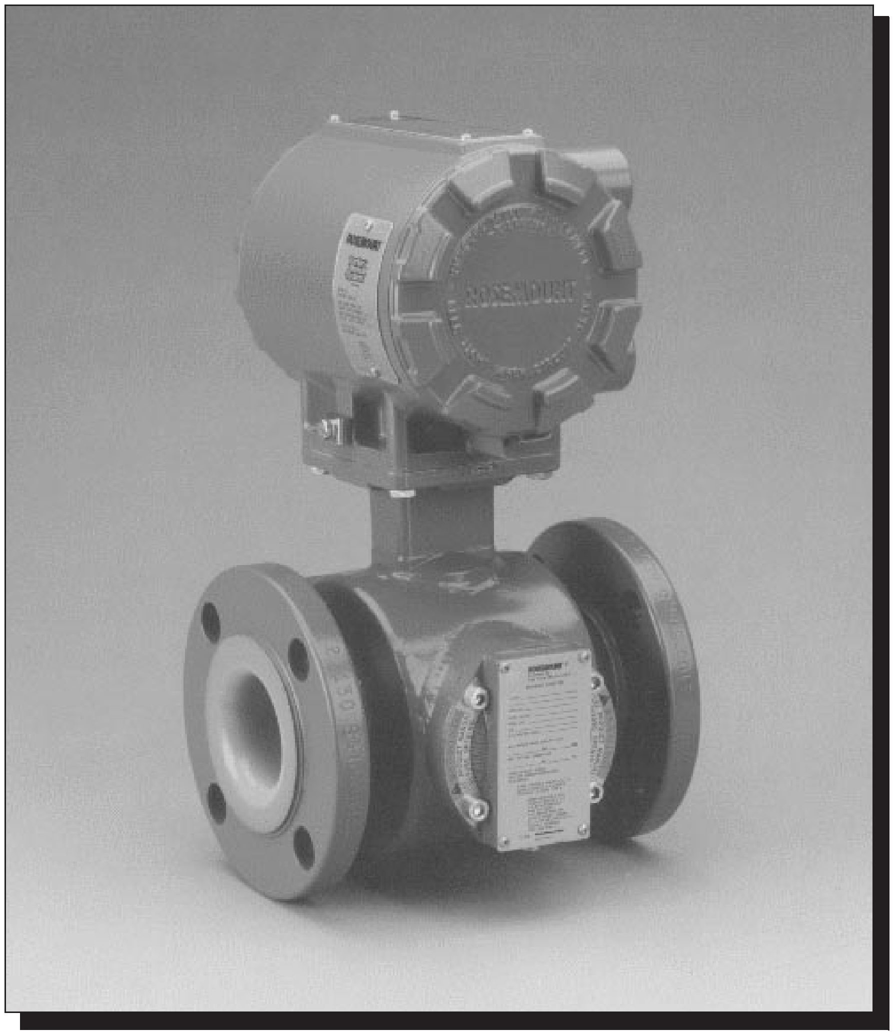
00809-0100-4725
English
Rev. BB

Model 8732C Integral Mount Magnetic Flowmeter System



ROSEMOUNT®

FISHER-ROSEMOUNT™ Managing The Process Better.™

Product Manual

Model 8732C
Integral Mount Magnetic Flowmeter System

NOTICE

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

Within the United States, Rosemount Inc. has two toll-free assistance numbers.

Customer Central: 1-800-999-9307 (*7:00 a.m. to 7:00 p.m. CST)*
Technical support, quoting, and order-related questions.

North American Response Center: 1-800-654-7768 (*24 hours a day – Includes Canada)*
Equipment service needs.

For equipment service or support needs outside the United States, contact your local Rosemount representative.

⚠CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

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

SNF-0004

Rosemount, the Rosemount logotype, and SMART FAMILY are registered trademarks of Rosemount Inc. HART is a registered trademark of the HART Communication Foundation.

Cover Photo: 8732-002AB.

CE Fisher-Rosemount satisfies all obligations coming from legislation to harmonize product requirements in the European Union.

Rosemount Inc.
8200 Market Boulevard
Chanhassen, MN 55317 USA
Tel 1-800-999-9307
Telex 4310012
Fax (612) 949-7001

PRINTED IN U.S.A.

http://www.rosemount.com

ROSEMOUNT®

FISHER-ROSEMOUNT™ Managing The Process Better.™

Table of Contents

IMPORTANT

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

SECTION 1: Introduction

SECTION 2: Installation

SECTION 3: Local Operator Interface

SECTION 4: Transmitter Functions

SECTION 5: Troubleshooting

SECTION 6: Model 8732C Specifications and Reference Data

SECTION 7: Model 8705 Specifications and Reference Data

SECTION 8: Model 8711 Specifications and Reference Data

APPENDIX A: HART Communicator

APPENDIX B: Operation Planning

APPENDIX C: Transmitter Output Instability

APPENDIX D: Magnetic Flow Operating Principles

INDEX

Section 1

Introduction

MANUAL SCOPE

This manual provides instructions for installing, configuring, operating, and troubleshooting the Rosemount Model 8732C Integral Mount Magnetic Flowmeter System.

Section 2: Installation

provides step by step instructions for installing and starting-up the Model 8732C Magnetic Flowmeter System.

Section 3: Local Operator Interface

introduces the Model 8732C local operator interface (LOI) and its function in configuring the Model 8732C.

Section 4: Transmitter Functions

guides you through the software configuration functions for the Model 8732C. Basic configuration covers the functions that are necessary to get the system up and running as well as special configuration.

Section 5: Troubleshooting

includes troubleshooting tables and software test procedures for diagnosing and repairing problems with the Model 8732C.

Section 6: Model 8732 Specifications and Reference Data

provides functional, performance, and physical specifications for the Model 8732C. It also includes ordering information and approvals.

Section 7: Model 8705 Specifications and Reference Data

provides functional, performance, and physical specifications for Model 8705 Flanged Magnetic Flowmeter Flowtubes. It also includes ordering information and approvals.

Section 8: Model 8711 Specifications and Reference Data

provides functional, performance, and physical specifications for Model 8711 Wafer Magnetic Flowmeter Flowtubes. It also includes ordering information and approvals.

Appendix A: Hart Communicator

is a detailed summary of the operational features of the HART Communicator. It includes a menu tree, Fast Key Sequence table, and other instructions.

Appendix B: Operation Planning

provides guidance for system planning when using a magnetic flowmeter system.

Appendix C: Transmitter Output Instability

describes the problems of signal noise and the signal processing system of the Rosemount Model 8732C Transmitter.

Appendix D: Magnetic Flow Operating Principles

explains the principles behind Series 8700 System operations, functions, and design.

SYSTEM DESCRIPTION

A complete magnetic flowmeter system consists of two components: the Rosemount Model 8732C microprocessor-based integral-mount magnetic flowmeter transmitter, and a Rosemount Model 8705 or 8711 flowtube.

The flowtube is installed in-line with process piping, either vertically or horizontally. Coils located on opposite sides of the flowtube create a magnetic field, and conductive liquid moving through the magnetic field generates a voltage that is detected by two electrodes.

The transmitter controls the generation of the magnetic field and senses the voltage detected by the electrodes. Based on the sensed voltage, the transmitter calculates a flow rate and produces analog and frequency output signals proportional to this 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 each section before performing any operations.

Section **2**

Installation

INTRODUCTION

This section covers the installation procedures for the Model 8732C Magnetic Flowmeter System.

SAFETY MESSAGES

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

Warnings

⚠WARNING

Explosions could result in death or serious injury:

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

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.
- Do not perform any service other than those contained in this manual unless qualified.

⚠WARNING

High voltage that may be present on leads could cause electrical shock:

- Avoid contact with leads and terminals.

PRE-INSTALLATION

There are several pre-installation steps that make the installation process easier. They include identifying the options and configurations that apply to your application, setting the hardware switches if necessary, and consideration of mechanical, electrical, and environmental requirements.

Please remember that the flowtube liner is vulnerable to handling damage. Never place anything through the flowtube for the purpose of lifting or gaining leverage. Liner damage can render the flowtube useless.

Identify Options and Configurations

Standard application of the Model 8732C includes a 4–20 mA output and control of the flowtube coils. Other applications may require one or more of the following configurations or options:

- Multidrop Communications
- Auxiliary Output
- Pulse Output

Additional options may also apply. Be sure to identify the options and configurations that apply to your situation, and keep a list of them nearby during the installation and configuration procedures.

Hardware Switches

The Model 8732C electronics board is equipped with three user-selectable hardware switches: Failure Alarm Mode, Output Power Source, and Software Lockout Mode. The standard configurations for these switches when shipped from the factory are as follows:

Failure Alarm Mode: *High*
Output Power Source: *Internal*
Software Lockout: *Off*

Definitions of these switches and their functions are provided below. If you determine that the settings must be changed, see **Changing Hardware Switch Settings** on page 2-3.

Failure Mode

If the Model 8732C experiences a catastrophic failure in the electronics, the current output can be driven high (22.50 mA) or low (3.75 mA). The switch is set in the *High* position when it leaves the factory.

Current Output Internally or Externally Powered

The Model 8732C 4–20 mA loop may be powered internally or by an external power supply. The Internal/External power supply switch determines the source of the 4–20 mA loop power. Transmitters leaving the factory are set in the *Internal* position.

The external power option is required for multidrop communications applications. A 10–30 V dc external supply is required, and the switch must be reset. For further information on 4–20 mA external power, see **Connect 4–20 mA Loop External Power Source** on page 2-20.

Transmitter Security

The Model 8732C has a switch that locks out any configuration changes attempted on the transmitter. Any changes to the configuration are disallowed whenever the switch is in the *On* position. However, the flow rate indication and totalizer functions remain active.

With the switch in the *On* position, you may still access and review any of the operating parameters and scroll through the available choices, but no actual data changes are allowed.

The local operator interface (LOI) has a display lock function that will restrict any changes to the configuration via the LOI only. (This restriction applies to the totalizer functions as well.) This protection is intended to prevent accidental activation of the optical LOI in the field. Refer to page 3-5 for information about activating and deactivating the display lock function. The display lock is *not* on when the Model 8732C leaves the factory.

