14226	6453	9025	4094	20404	9255	14226	6453

A.4 HART specifications

Output signals

Digital HART signal Bell 202 superimposed on 4–20 mA signal

Optional scalable pulse output 0 to 10000 Hz; transistor switch closure with adjustable scaling via HART communications; capable of switching from 5 to 30 Vdc, 120 mA maximum

Analog output adjustment

Engineering units and lower and upper range values are user-selected. Output is automatically scaled to provide 4 mA at the selected lower range value, 20 mA at the selected upper range value. No frequency input is required to adjust the range values.

Scalable frequency adjustment

The scalable pulse output can be set to a specific velocity, volume, or mass (i.e. 1 pulse = 1 lb). The scalable pulse output can also be scaled to a specific rate of volume, mass, or velocity (i.e. 100 Hz = 500 lb/hr).

Analog 4–20 mA Power supply

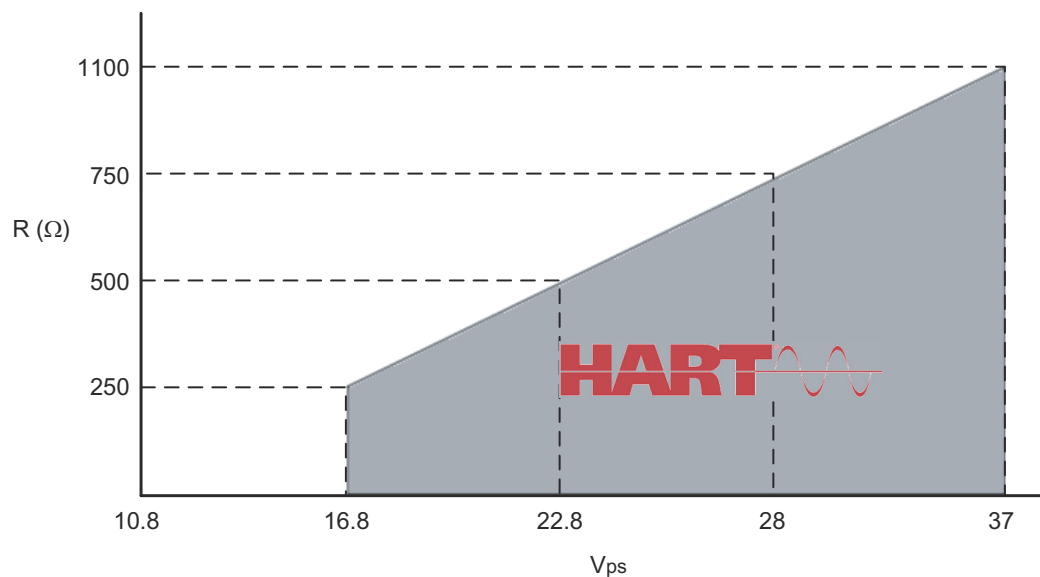
External power supply required. Each transmitter operates on 10.8 VDC to 42 VDC terminal voltage. See [Figure A-2](#).

Power consumption

One watt maximum per transmitter.

HART communication

Figure A-2: HART communication voltage/resistance requirement



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

Note that HART Communication requires a minimum loop resistance of 250 ohms up to a maximum of 1100 ohms.

R(Ω) Load resistor value.

V_{ps} Minimum power supply voltage required

$$R(\Omega)_{\max} = 41.7 (V_{ps} - 10.8 \text{ V}).$$

Failure mode alarm levels

If transmitter self-diagnostics detect a fault condition, the analog signal will be driven to the values in [Table A-28](#).

Table A-28: mA outputs for low and high alarm

Alarm jumper position	mA output by Alarm Type setting ⁽¹⁾	
	Rosemount standard	NAMUR-compliant
Low	3.75	3.60
Hi	21.75	22.6

(1) The Alarm and Saturation Type settings can be pre-configured at the factory (Options C4 and CN for NAMUR-compliance) or user-configured.

Saturation output values

When the operating flow is outside the range points, the analog output continues to track the operating flow until reaching the saturation values in Table A-29. The output does not exceed the listed saturation value regardless of the operating flow.

Table A-29: mA output saturation values

	mA output saturation value by type ⁽¹⁾	
	Rosemount standard	NAMUR-Compliant
Low	3.9	3.8
Hi	20.8	20.5

(1) The Alarm and Saturation Type settings can be pre-configured at the factory (Options C4 and CN for NAMUR-compliance) or user-specified.