Changing Hardware Switch Settings

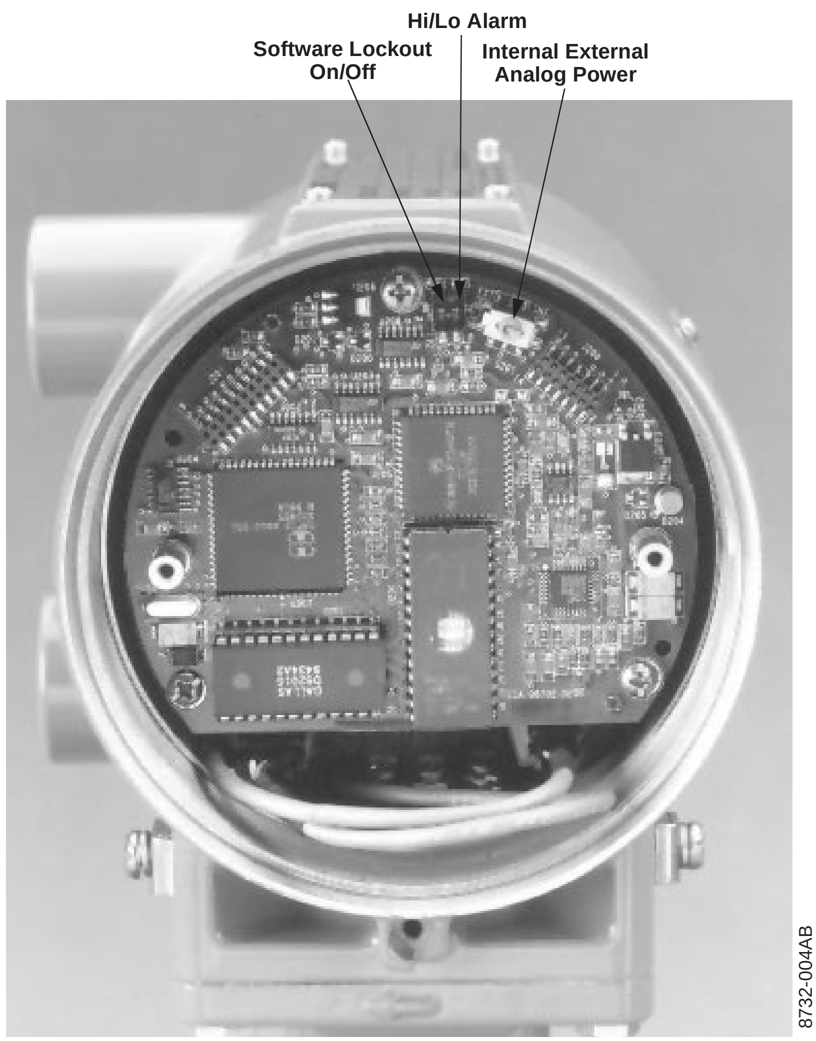
In most cases, it is not necessary to change the setting of the hardware switches. If you need to change the switch settings, complete the steps outlined below:

NOTE
The hardware switches are located under the cover opposite the terminal block. Because changing their settings requires opening the electronics housing, make every attempt possible to carry out these procedures away from the plant environment to protect the electronics.

---

1. Disconnect power to the transmitter.
2. Unscrew and remove the electronics cover.
3. Identify the location of each switch (see Figure 2-1).
4. Change the setting of the desired switches with a small screwdriver.
5. Reinstall and tighten the electronics cover.

FIGURE 2-1. Model 8732C Electronics Board and Hardware Switches.

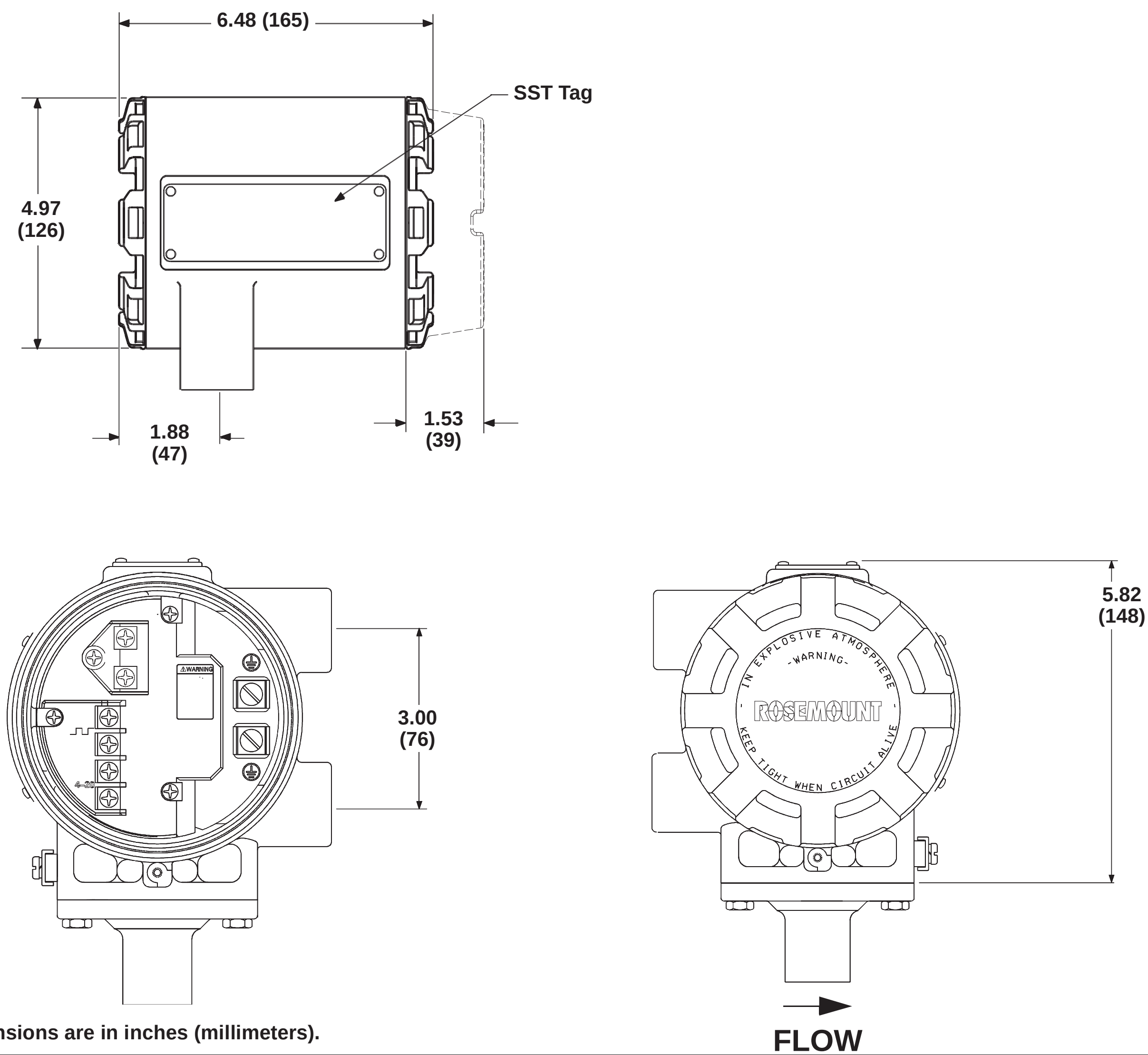


Mechanical Considerations

The mounting site for the Model 8732C Integral Mount Transmitter should provide enough room for secure mounting, easy access to the conduit ports, full opening of the transmitter covers, and easy readability of the local operator interface (LOI) screen (see Figure 2-2). The electronics housing can be rotated on the flowtube in 90° increments. This can be done by loosening the four mounting bolts on the bottom of the housing, rotating the housing, and reinstalling the bolts. Be sure the surface is clean and there is not a gap when returning the housing to its original position.

The LOI can also be rotated in 90° increments. This should be performed prior to installing the magnetic flowmeter system. Refer to **LOI Rotation** on page 3-3 for additional information.

FIGURE 2-2. Model 8732C Dimensional Drawings.



NOTE
Dimensions are in inches (millimeters).

8732-1002A01B, 1002E01A, 1002G01A

Electrical Considerations

Before making any electrical connections to the Model 8732C, consider the following standards and be sure to have proper power supply, conduit, and other accessories.

Conduit Connections

The Model 8732C Integral Mount Magnetic Flowmeter Transmitter has two ¾–inch NPT conduit connections. If one of these ports is not being used, it must be sealed with a conduit seal. In some cases, conduits may also require drainage if moisture could build up in the line.

Transmitter Input Power

The Model 8732C Transmitter is designed to be powered by voltages ranging from 90 to 250 V ac (50 to 60 Hz) or 15–30 V dc. Units powered with an ac power supply should be connected to standard ac connections for 90 V ac or 250 V ac. Units powered by a 15–30 V dc power supply have special considerations.

DC Power Requirements

Units powered with 15–30 V dc may draw up to 2 amps of current. As a result, the input power wire must meet certain gauge requirements. Table 2-1 and Table 2-2 show the maximum wire length for corresponding supply voltages, wire gauges, and wire type.

TABLE 2-1. Length of Annealed Copper Wires.

Types of Power Supply Wires		Maximum Length of the Wire for Each Corresponding Power Supply Source		
Wire Gauge	**Milliohms/ft Annealed Cu**	**30 V Supply (ft)**	**24 V Supply (ft)**	**20 V Supply (ft)**
20	10.15	1,230	625	365
18	6.385	1,955	990	585
16	4.016	3,110	1,580	930
14	2.525	4,950	2,515	1,485
12	1.588	7,870	3,995	2,360
10	0.999	12,510	6,355	3,750

TABLE 2-2. Length of Hand-drawn Copper Wires.

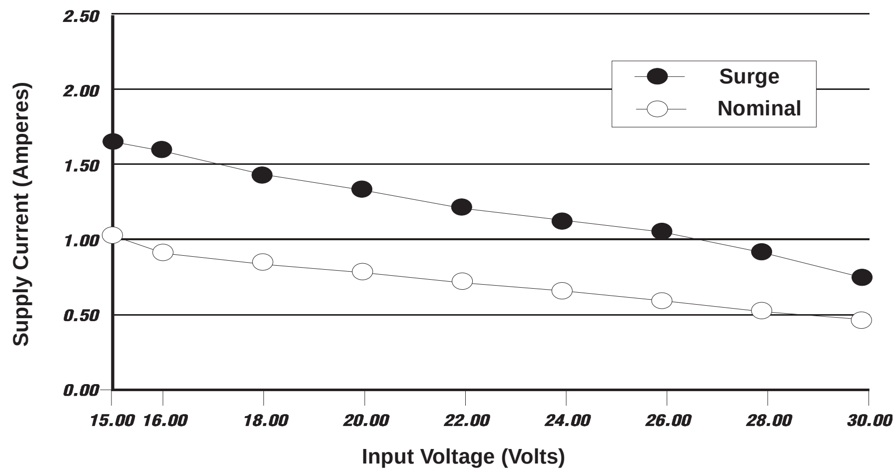
Types of Power Supply Wires		Maximum Length of the Wire for Each Corresponding Power Supply Source		
Wire Gauge	**Milliohms/ft Hand-drawn Cu**	**30 V Supply (ft)**	**24 V Supply (ft)**	**20 V Supply (ft)**
18	6.640	1,880	955	565
16	4.176	2,990	1,520	895
14	2.626	4,760	2,415	1,425
12	1.652	7,565	3,840	2,270
10	1.039	12,030	6,110	3,605

Figure 2-3 shows the surge current for each corresponding supply voltage. For combinations not shown above, you can calculate the maximum distance given the surge current, the voltage of the source, and the minimum start-up voltage of the transmitter, 15 V dc using the following equation:

Max. Resistance = *(Supply Voltage –15 V dc) / Surge Current*

Use Tables 2-1 and 2-2 to determine the maximum wire length allowable for your power supply and maximum resistance.

FIGURE 2-3. Supply Current vs. Input Voltage.



IMPORTANT USER NOTES

Installation Category

Installation (Overvoltage) Category II.

Supply Wire Requirements

12- to 18-gauge wire. For connections in ambients in excess of 60° C (140° F), use wire rated to at least 90° C (194° F).

Disconnects

The supply wires should be connected to the device through an external disconnect or circuit breaker. The disconnect or circuit breaker should be clearly labeled and located near the transmitter.

Overcurrent Protection

Model 8732 requires overcurrent protection of the supply lines. Maximum rating of overcurrent devices are as follows:

Power System	Fuse Rating	Manufacturer
110 V ac	250 V; 1 Amp, Quick Acting	Bussman AGCI or Equivalent
220 V ac	250 V;.5 Amp, Quick Acting	Bussman AGCI or Equivalent
15 to 50 V dc	250 V; 3 Amp; Quick Acting	Bussman AGCI or Equivalent

Transmitter Symbols

⚠ Caution Symbol — Check product documentation for details.

⏚ Protective conductor (grounding) terminal.

Environmental Considerations

To ensure maximum transmitter life, avoid excessive heat and vibration. Typical problem areas include high-vibration lines with integrally mounted transmitters, warm-climate installations in direct sunlight, and outdoor installations in cold climates.

Because the Model 8732C System requires external power, access to a suitable power source must be ensured.

Overheating will damage the flowtube. Do not encapsulate the flowtube with heating elements.

INSTALLATION PROCEDURES

These installation tasks provide detailed mechanical and electrical installation procedures.

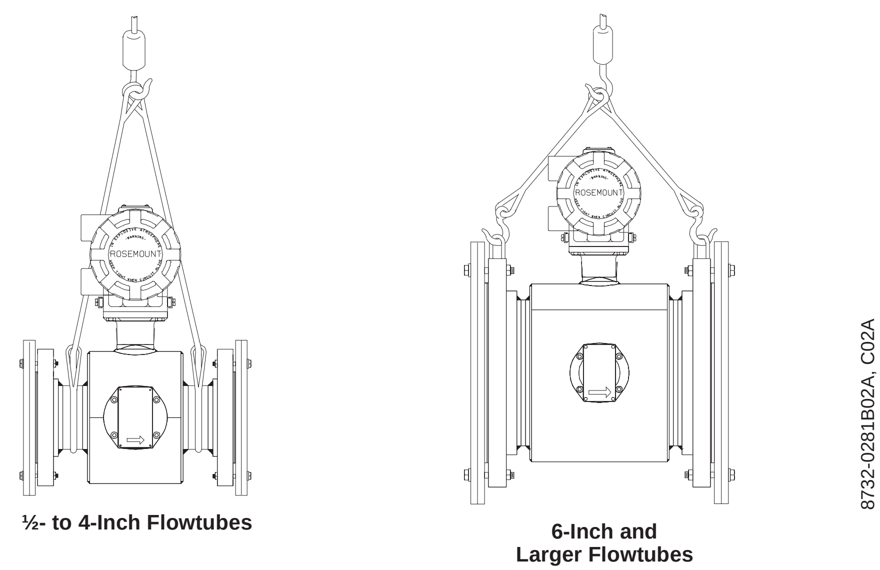
Handling

All parts should be handled carefully to prevent damage. Whenever possible, transport the system to the installation site in the original shipping containers. The flowtube is shipped with end covers to protect it from mechanical damage and normal unrestrained distortion. End covers should not be removed until just before installation. Keep shipping plugs in conduit connections until conduits are connected and sealed.

All flowtube liners are vulnerable to handling damage. Never place anything through the flowtube for the purpose of lifting or gaining leverage. Liner damage can render the flowtube useless.

Flanged flowtubes have different lifting and transportation guidance. Refer to Figure 2-4 for correct handling techniques. Wafer style flowtubes have no special lifting directions, however every precaution should be taken to avoid liner damage.

FIGURE 2-4. Model 8705 Flowtube Support for Handling.



Flowtube Mounting

Physical mounting of a flowtube is similar to installing a typical section of pipe. Only conventional tools, equipment, and accessories (such as bolts, gaskets, and grounding hardware) are required.

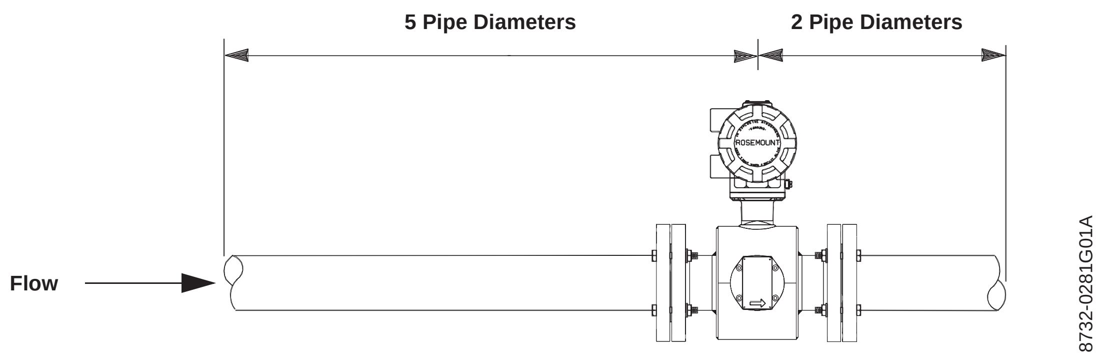
Calibration

Rosemount magnetic flowmeter systems are wet-calibrated at the factory and need no further calibration during installation.

Upstream/Downstream Piping

To ensure specific accuracy over widely varying process conditions, install the flowtube with a minimum of five straight pipe diameters upstream and two pipe diameters downstream from the electrode plane, as shown in Figure 2-5. This flowtube placement is usually adequate to allow for disturbances created by elbows, valves, and reducers.

FIGURE 2-5. Upstream and Downstream Straight Pipe Diameter.



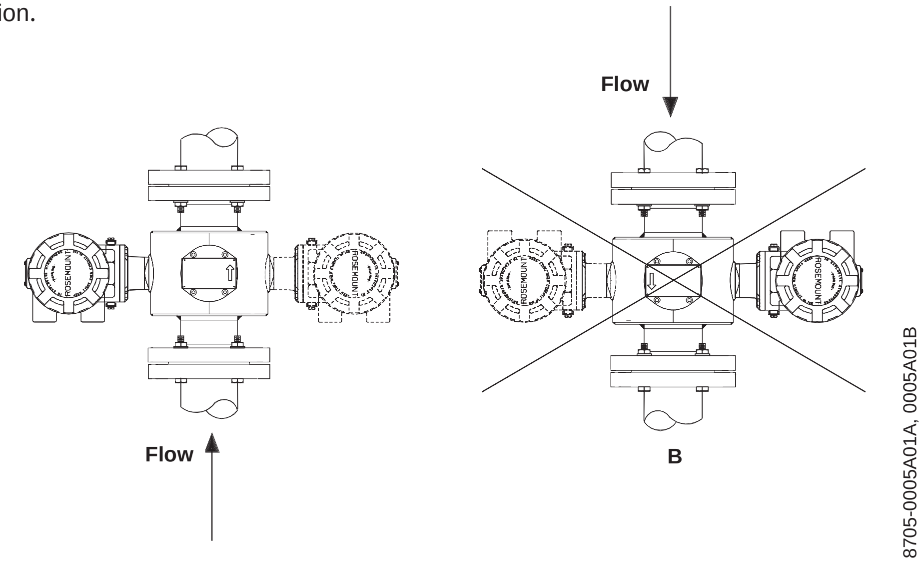
Flowtube Orientation

Vertical Installation

Vertical installation allows upward process fluid flow and is generally preferred. Upward flow keeps the cross-sectional area full, regardless of flow rate. Orientation of the electrode plane is unimportant in vertical installations.

NOTE
As shown in Figure 2-6, avoid downward vertical flows where back pressure is inadequate to ensure that the flowtube remains full.

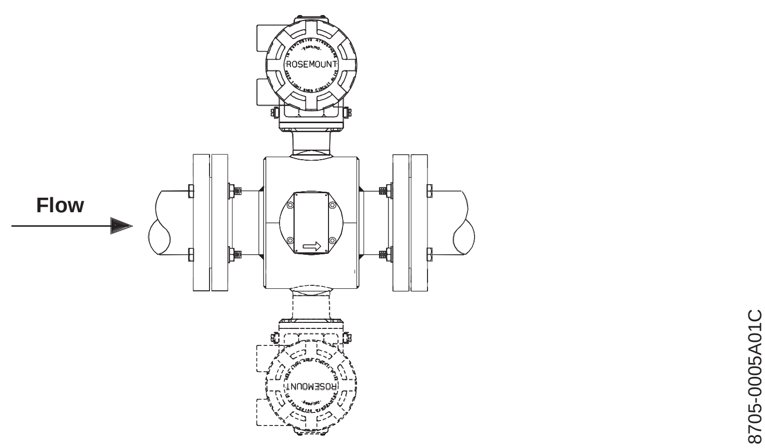
FIGURE 2-6. Vertical Flowtube Orientation.



Horizontal Installation

Horizontal installation should be restricted to low piping sections that are normally full. Orient the electrode plane to within 45 degrees of horizontal in horizontal installations. A deviation of more than 45 degrees of horizontal would place an electrode at or near the top of the flowtube–making it more susceptible to insulation by air or entrapped gas at the top of the flowtube.

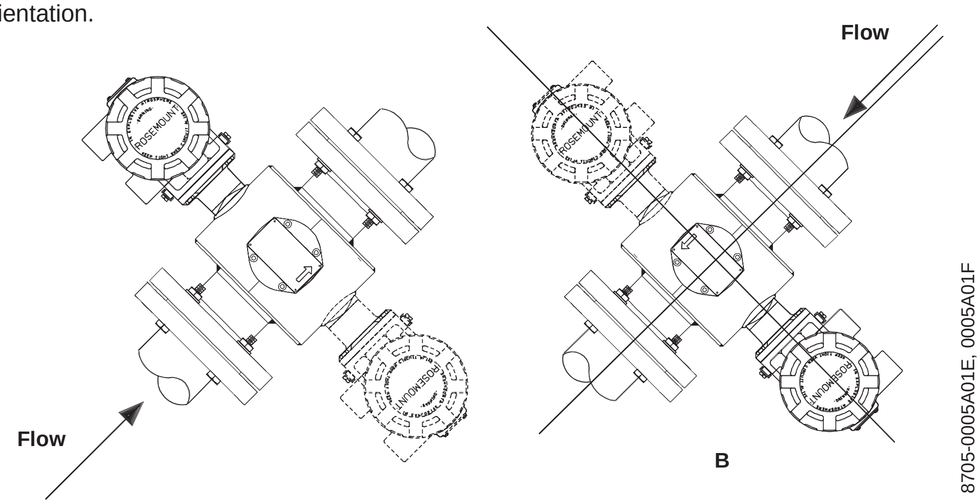
FIGURE 2-7. Horizontal Flowtube Orientation.



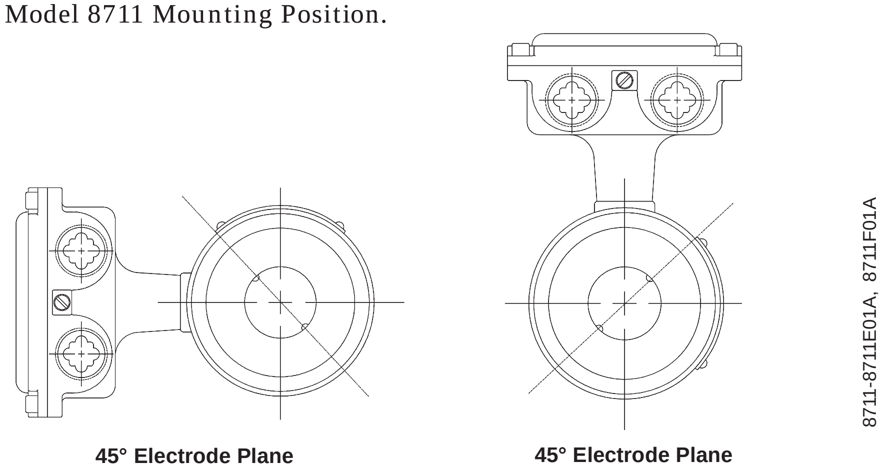
An inclined installation, as shown in Figure 2-8, is an acceptable installation technique. This tends to keep the cross-sectional area full.

NOTE
As shown in Figure 2-8, avoid declining installations where back pressure is inadequate to ensure that the flowtube remains full.

FIGURE 2-8. Incline or Decline Orientation.