Damping

Flow Damping adjustable between 0.2 and 255 seconds.

Process temperature damping adjustable between 0.4 and 32.0 seconds (MTA/MCA Option only).

Response time

Three vortex shedding cycles or 300 ms, whichever is greater, maximum required to reach 63.2% of actual input with the minimum damping (0.2 seconds).

Turn-on time

Less than six seconds plus the response time to rated accuracy from power up (less than eight seconds with the MTA/MCA Option).

Security lockout

When the security lockout jumper is enabled, the electronics will not allow you to modify parameters that affect flowmeter output.

Output testing

Analog output Flow meter may be commanded to set the analog output to a specified value between 3.6 mA and 22.6 mA.

Pulse output Flow meter may be commanded to set the pulse output frequency to a specified value between 0 Hz and 10000 Hz.

Low flow cutoff

Optimized at the factory per the user's process conditions per Rosemount 8800D Configuration Data Sheet (00806-0100-4004) and typically required no adjustment. In certain cases, if required, it can be further adjusted after installation. Below selected value, output is driven to 4 mA and zero pulse output frequency.

Overrange capability

Analog signal output continues to 105 percent of span for Standard limits (or 103.1% for NAMUR), then remains constant with increasing flow. The digital and pulse outputs will continue to indicate flow up to the upper sensor limit of the flowmeter and a maximum pulse output frequency of 10400 Hz.

Magnetic-field interference

- Output error less than $\pm 0.025\%$ of span at 30 A/m (rms).
- Tested per EN 61326.

Note

During a surge event, devices with 4–20 mA (Outputs option codes D and P) or Modbus output (Output option code M) may exceed maximum EMC deviation limit or reset; however, device will self-recover and return to normal operation within specified start-up time.

Series mode noise rejection

Output error less than $\pm 0.025\%$ of span at 1 V rms, 60 Hz.

Common mode noise rejection

Output error less than $\pm 0.025\%$ of span at 30 V rms, 60 Hz.

Power supply effect

Less than 0.005% of span per volt

Transmitter electrical connections

Model	Terminal type
Analog 4–20 mA/HART	Compression screw terminal permanently fixed to the terminal block.
Analog 4–20 mA/HART + Pulse	

Field Communicator connections

Communication and test terminals	
All models	Clip connections permanently fixed to the terminal block.

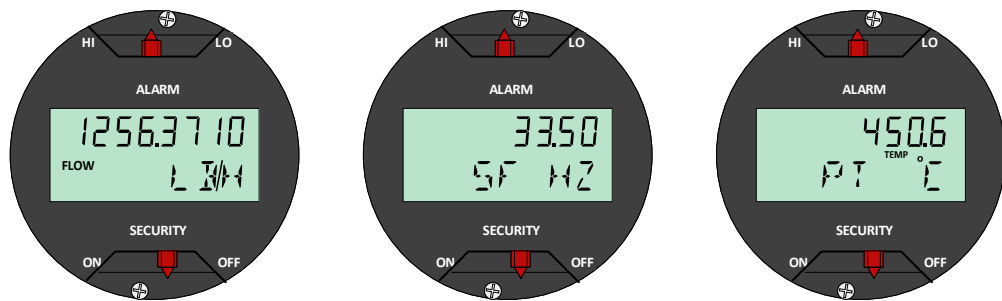
The transmitter test function permits testing the loop output current without disconnecting the loop power.

A.5 LCD indicator functional specifications

Optional LCD indicator

The optional 11 digit, two-decimal, two-line integral LCD display can be configured to alternate between selected display options, which differ depending upon the output type selected.

Figure A-3: Examples



When more than one item is selected, the display will scroll through all items selected. In the event of a fault, the display shows the applicable fault code.

Indicator options

- Primary Variable
- Velocity Flow
- Volumetric Flow
- Corrected Volumetric Flow
- Mass Flow
- Signal Strength
- Percent of Range
- Analog Output
- Totalizer
- Shedding Frequency
- Pulse Output Frequency
- Electronics Temperature
- Process Temperature (MTA/MCA only)
- Process Pressure (MPA/MCA only)
- Calculated Process Density (MTA/MCA/MPA only)
- Elapsed Time Meter (ETM)

B Spacers

Spacers are available with the Rosemount 8800D to maintain the Rosemount 8800A dimensions. Spacers are installed downstream from the meter body. The spacer kit comes with an alignment ring for ease of installation. Gaskets are placed on each side of the spacer.

Table B-1: Spacer dimensions for 8800A lay length

Line size	Dimensions inch (mm)
1.5 (40)	0.47 (11,9)
2 (50)	1.17 (29,7)
3 (80)	1.27 (32,3)
4 (100)	0.97 (24,6)

C Electronics verification

8800D electronics verification is done using either the internal signal simulation capability, or by applying an external signal source to the TEST FREQ IN and GROUND pins.

Electronics functionality is verified via two different verification methods:

- Flow Simulation Mode
- Using an External Frequency Generator

Both methods require a HART communication device or the AMS Device Manager. Disconnecting the sensor is not required when verifying electronics since the transmitter is capable of disconnecting the sensor signal at the input to the electronics. To physically disconnect the sensor from the electronics, refer to [Replacing the electronics boards](#).

Note

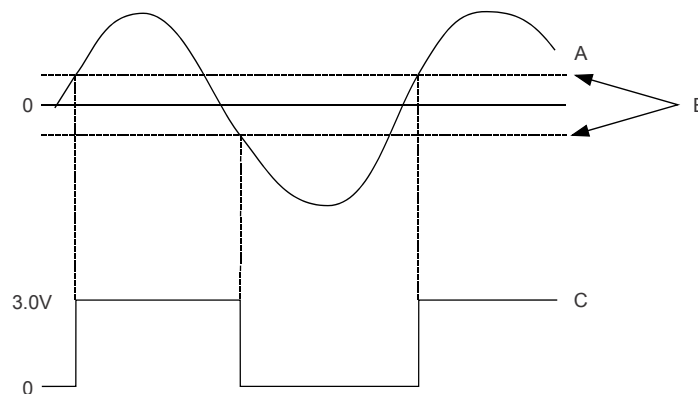
The best method for flow simulation in this case is to change the process fluid to gas or steam and have Desired Compensation set to none.

Flow simulation cannot be enabled when the primary variable is Process Temperature.

C.1 Electronics verification using flow simulation mode

Electronics verification is done by using the internal flow simulation functionality. The Rosemount 8800D is capable of simulating either a fixed flow rate or a varying flow rate. The amplitude of the simulated flow signal is based on the minimum required process density for the given line size and service type. Either type of simulation (fixed or varying) will effectively disconnect the Rosemount 8800D sensor from the electronics charge amplifier input (see the following figure) and replace it with the simulated flow signal.

Figure C-1: Clean signals



- A. Vortex signal (TP1)
 - B. Trigger level
 - C. Shedding frequency output
-

C.2 Fixed flow rate simulation

The fixed flow simulation signal is entered in either percent of range or flow rate in engineering units. The resulting flow rate and/or shedding frequency can be continuously monitored using a HART communication device or an AMS Device Manager.

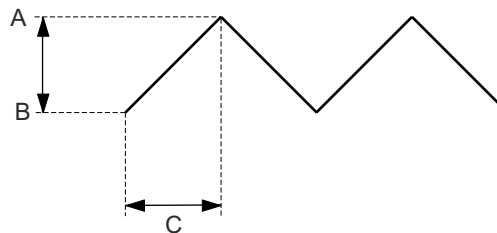
C.3 Varying flow rate simulation

The profile of the varying flow simulation signal is a repetitive triangular waveform as illustrated in the following figure. The minimum and maximum flow rate is entered in either percent of range or entered as a flow rate in engineering units. The ramp time is entered in seconds from a minimum of 0.6 seconds to a maximum of 34,951 seconds. The resulting flow rate and/or shedding frequency can be continuously monitored using a HART communication device or an AMS Device Manager.

Note

To manually disconnect the sensor for precautionary measures, see [Replacing the electronics housing](#).

Figure C-2: Profile of varying flow simulation signal



- A. Maximum flow rate
- B. Minimum flow rate
- C. Ramp time

C.4 Verify electronics using an external frequency generator

Test points on the electronics are available for an external frequency.

Make sure you have the following tools:

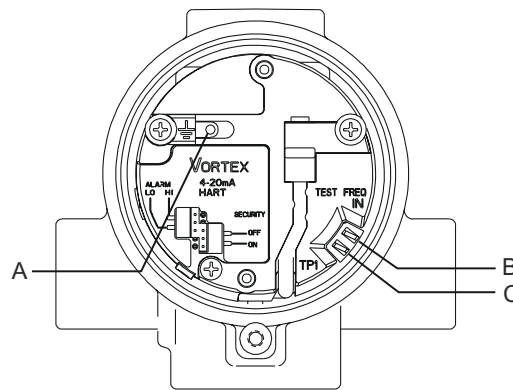
- A HART communication device or AMS Device Manager
- A standard sinewave function generator
 1. Remove the electronics compartment cover.
 2. Remove the two screws and the LCD indicator, if applicable.
 3. Connect a HART communication device or AMS Device Manager to the loop.
 4. Access the flow simulation menu on the communicator and select Sim Flow External.