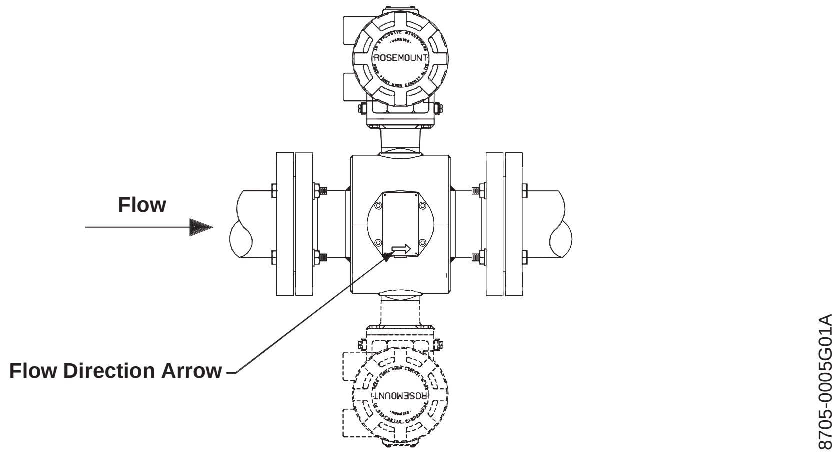
The electrodes in the Model 8711 are properly oriented when the top of the flowtube is either vertical or horizontal, as shown in Figure . Avoid any mounting orientation that positions the top of the flowtube at 45° from the vertical or horizontal position.
Model 8711 Mounting Position.



Flow Direction

The flowtube should be mounted so that the FORWARD end of the flow arrow, shown on the flowtube identification tag, points in the direction of flow through the tube (see Figure 2-9).

FIGURE 2-9. Flow Direction.

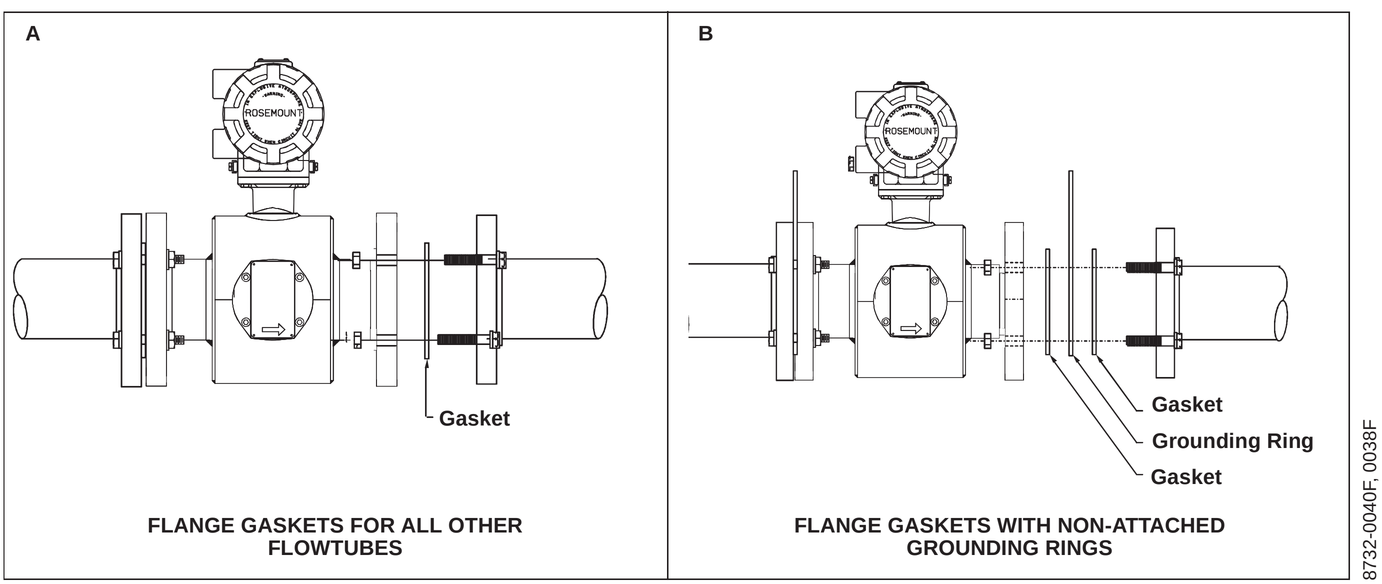


Gaskets

The flowtube requires gaskets at each of its connections to adjacent equipment or piping. The gasket material selected must be compatible with the process fluid and operating conditions, and must not damage the liner.

NOTE
To avoid possible flowtube damage, do not use metallic or spiral wound gaskets.

FIGURE 2-10. Model 8705 Flange Gaskets.



Flange Bolts

Flowtube sizes and torque values for Class 150 and Class 300 flanges are listed in Table 2-3. Tighten flange bolts in the incremental sequence shown in Figure 2-11.

Model 8705

Correct flange bolt tightening is crucial for proper flowtube operation and life. All bolts must be tightened in the proper sequence to the specified torque limits. Failure to observe these instructions could result in severe damage to the flowtube lining and possible flowtube replacement.

Always check for leaks after tightening flange bolts. All flowtubes require a second torquing 24 hours after initial flange bolt tightening.

FIGURE 2-11. Model 8705 Flange Bolt Torquing Sequence.

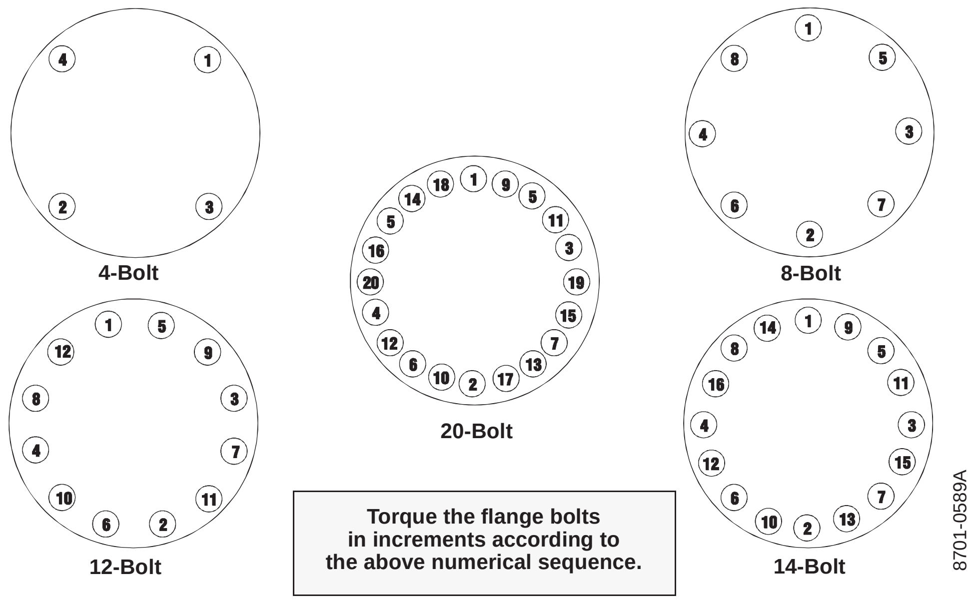


TABLE 2-3. Model 8705 Flange Bolt Torque Specifications.

Nominal Flowtube Size (inches)	Flange Bolt Torque Specifications in Foot-Pounds	
	Class 150 Flange	Class 300 Flange
½	10	10
1	10	10
1½	17	22
2	25	17
3	45	35
4	35	50
6	60	65
8	80	60
10	70	65
12	80	80
14	100	—
16	90	—
18	125	—
20	125	—
24	150	—
30	150	—
36	200	—

Model 8711

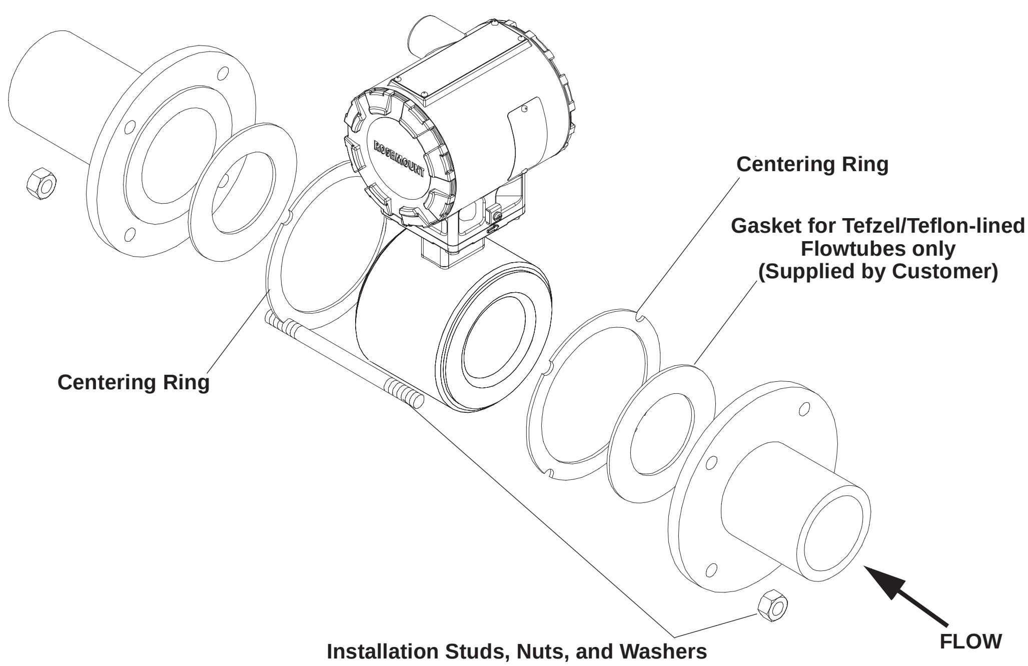
For Model 8711, the flowtube inside diameter should be centered with respect to the inside diameter of the adjoining upstream and downstream piping. This will ensure the flowmeter achieves its specified accuracy. Mounting bolts supplied with 0.15 through 1-inch (4–25 mm) line sizes are specifically sized to properly align these flowtubes with the flange configurations specified. For 1.5 through 8-inch (40–200 mm) line sizes, two centering rings are supplied for alignment purposes. Place the centering rings over the flowtube using the following instructions as a reference. If you received two centering sleeves, follow the steps described under **Alignment with Centering Sleeves**.

Alignment with Centering Rings

1. Insert the two studs for the bottom side of the flowtube between the pipe flanges.
2. Place the two centering rings over each end of the flowtube.
3. Place the flowtube between the flanges. Make sure that the centering rings are properly placed in the studs. The studs should be aligned with the markings on the rings that correspond to the flange you are using.
4. Insert the remaining studs, and install the washers and nuts.
5. Tighten the nuts to the specifications listed in Table 2-4.

NOTE
On the 4- and 6-inch PN 10–16, the installer will need to insert the flowtube with rings first and then insert the studs. The slots on this ring scenario are located on the inside of the ring.

FIGURE 2-12. Alignment with Centering Rings.



Alignment with Centering Sleeves

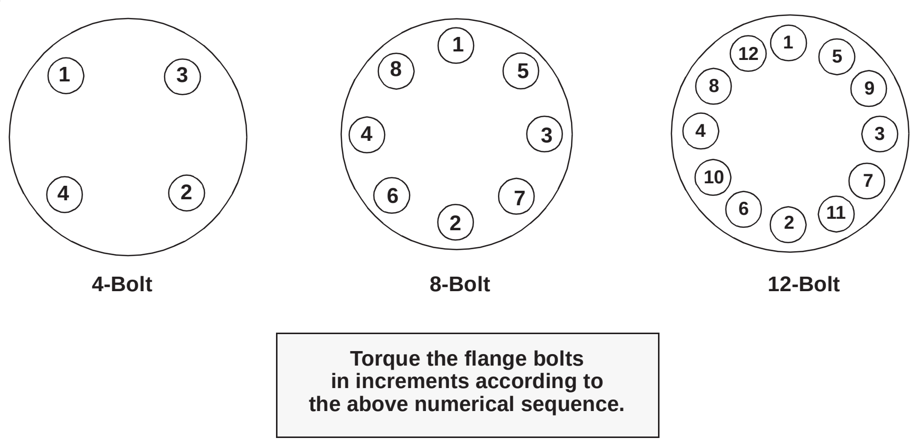
Follow the instructions below for the 1.5- through 8-inch (40 to 200 mm) line sizes if you received two centering sleeves instead of centering rings:

1. Insert the two studs for the bottom side of the flowtube, with the centering sleeves, between the pipe flanges.
2. Place the flowtube firmly against the two centering sleeves, between the flanges.
3. Insert the remaining studs.
4. Install the washers and nuts.
5. Tighten the nuts to the specifications listed in Table 2-4.

TABLE 2-4. Flange Bolt Torque Specifications.

Nominal Flowtube Size, Inches (mm)	Bolt Torque Specifications in Foot-Pounds Applicable for Both Class 150 and 300 Flanges
0.15 (4)	5
0.30 (8)	5
0.50 (15)	5
1 (25)	10
1.50 (40)	15
2 (50)	25
3 (80)	40
4 (100)	30
6 (150)	50
8 (200)	70

FIGURE 2-13. Model 8711 Flange Bolt Torquing Sequences.



Grounding

Grounding the flowtube is one of the most important details of flowtube installation. Proper grounding ensures that only the voltage induced in the flowtubes magnetic field is measured.

Model 8705

Use Table 2-5 to determine which grounding option figure to use for proper installation.

NOTE
Consult factory for installations requiring cathodic protection or situations where high currents or high potential exist in the process.

TABLE 2-5. Model 8705 Grounding Installation.

Type of Pipe	Grounding Options			
	No Grounding Options	Grounding Rings	Grounding Electrodes	Lining Protectors
Conductive Unlined Pipe	See Figure 2-14	Not Required	Not Required	See Figure 2-15
Conductive Lined Pipe	Insufficient Grounding	See Figure 2-16	See Figure 2-14	See Figure 2-15
Non-conductive Pipe	Insufficient Grounding	See Figure 2-18	See Figure 2-19	See Figure 2-17

FIGURE 2-14. Model 8705 Grounding for Conductive Unlined Pipe and Grounding for Conductive Lined Pipe with Grounding Electrodes.

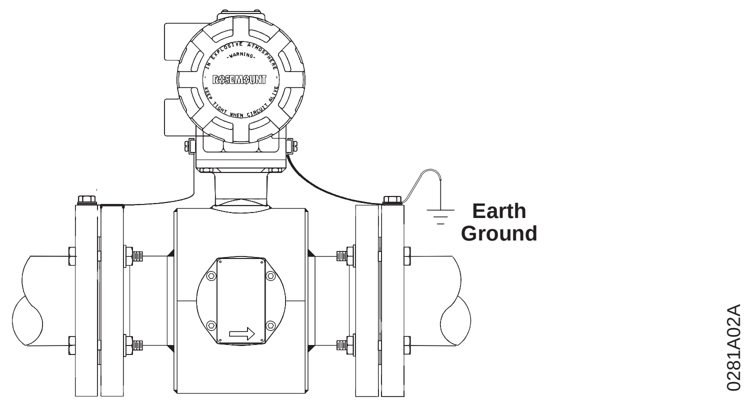


FIGURE 2-15. Model 8705 Grounding for Conductive Unlined Pipe with Lining Protectors and Grounding for Conductive Lined Pipe with Lining Protectors.

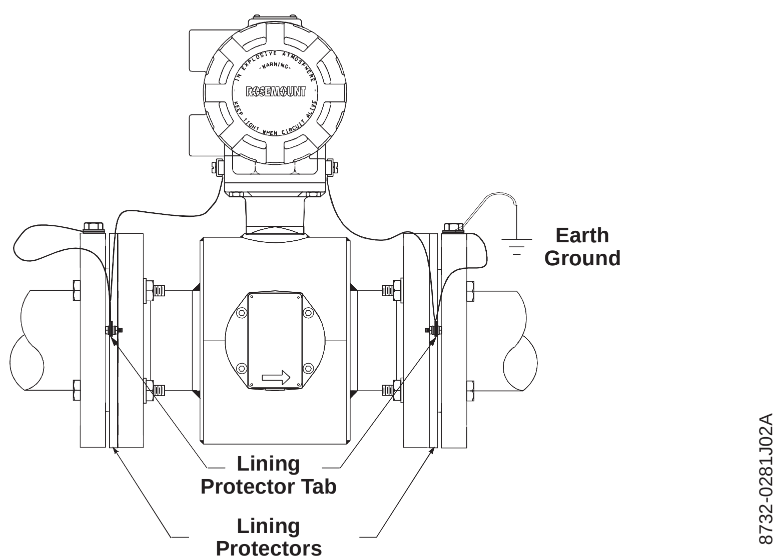


FIGURE 2-16. Model 8705 Grounding for Conductive Lined Pipe with Grounding Rings.

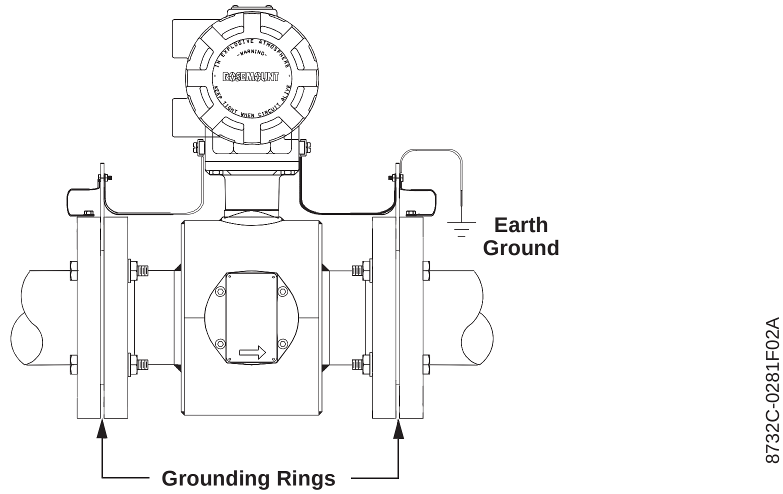


FIGURE 2-17. Model 8705 Grounding for Non-Conductive Pipe with Lining Protectors.

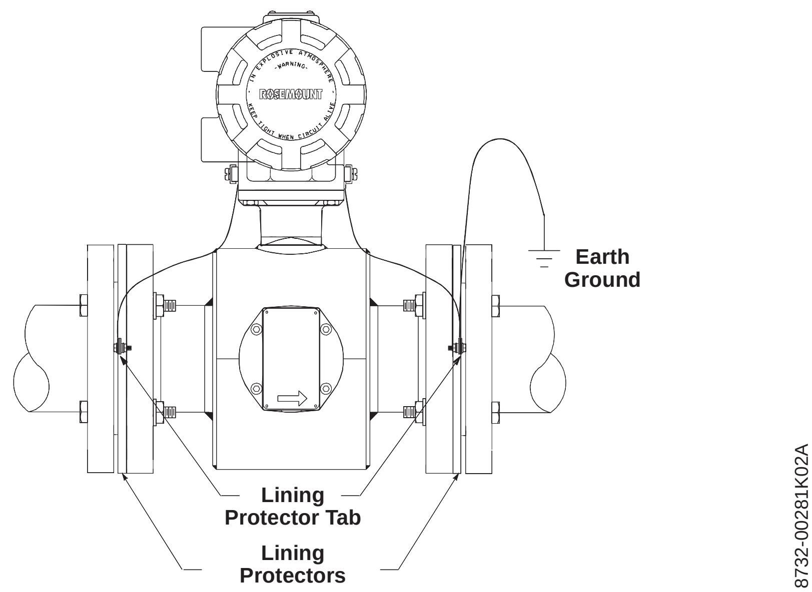


FIGURE 2-18. Model 8705 Grounding for Non-Conductive Pipe with Grounding Rings.

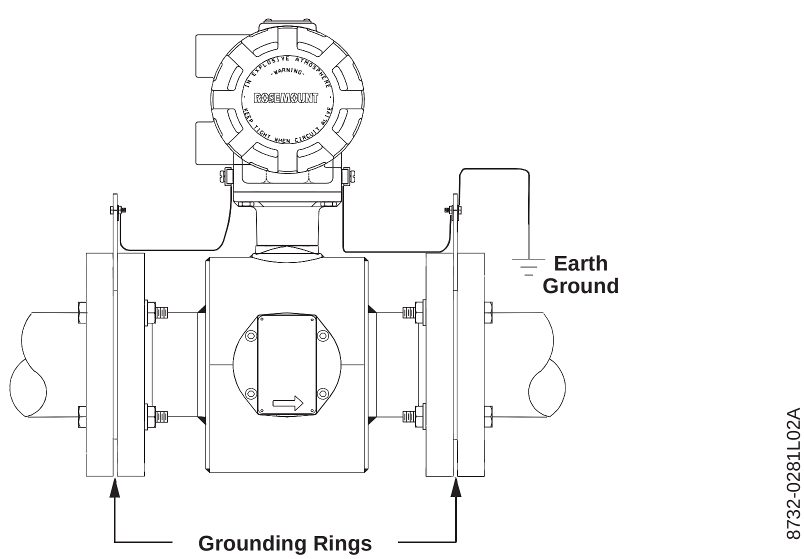
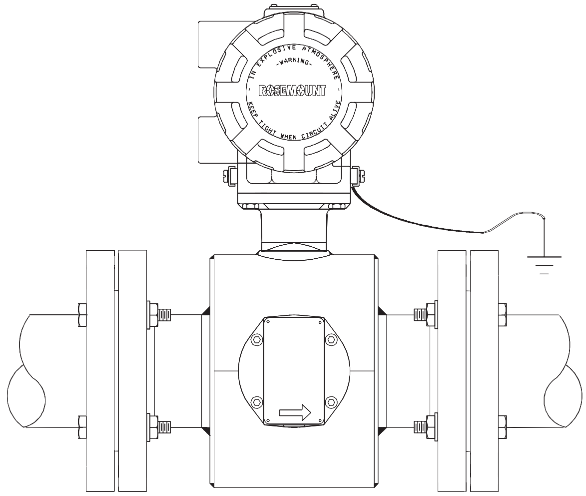


FIGURE 2-19. Model 8705 Grounding for Non-Conductive Pipe with Grounding Electrodes.



Model 8711

Use Table 2-6 to help determine the grounding option required for proper operation.

TABLE 2-6. Model 8711 Grounding Installation.

Type of Pipe	Grounding Options		
	No Grounding Options	Grounding Rings	Grounding Electrodes
Conductive Unlined Pipe	See Figure 2-20	Not Required	Not Required
Conductive Lined Pipe	Insufficient Grounding	See Figure 2-21	See Figure 2-20
Non-conductive Pipe	Insufficient Grounding	See Figure 2-22	See Figure 2-23

FIGURE 2-20. Model 8711 Grounding for Conductive Unlined Pipe and Grounding for Conductive Lined Pipe with Grounding Electrodes.