This option is used with an external frequency generator to disconnect the Rosemount 8800D sensor input from the charge amplifier input of the electronics (see [Figure C-2](#)). The simulated flow and/or the shedding frequency values are now accessible using a HART communication device or AMS Device Manager.

5. Connect the sinewave generator to the TEST FREQ IN and GROUND points as shown in the following figure.

This step assumes that the flow sensor is still connected to the transmitter. If the flow sensor is not connected to the transmitter, attach the sinewave generator to the sensor header. This is the same connection point used by the flow sensor during normal installation.

Figure C-3: Test frequency output and chassis ground points



- A. Ground
- B. Test frequency input
- C. Test point 1

6. Set the sinewave generator amplitude to $2V_{pp} \pm 10\%$.
7. Select the desired sinewave generator frequency.
8. Verify the generator frequency against the frequency displayed on the HART communication device or AMS Device Manager.
9. Exit the Flow Simulation Mode.
10. Reconnect the LCD indicator option, if applicable, to the electronics board by replacing and tightening the two screws.
11. Replace and tighten the electronics compartment cover.

Note

To manually disconnect the sensor as a precaution, see [Replacing the electronics housing](#).

C.5 Output variable calculations with known input frequency

Use the following equations with a known input frequency to verify a flow rate or a 4–20 mA output within a given calibrated range. Select the proper equation depending on whether you are verifying a flow rate, mass flow rate, 4–20 mA output, or special units. Use [Example calculations](#) to clarify how these equations are used.

Flow rate calculation

For a given input frequency F (Hz), and K-factor (compensated), find the flow rate Q where C_x is the unit conversion (see [Unit conversion table](#)) and K is the compensated K-factor in units of pulses/gallon:

$$Q = F(\text{Hz}) / (K \times C_x)$$

Standard or normal flow rate calculation

$$Q = F(\text{Hz}) \times ((\text{DensityRatio}) / K \times C_x)$$

Mass flow rate calculation

For a given mass frequency F (Hz), and K-factor (compensated), find the mass flow rate M where C is the unit conversion and ρ is density at operating conditions:

$$M = \frac{F}{(K/\rho) - C}$$

Where C_x is the unit conversion (see [Unit conversion table](#)) using density (ρ):

$$M = F(\text{Hz}) / (KC_x)$$

4-20 mA output calculation

For a given input frequency F (Hz), and K-factor (compensated), find output electrical current I :

$$I = \left(\left[\frac{F / (K \times C_x - LRV)}{URV - LRV} \right] \times (16) \right) + 4$$

Where C_x is the unit conversion (see [Unit conversion table](#)), URV is the upper range value (user units), and LRV is the lower range value (user units).

Special units output calculation

For special units, divide the special unit-conversion factor into the base unit factor C_x .

$$C_{20} = C_x / \text{special units conversion factor}$$

See [Unit conversion table](#).

C.6 Unit conversion table

Use the following table when converting units of measure.

Unit conversions

C _x	Units (actual)	Conversion factor
C ₁	gal/s	1.00000E+00
C ₂	gal/m	1.66667E-02
C ₃	gal/h	2.77778E-04
C ₄	Impgal/s	1.20095E+00
C ₅	Impgal/m	2.00158E-02
C ₆	Impgal/h	3.33597E-04
C ₇	L/s	2.64172E-01
C ₈	L/m	4.40287E-03
C ₉	L/h	7.33811E-05
C ₁₀	CuMtr/m	4.40287E+00
C ₁₁	CuMtr/h	7.33811E-02
C ₁₂	CuFt/m	1.24675E-01
C ₁₃	CuFt/h	2.07792E-03
C ₁₄	bbbl/h	1.16667E-02
C ₁₅	kg/s	C ₁₀ × 60/ρ (kg/m ³)
C ₁₆	kg/h	C ₁₁ /ρ (kg/m ³)
C ₁₇	lb/h	C ₁₃ /ρ (lb/ft ³)
C ₁₈	shTon/h	C ₁₇ × 2000
C ₁₉	mTon/h	C ₁₆ × 2000
C ₂₀	SPECIAL	C _x /(special units conversion factor)

C.7 Example calculations

The following examples describe the flowrate calculations that may be necessary for your application. Water, saturated steam, and natural gas applications are represented in the examples. The first set of three examples is in English units. The second set of three examples is in SI units.

C.7.1 Imperial unit examples

Example 1

Fluid	Water
-------	-------

Line size	3 inch
Line pressure	100 psi
Vortex frequency	75 Hz
URV	500 gpm
LRV	0 gpm
C ₂	1.66667E-02 (from Unit conversion table)
K-factor compensated	10.79 pulses/gallon using a HART communication device or AMS Device Manager

$$\begin{aligned}
 Q &= F / (K \times C_2) \\
 &= 75 / (10.79 \times 0.0166667) \\
 &= 417.1 \text{ gpm}
 \end{aligned}$$

An input frequency of 75 Hz represents a flow rate of 417.1 gpm in this example.

For a given input frequency, you can also determine the electrical current output. Use the values in the previous table with an input frequency of 75 Hz:

F _{in}	75 Hz
-----------------	-------

$$\begin{aligned}
 I &= \left(\left[\frac{F / (K \times C_x - LRV)}{URV - LRV} \right] \times (16) \right) + 4 \\
 I &= \left(\left[\frac{75 / (10.79 \times 0.0166667) - 0}{500 - 0} \right] \times (16) \right) + 4 \\
 &= 17.35 \text{ mA}
 \end{aligned}$$

An input frequency of 75 Hz represents an electrical current output of 17.35 mA.

Example 2

Fluid	Saturated steam
Line size	3 inch
Line pressure	500 psia
Operating temp	467 °F
Viscosity	0.017 cp
URV	40000 lb/hr
LRV	0 lb/hr
C ₁₇	C ₁₃ /ρ (from Unit conversion table)
Density (ρ)	1.078 lb/cu-ft
Vortex frequency	400 Hz
K-factor (compensated)	10.79 pulses/gallon using a HART communication device or AMS Device Manager

M	$\frac{F}{(K \times C_{17})}$ $\frac{400}{\{10.678 \times (C_{13}/\rho)\}}$ $\frac{400}{\{10.678 \times (0.00207792/1.078)\}}$ $\frac{400}{(10.678 \times 0.0019276)}$ 19433.6 lb/hr
---	--

An input frequency of 400 Hz represents a flow rate of 19433.6 lb/hr in this application.

For a given input frequency, you can also determine the electrical current output. Use the values in the previous table with an input frequency of 300 Hz:

F_{in}	300 Hz
----------	--------

$$I = \left(\left[\frac{F/(K \times C_{17} - LRV)}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{300/(10.678 \times 0.0019276) - 0}{40000 - 0} \right] \times (16) \right) + 4$$

$$I = 9.83 \text{ mA}$$

An input frequency of 300 Hz represents an electrical current output of 9.83 mA.

Example 3

Fluid	Natural gas
Line size	3 inch
Line pressure	140 psia
Operating temp	50 °F
Viscosity	0.01 cp
URV	5833 SCFM
LRV	0 SCFM
C_{20}	C_x /sp. units factor (from Unit conversion table)
Density (ρ)	0.549 lb/cu-ft (operating)
Input frequency	700 Hz
K-factor (compensated)	10.678 pulses/gallon using a HART communication device or AMS Device Manager
Q	$\frac{F}{(K \times C_{20})}$ where: $C_{20} = C_{12}/10.71$ (density ratio) $\frac{700}{\{10.797 \times (0.124675/10.71)\}}$ 5569.4 SCFM

An input frequency of 700 Hz represents a flow rate of 5569.4 SCFM in this application.

For a given input frequency, you can also determine the electrical current output. Use the values in the previous table with an input frequency of 200 Hz.

F_{in}	200 Hz
----------	--------

$$I = \left(\left[\frac{F/(K \times C_{20} - LRV)}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{200/(10.797 \times 0.011641) - 0}{5833 - 0} \right] \times (16) \right) + 4$$

$$I = 8.36mA$$

An input frequency of 200 Hz represents an electrical current output of 8.36 mA.

C.7.2 SI unit examples

Example 1

Fluid	Water
Line size	80 mm
Line pressure	700 kPas
Operating temp	16 °C
Input frequency	80 Hz
K-factor (compensated)	10.772 pulses/gallon using HART communication device or AMS Device Manager
URV	2000 lpm
LRV	0 lpm
C ₈	4.40287E-03 (from Unit conversion table)
M	F/K x C _g 80/(10.722x0.00440287) 1694.6 lpm

An input frequency of 80 Hz represents a flow rate of 1694.6 lpm in this application.