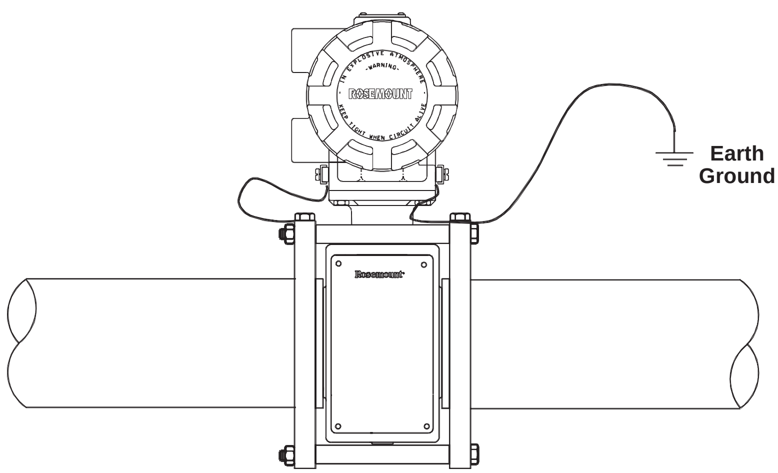


FIGURE 2-21. Model 8711 Grounding for Conductive Lined Pipe with Grounding Rings.

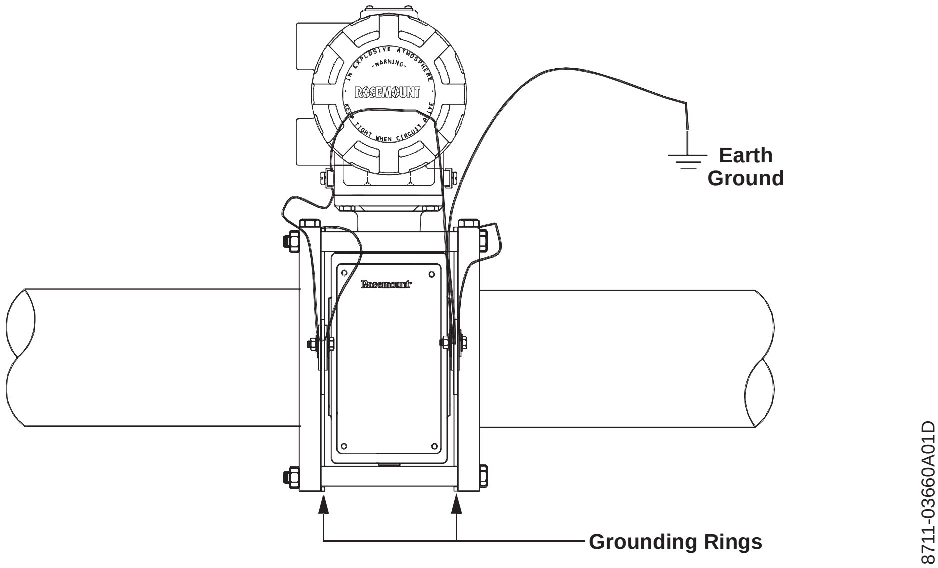


FIGURE 2-22. Model 8711 Grounding for Non-Conductive Pipe with Grounding Rings.

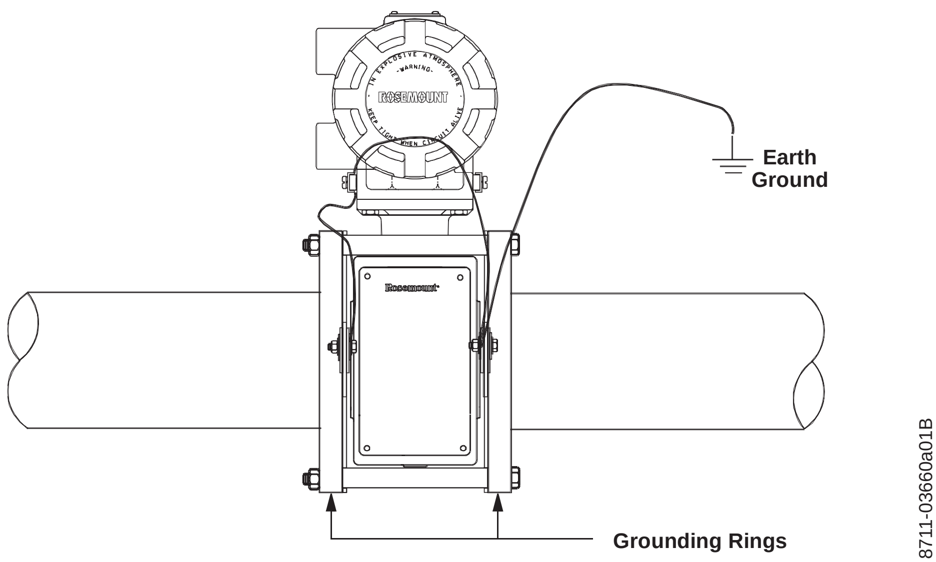
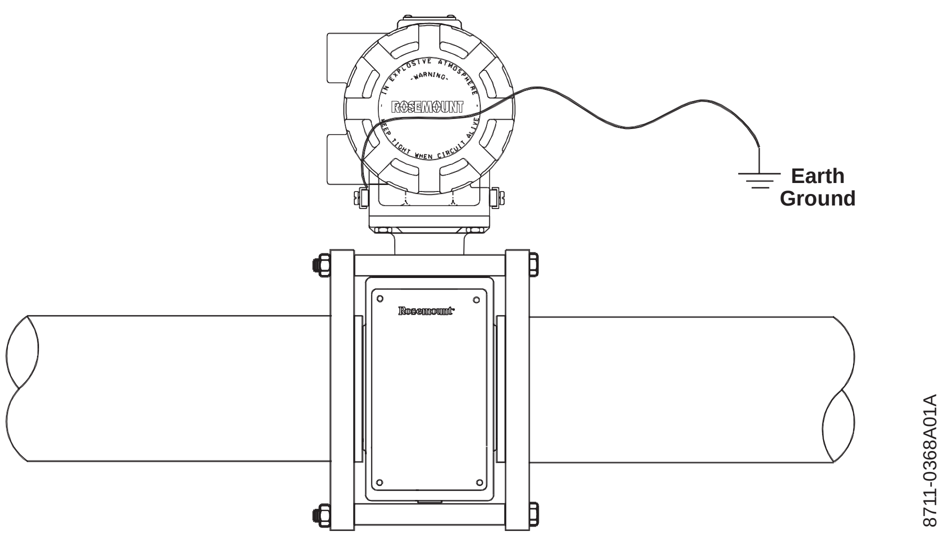


FIGURE 2-23. Model 8711 Grounding for Non-Conductive Pipe with Grounding Electrodes.



Install Conduit

Transmitter junction boxes have ports for ¾-inch NPT conduit connections.

1. Connect the ¾-inch NPT conduit to the transmitter in accordance with local or plant electrical codes.
2. Seal unused ports to prevent moisture or other contamination from entering the junction box.

Do not overtighten metal plugs used to seal wiring compartment ports; overtightening can damage the housing.

Power Connections

To connect power to the transmitter, complete the following steps:

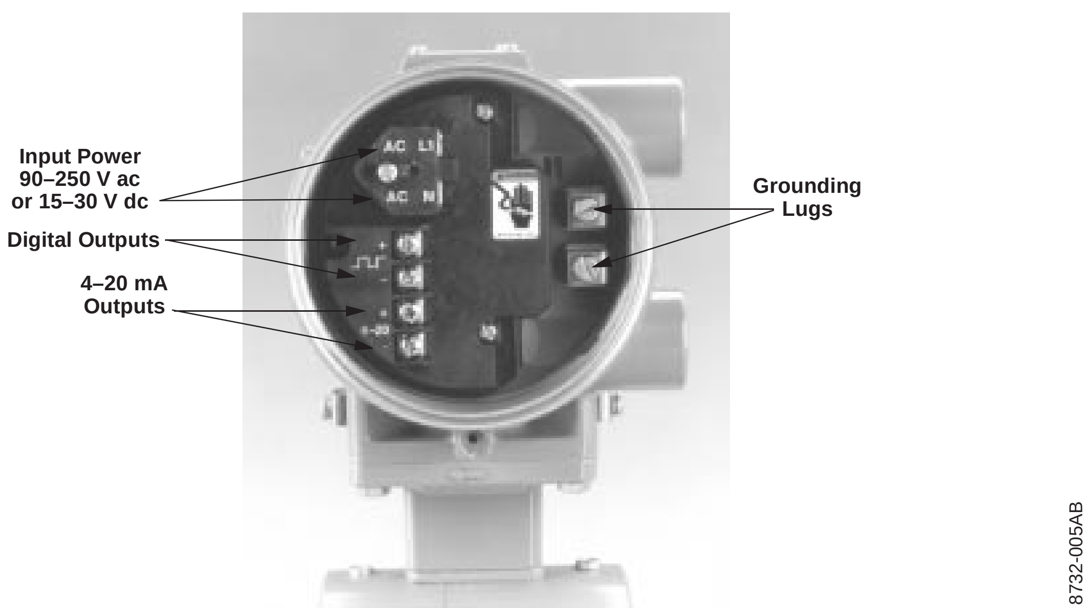
1. Ensure that the power source and connecting cable meet the requirements outlined in **Transmitter Input Power** on page 2-5.
2. Turn off the power source.
3. Open the power terminal cover.
4. Run the power cable through the conduit to the transmitter.
5. Loosen the terminal cable guard for the input power terminals L1 and N or +dc and -dc.
6. Connect the power cable leads as follows:

   For an ac-powered transmitter:
   - Connect ac Ground to a grounding lug.
   - Connect ac Neutral to terminal N.
   - Connect ac Line to terminal L1.

   For a dc-powered transmitter:
   - Connect dc Ground to a grounding lug.
   - Connect + dc.
   - Connect – dc.

The dc-powered transmitter has a different terminal block and different electronics that are not compatible with an ac-powered transmitter.

FIGURE 2-24. Power Connections.



OPTIONS, CONSIDERATIONS, AND PROCEDURES

If your application of the Model 8732C includes an externally powered 4–20 mA loop, auxiliary output control or pulse output, certain requirements may apply in addition to those previously listed. Satisfy these requirements *before* attempting to install and operate the Model 8732C.

Connect 4–20 mA Loop External Power Source

The 4–20 mA output loop is powered either internally or externally.

Internal

The loop may be powered from the transmitter itself. Resistance in the loop must be 1,000 ohms or less. If a HART-based communicator or a distributed control system (DCS) is used, it must be connected across a minimum of 250 ohms resistance in the loop.

External

External power must be supplied if the Model 8732C is to be used in a multidrop installation (see **Multidrop Communications** on page 4-18). A 10–30 V dc power source is required. If a HART-based Communicator or DCS is used, it must be connected across a minimum of 250 ohms resistance in the loop.

If your application uses the external power option for the 4–20 mA loop, complete the following steps to connect the power source to the transmitter:

1. Ensure that the power source and connecting cable meet the requirements outlined above and in **Electrical Considerations** on page 2-5.
2. Turn off the transmitter and analog loop power sources.
3. Run the power cable into the transmitter.
4. Connect – dc to terminal – 4–20 mA.
5. Connect + dc to terminal + 4–20 mA.

FIGURE 2-25. 4–20 mA Loop Power Connections.

8732-005AB

Connect Pulse Output Power Source

The Pulse Output function provides an isolated switch-closure frequency output signal that is proportional to the flow through the flowtube. The signal is normally used in conjunction with an external totalizer or control system. The following requirements apply:

Supply Voltage: *Up to 24 V ac or dc.*
Load Resistance: *100 to 100 k ohms (typical ≈ 1 k).*
Pulse Duration: *0.5 to 100 msec (adjustable).*
Maximum Power: *5.75 watts.*
Switch Closure: *Bi-directional MOFSET.*

If your application uses the pulse output option, complete the following steps to connect the power source to the transmitter:

1. Ensure that the power source and connecting cable meet the requirements outlined above.
2. Turn off the transmitter and pulse output power sources.
3. Run the power cable into the transmitter.
4. Connect the two wires that convey switch closure information to the + and – terminals.