For a given input frequency, you can also determine the electrical current output. Use the values in the previous table with an input frequency of 80 Hz:

F _{in}	80 Hz
-----------------	-------

$$I = \left(\left[\frac{F/(K \times C_8 - LRV)}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{80/(10.772 \times 0.00440287) - 0}{2000 - 0} \right] \times (16) \right) + 4$$

$$I = 17.49mA$$

An input frequency of 80 Hz represents an electrical current output of 17.49 mA.

Example 2

Fluid	Saturated steam
Line size	80 mm
Line pressure	700 kPas

Operating temp	77 °C
Viscosity	0.015 cp
Input frequency	650 Hz
K-factor (compensated)	10.715 pulses/gallon using HART communication device or AMS Device Manager
URV	3600 kg/hr
LRV	0 kg/hr
C ₁₆	C ₁₁ /ρ (from Unit conversion table)
M	F(Hz) / (K x C ₁₆) 650 / {10.715 x (C ₁₁ /ρ)} 650 / {10.715 x (0.0733811/4.169)} 650 / (10.715 x 0.017602) 3446.4 kg/hr

An input frequency of 650 Hz represents a flow rate of 3446.4 kg/hr in this application.

For a given input frequency, you can also determine the electrical current output. Use the values in the previous table with an input frequency of 275 Hz:

F _{in}	275 Hz
-----------------	--------

$$I = \left(\left[\frac{F / (K \times C_{16} - LRV)}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{275 / (10.715 \times 0.017602) - 0}{3600 - 0} \right] \times (16) \right) + 4$$

$$I = 10.48mA$$

An input frequency of 275 Hz represents an output electrical current of 10.48 mA.

Example 3

Fluid	Natural gas
Line size	80 mm
Line pressure	1000 kPas
Operating temp	-12 °C
Viscosity	0.01 cp
Input frequency	700 Hz
K-factor (compensated)	10.797 pulses/gallon using HART communication device or AMS Device Manager
URV	10,000 NCMH
LRV	0 NCMH
C ₂₀	C _x /sp. units factor (from Unit conversion table)
Density (ρ)	9.07754 kg/cu-mtr (operating)

Density ration	10.48
Q	$F/K \times C_{20}$ where $C_{20} = C_{11}/(\text{density ratio})$ $700/[10.797 \times (.0733811/10.48)]$ 9259.2 NCMH

An input frequency of 700 Hz represents a flow rate of 9259.2 NCMH in this application.

For a given input frequency, you can also determine the electrical current output. Use the values in the previous table with an input frequency of 375 Hz.

F_{in}	375 Hz
----------	--------

$$I = \left(\left[\frac{F/(K \times C_{20} - LRV)}{URV - LRV} \right] \times (16) \right) + 4$$

$$I = \left(\left[\frac{375/(10.797 \times 0.0070020) - 0}{10000 - 0} \right] \times (16) \right) + 4$$

$$I = 11.94mA$$

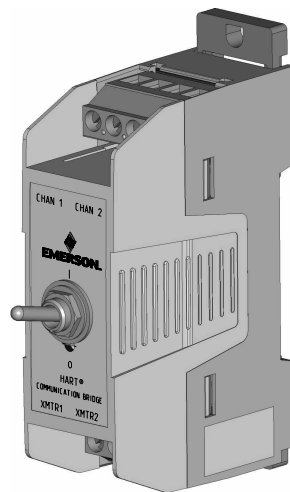
An input frequency of 375 Hz represents an electrical current output of 11.94 mA.

D Dual and Single Analog Wiring Configuration with the HART Communication Bridge

HART Communication Bridge overview

Many installations require each transmitter to use separate current loops to enable analog signaling in the 4–20 mA range. For mass compensated flow measurement based on measured pressure, the Vortex MV needs to receive this information via coupled HART communication, which is not available with separate current loops. The HART Communication Bridge is a compact convenient device to easily allow communication from a pressure transmitter to a Vortex MultiVariable transmitter. The HART Communication Bridge is designed to provide this coupling with the ability to easily disconnect when needed. When a flow meter is ordered with the MPA or MCA option, the bridge is shipped with the flow meter.