NOTE
If dc power is used, it is preferred to connect – dc to terminal – and + dc to terminal +.

FIGURE 2-26. Pulse or Digital Output Connections.

Connect Auxiliary Output Control

In lieu of pulse output, the auxiliary output control function allows you to externally signal a zero flow or reverse flow condition. The following requirements apply:

Supply Voltage: *Up to 24 V ac or dc.*
Load Resistance: *100 to 100 k ohms (typical ≈ 1 k).*
Pulse Duration: *0.5 to 100 msec (adjustable).*
Maximum Power: *5.75 watts.*
Switch Closure: *Bi-directional MOFSET.*

If your application uses auxiliary output control, complete the following steps to connect the power source to the transmitter:

1. Ensure that the power source and connecting cable meet the requirements outlined above.
2. Turn off the transmitter and pulse output power sources.
3. Run the power cable into the transmitter.
4. Connect the two wires that convey switch closure information to the positive and negative terminals.

NOTE
If dc power is used, it is preferred to connect – dc to terminal – and + dc to terminal +.

QUICK START-UP

Once the magnetic flowmeter system is installed and communication is established, final configuration of the transmitter must be completed. You may perform these functions with the LOI (**Section 3: Local Operator Interface**) or HART Communicator (**Appendix A: HART Communicator**). Specific instructions regarding these functions are provided in **Section 4: Transmitter Functions**.

To initiate a basic flowmeter system start-up, only two parameters are required:

1. Set Units
2. Analog Output Range

If your application of the magnetic flowmeter system involves more advanced functions such as multidrop or pulse output, additional configuration steps may be required to enable full functionality. See **Section 4: Transmitter Functions**.

Installation Check and Guide

Use this guide to check new installations of Rosemount Magnetic Flowmeter Systems that appear to malfunction. For detailed troubleshooting instructions, see **Section 5: Troubleshooting**.

Before You Begin

Be sure that power to your system is off before beginning these checks.

Transmitter

1. Check for correct flowtube calibration number entered in the software. (The calibration number is listed on the flowtube nameplate.)
2. Check for correct flowtube line size entered in the software. (The line size value is listed on the flowtube nameplate.)
3. Check that the analog range of the transmitter matches the analog range in the control system.
4. Check that the forced analog output of the transmitter produces the correct output at the control system.

Flowtube

1. For horizontal flow installations, ensure that the electrodes are in a plane such that they remain covered by process fluid.
2. For vertical or inclined installations, ensure that process fluid is flowing up into the flowtube to keep the electrodes covered by process fluid.
3. Ensure that the grounding straps on the flowtube are connected to grounding rings, lining protectors, or the adjacent pipe flanges. Improper grounding will cause erratic operation of the system.

Process Fluid

1. Process fluid conductivity should be 5 μmhos per centimeter, minimum.
2. Process fluid must be free of air and gasses.
3. Flowtube should be full of process fluid.

PROCESS LEAK PROTECTION (MODEL 8705 ONLY)

The Model 8705 Flowtube housing is fabricated from carbon steel to perform two separate functions in the flowtube design. First, it provides shielding for the flowtube magnetics so that external disturbances cannot interfere with the magnetic field and thus affect the flow measurement.

Second, it provides the physical protection to the coils and other internal components from contamination and physical damage that might occur in the industrial environment. The housing is completely welded, and the joints contain no gaskets; the totally leak-free enclosure protects the internal components, even in the most demanding installations.

Process Leak Containment

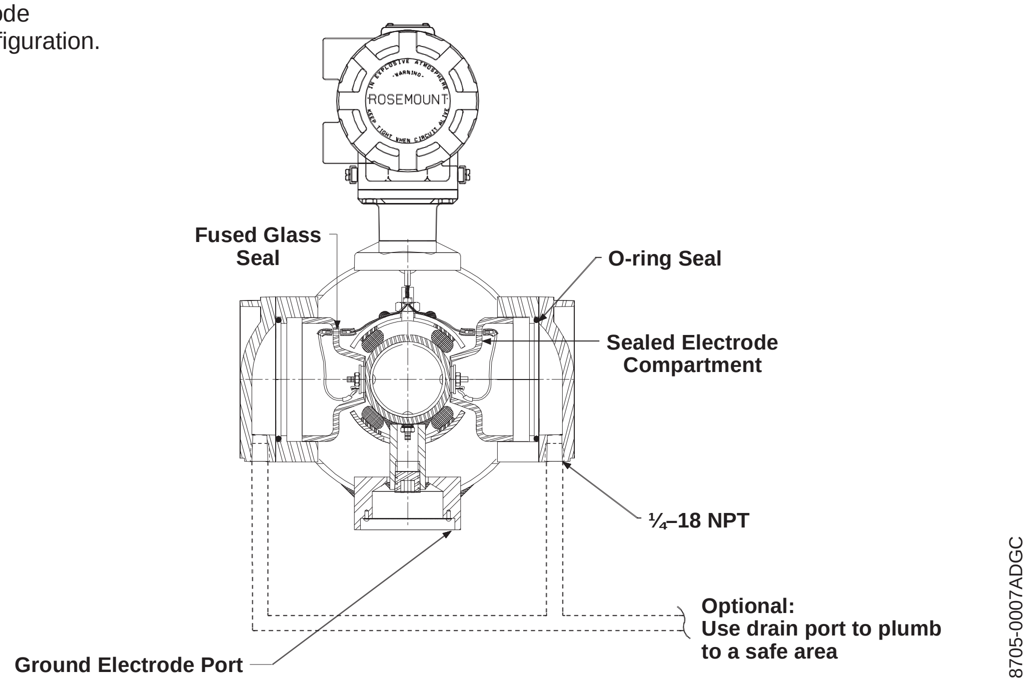
As shown in Figure 2-27, the standard configuration divides the housing into three separate compartments: one for each electrode and one for the coils. The electrodes are separated from the rest of the internal components and the coils.

If a damaged liner allows process fluid to migrate behind the electrode seals, the fluid is contained in the electrode compartment. The sealed electrode compartment prevents the process fluid from entering the coil compartment where it would damage the coils and other internal components.

The electrode compartments are designed to contain the process fluid at full line pressure. An O-ring sealed cover provides access to each of the electrode compartments from outside the flowtube; drainports are provided in each cover for the removal of fluid.

⚠ The electrode compartment could contain full line pressure and it must be depressurized before the cover is removed. Removing the cover before depressurizing may result in death or serious injury.

FIGURE 2-27. Sealed Electrode Compartment–Standard Configuration.



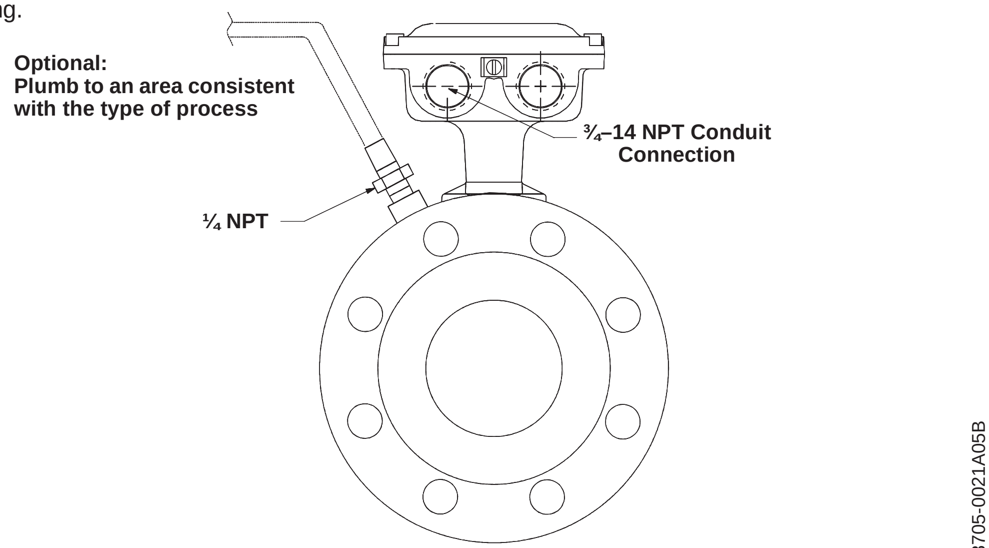
If it is necessary to capture any process fluid leakage for fugitive emission control, connect the appropriate piping to the drainports and provide for proper disposal as shown in Figure 2-27.

The second configuration uses a completely welded coil housing but does not provide the separate electrode compartment or external electrode access of the standard construction. This housing configuration is identified by a “W1” in the option code of the model number.

Relief Valves

Housing configuration “W1” provides a relief valve in the housing to prevent possible overpressuring caused by damage to the lining or other situations that might allow process pressure to enter the housing. The relief valve will vent when the pressure inside the flowtube housing exceeds 5 psi. Additional piping (provided by the user) may be connected to this relief valve to drain any process leakage to safe containment (see Figure 2-28). In the event of a process leak, these models will not protect the coils or other sensitive areas of the flowtube from exposure to the pressure fluid.

FIGURE 2-28. Relief Valve Venting.



Field-Removable Electrodes

The field-removable electrode option allows the user to remove the electrode assembly with the flowtube still mounted in the line. Frequently, this option will be used for cleaning the electrode head when coating is of concern.

The flowtube should be drained of any process fluid prior to disassembly of electrodes. Care should be taken when handling products, or electrodes having been in contact with products of a corrosive nature, to avoid personal injury. Take care to avoid rotating the electrode when removing it to avoid leakage. Some resistance may be experienced due to the tight o-ring fit.

Remove the Electrode Assembly

Use the following procedure to remove the electrode assembly from the flowtube.

1. Loosen and remove the screws that secure the electrode cover.
2. Remove the electrode cover and o-rings. *It is generally recommended that new o-rings be installed upon reassembly.*
3. Loosen and remove the screw that secures the signal wire to the electrode.
4. Remove the retaining nut.
5. Take the electrode from the electrode housing by pulling it out, with firm pressure, along the axis of the electrode.

Replace the Electrode Assembly

Use the following procedure to replace the electrode assembly into the flowtube.

1. Lubricate the o-rings.
2. Install the o-rings on the electrode.
3. Insert the electrode assembly into the electrode housing.
4. Secure the electrode into the housing with the retaining nut. Tighten the retaining nut to 15 in/oz of torque.
5. Secure the signal wire to the electrode with a screw.
6. Install the o-rings into the electrode cover.
7. Secure the electrode cover to the flowtube with the screws.

Section 3

Local Operator Interface

THE LOCAL OPERATOR INTERFACE (LOI)

The LOI option is an operator communications center for the Model 8732C. Through the LOI, the operator can access any transmitter function for changing configuration parameter settings, checking totalized values, or other functions.

SAFETY MESSAGES

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

⚠WARNING

Explosions could result in death or serious injury:

- Verify that the operating atmosphere of the flowtube and transmitter is consistent with the appropriate hazardous locations certifications.
- Do not remove the transmitter cover in explosive atmospheres when the circuit is alive.
- Both transmitter covers must be fully engaged to meet explosion-proof requirements.

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

- Make sure only qualified personnel perform these procedures.
- Do not perform any service other than those contained in this manual unless qualified.

⚠WARNING

High voltage that may be present on leads could cause electrical shock:

- Avoid contact with leads and terminals.

LOI Features

The LOI option contains a two-line, 16-character liquid crystal display (LCD) that is back-lit and visible from any angle. This display uses optical switches that reliably detect the touch of a finger on the LOI glass. Because the switches are completely enclosed, they will not be affected by the process environment.