Figure D-1: HART Communication Bridge



Installation Considerations

- Install the bridge in a location where it will be within the operating temperature specification of -40°F to 140°F (-40°C to 60°C)
- A bridge cannot be installed in hazardous areas.
- Wiring need not be shielded, but twisted pairs should be used for best results.

Mechanical Considerations

The bridge allows four different mounting options:

- asymmetrical 32 mm G rail
- symmetrical 35 x 7.5 mm top hat rail

- symmetrical 35 x 15 mm top hat rail
- wall mount with tab

Snap the bridge onto the rail in the desired location or use the tab to mount the bridge on the wall. Because the bridge is designed for non-hazardous locations, it can only be installed on the safe side of an I.S. barrier.

There is a switch on the front face of the bridge that allows for the coupling for both devices when the switch is in the ON "I" position and disables the coupling when the switch is in the OFF "0" position.

Electrical Considerations

Input	42VDC Max, 4–20mA HART
Loop Resistance	51 Ω per loop

Note

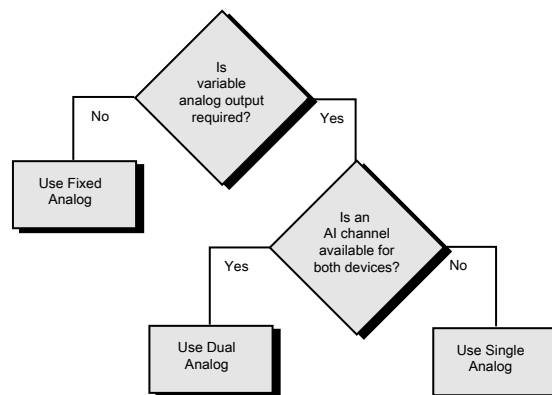
Loop resistance needs to be considered in determining minimum power supply voltage. See [Power supply](#).

Environment	Indoor use only
Ingress Protection	IP20
Altitude	13123 feet (4000m)

HART communication bridge wiring

There are multiple wiring possibilities to utilize a pressure input from a pressure transmitter for pressure compensation with the vortex meter. [Figure D-2](#) is a flow chart that helps guides to one of the three wiring diagram that best suits the system requirements. For more information about Fixed Analog wiring configuration, see [Fixed analog](#).

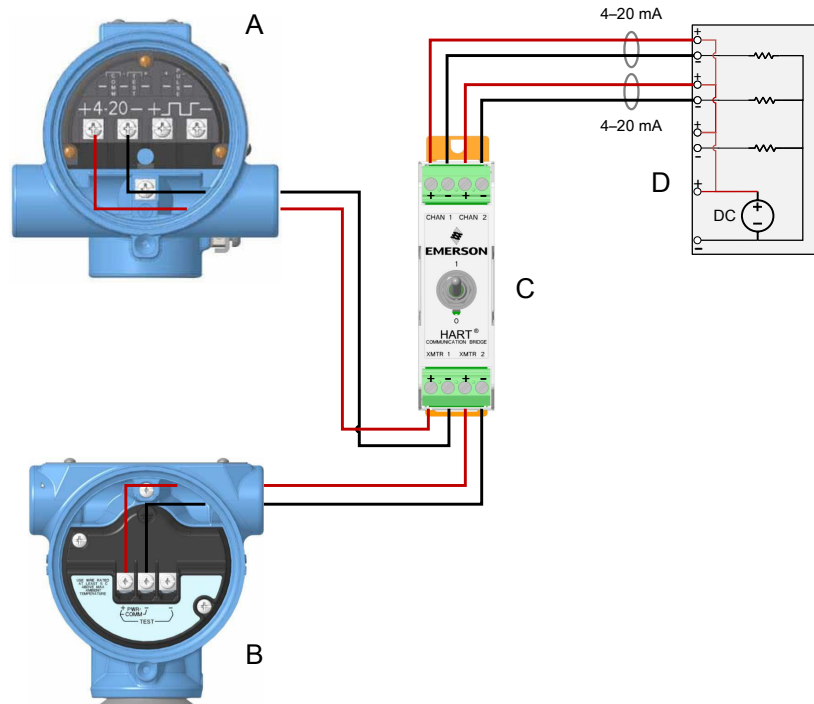
Figure D-2: HART Communication Bridge wiring decision tree



Dual analog 4–20 mA loops

Dual analog wiring configuration provides the capability for the vortex meter to receive the pressure input from a HART pressure transmitter while maintaining the ability for independent 4–20 mA outputs from the pressure transmitter and vortex meter. A HART communication bridge is required with this wiring configuration.

Figure D-3: Dual analog flow and pressure wiring to DCS with integral power supply



- A. Vortex transmitter
- B. Pressure transmitter
- C. HART Communication Bridge
- D. DCS with analog input (AI) card and integral dc power supply

Follow these steps to properly wire the flow meter, pressure transmitter with the HART communication bridge:

1. Wire and connect all devices as shown in [Figure D-3](#). Be sure to observe the correct polarity.
2. Ensure the HART communication bridge is toggled to the OFF “0” position.
3. Power the transmitters and establish HART communications with the DCS, if supported. Verify each device is at HART address 0.
4. Configure the pressure transmitter to “Burst” its Primary Variable (Burst Command 1).
5. Toggle the HART communications to the ON “1” position.



CAUTION

To maintain an intrinsically safe output, HART compatible I.S. barriers must be used.

Note

Load resistance is assumed sufficient ($\geq 250 \Omega \leq 1000 \Omega$) in the AI card for HART communication.

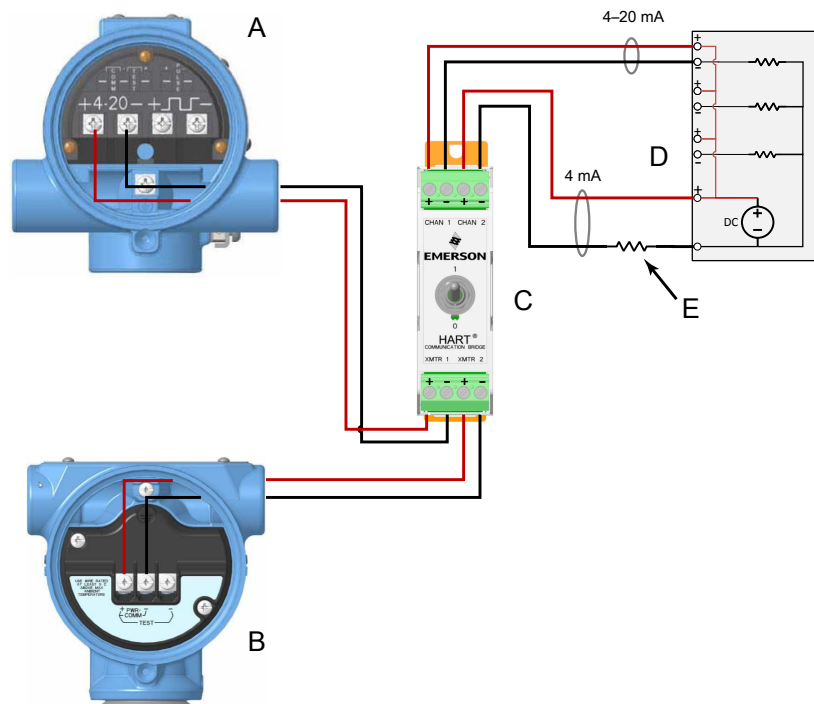
Note

Connections are polarity-sensitive as indicated in Figure D-3.

Single analog 4–20 mA

Single analog wiring configuration provides the capability for the vortex meter to receive the pressure input from a HART pressure transmitter while maintaining availability of the 4–20 mA output from one of the devices. This is a great solution for applications when the 4–20 mA output is only required for one of the devices and AI channels are at a premium. A HART communication bridge is required with this wiring configuration.

Figure D-4: Single analog flow and pressure wiring to DCS with integral power supply



- A. Vortex transmitter
- B. Pressure transmitter
- C. HART Communication Bridge
- D. DCS with analog input (AI) card and integral dc power supply
- E. HART Communication load resistor

Follow these steps to properly wire the flow meter, pressure transmitter with the HART communication bridge:

1. Wire and connect all devices as shown in [Figure D-4](#). Be sure to observe the correct polarity.
2. Ensure the HART communication bridge is toggled to the OFF “0” position.
3. Power the transmitters and establish HART communications between the AI connected transmitter (Vortex) and the DCS, if supported.
4. Configure the non-AI connected transmitter (Pressure) to a non-zero HART address. This will fix the analog output at 4 mA.
5. Configure the pressure transmitter to “Burst” its Primary Variable (Burst Command 1).
6. Toggle the HART communications to the ON “1” position.



CAUTION

To maintain an intrinsically safe output, HART compatible I.S. barriers must be used.

Note

Use a 250 to 1k ohm resistor for HART communication on non-AI connected device.

Note

Connections are polarity-sensitive as indicated in [Figure D-4](#).



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