A red light emitting diode (LED) on the display illuminates whenever an optical switch is activated providing positive operator feedback and guarding against accidental configuration changes. Table 3-1 lists and details the functions of the LOI keys.

FIGURE 3-1. Model 8732C Local Operator Interface.

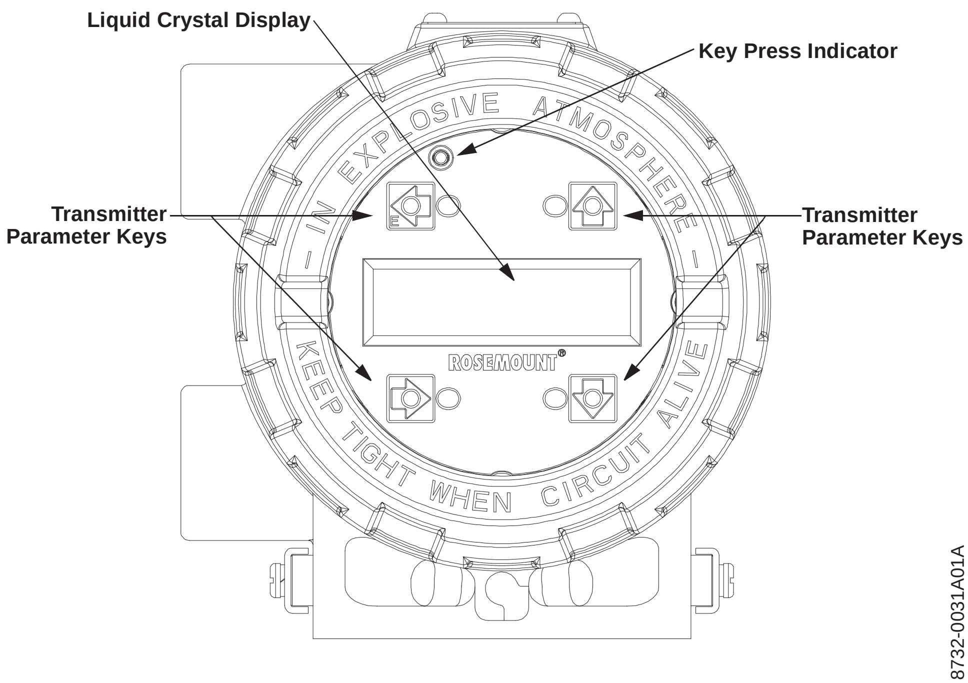


TABLE 3-1. LOI Keys and Functions.

LOI Key	Function Performed
E ←	Enter. Moves to the previous display field. Starts the totalizing function if it is stopped, and stops the function if it is running.
↑	Moves the cursor to the next higher field. Changes user-selected variables in a field to next higher value. Changes parameters on a predefined list.
↓	Moves the cursor to the next lower field. Changes user-selected variables in a field to next lower value. Changes parameters on a predefined list.
→	Enters a specific field on the LOI. Moves cursor to next user-selected variable. Changes parameters on a predefined list. Aborts a chosen operation. Stops the totalizing display (totalizing function continues to run). Resets the net totalizing display after the display is stopped.

LOI Rotation

Each magnetic flowmeter installation is different from application to application; therefore, the LOI display can be rotated to accommodate various setups using the following procedure:

1. Remove power from the transmitter.
2. Unscrew and remove the LOI cover. Do not remove the cover in explosive atmospheres when the circuit is alive.
3. Unfasten the 2 screws that attach the LOI assembly to the main circuit assembly.
4. Carefully remove the LOI assembly by pulling it away from the transmitter.
5. Remove the pin assembly from the back of the LOI.
6. Insert the short end of the pin assembly into the circuit board connector J201. Ensure that all pins are engaged.
7. Position the LOI in a preferred 90° rotation and carefully press LOI into the pin assembly.

NOTE
Misalignment may cause permanent pin damage.

8. Fasten the two screws that attach the LOI to the main circuit assembly.
9. Replace the LOI cover.

Data Entry

The LOI keypad has no numerical keys. Enter numerical data using the following procedure:

1. Access the appropriate function.
2. Use → to highlight the digit you want to enter or change.
3. Use ↑ or ↓ to change the highlighted value.

   For numerical data, ↑ or ↓ toggles through the digits **0–9**, **decimal point**, **dash**, and **blank**.

   For alphabetical data, they toggle through the letters of the alphabet **A–Z**, digits **0–9**, and the symbols **&**, **+**, **–**, *****, **/**, **$**, **@**, **%,** and the **blank space**.

   (↑ or ↓ is also used to toggle through pre-determined choices that do not require data entry.)
4. Use → to highlight and change other digits you want to change.
5. Press **E**← when the desired choice is displayed on the screen.

LOI EXAMPLES

Use the *Transmitter Parameter* keys shown in Figure 3-1 to change the parameters. The parameters are set in one of two ways: Table Value and Select Value.

Table Values

Parameters that are available from a predefined list, such as units.

Select Values

Parameters that consist of a user-created number or character string, such as a calibration number. Values are entered one character at a time using the data entry keys.

Table Value Example

Setting the TUBE SIZE:

1. Access the tube size through basic setup.
2. Press ↑ or ↓ to increment the tube size to the next value.
3. When you reach the desired size, press **E**←.
4. Set the loop to manual if necessary, and press **E**← again.

After a moment, the LCD will display the new tube size and the maximum flow rate.

Select Value Example

Changing the UPPER RANGE VALUE (URV):

1. Access the URV through basic setup.
2. Press → to position the cursor.
3. Press ↑ or ↓ to set the number.
4. Repeat steps 2 and 3 until the desired number is displayed.
5. Press **E**←.

LOI SCREEN FLOW

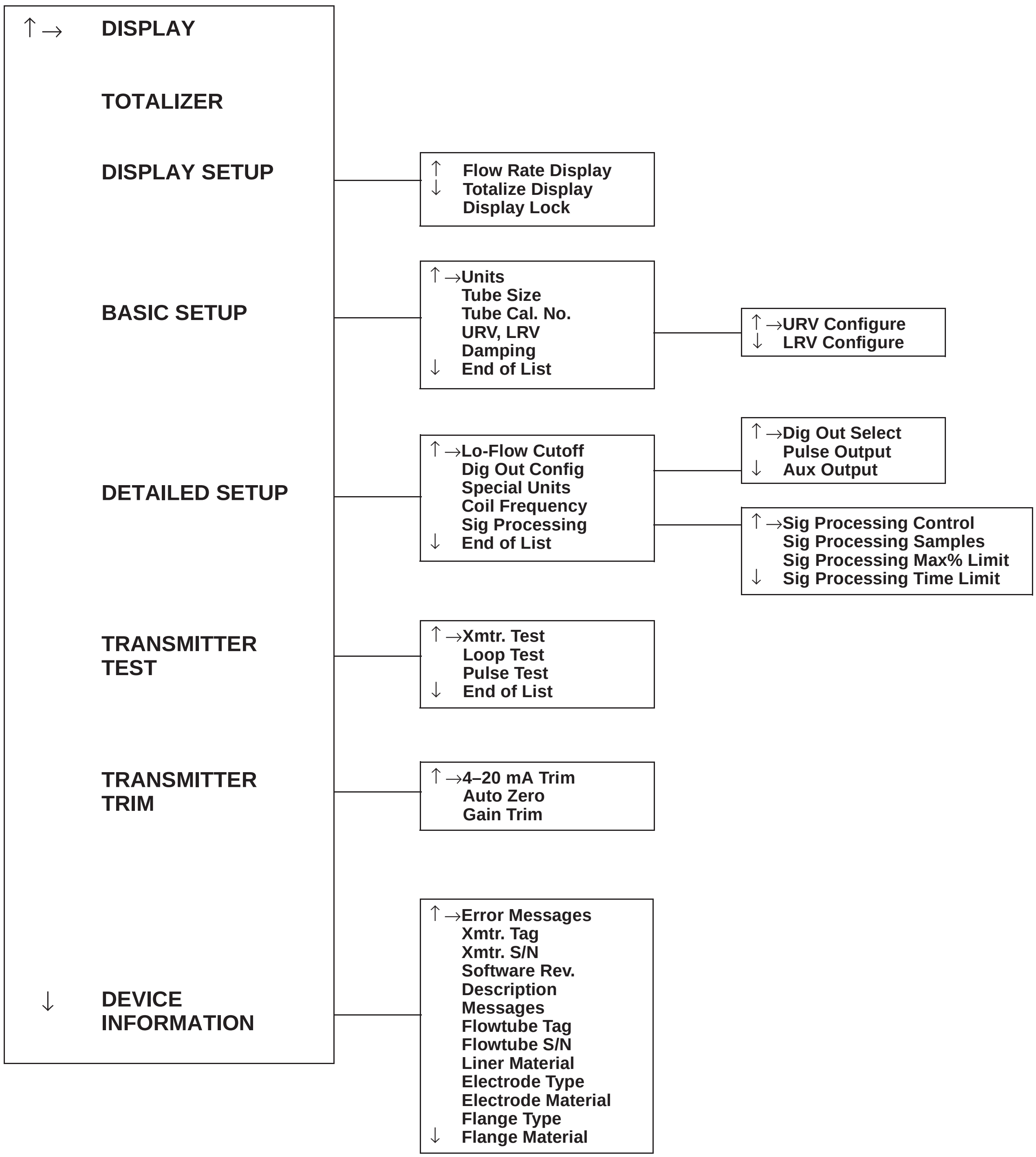


TABLE 3-2. LOI Display and Functions.

LOI Display	Transmitter Function
Display Setup	Display Lock .... Locks out configuration changes (including totalizer start/stop/reset) from being made via the LOI. A DL indicator will show on the main flow rate screen. All values can still be viewed. Flow Rate Display........... User-selected settings for transmitter flow indication: Flow-% Span, Flow-Totalize, %Span-Totalize. Totalize Display............... User-selected settings for transmitter totalizer indication: Forward-Reverse, Net-Gross.
Basic Setup	Units:.................................. Specifies the desired units: Gal/Min, Lit/Min, IG/Min, CuM/Hr, Ft/Sec, M/Sec, Lit/sec, Special. Tube Size........................ Specifies the flowtube size (0.15 through 60 inches) and identifies the corresponding maximum flow. Tube Cal No. .... Identifies the flowtube calibration number. URV, LRV........................ Sets the desired 20 mA (Upper Range Value) and 4 mA (Lower Range Value) points. Flowtube size must be set first. Damping .... Sets response time, in seconds, to a step change in flow.
Detailed Set-up	Lo-Flow Cutoff................. Determines the flow rate at which the transmitter indicates an output of zero flow and 4 mA. Dig Out Config .... Selects pulse or auxiliary outputs, set pulse scaling and width, and select an auxiliary output (zero or reverse flow). Special Units................... Specifies input base unit, conversion, and time base for special units. Coil Frequency................ Specifies coil drive frequency of 6 or 30 Hz. Sig Processing................ Specifies signal processing status (on/off) and sets signal processing parameters.
Transmitter Test	XMTR Test .... Performs a test of the transmitter electronics. Loop Test .... Drives the transmitter analog output to a user-specified value. Pulse Test .... Drives the transmitter digital output to a user-specified value.
Transmitter Trim	4–20 mA Trim .... Adjusts the 4–20 mA Output. Auto Zero .... Performs flowtube zero for 30 Hz operation. Gain Trim .... Performs a calibration of the transmitter.
Device Information	Permits viewing and changing useful information about the transmitter and flowtube.

DIAGNOSTIC MESSAGES

The following error messages appear on the LOI screen when a diagnostic error is detected. To correct the problem, complete the steps as indicated. If the problem persists, contact your sales or service representative.

TABLE 3-3. LOI Error Messages.

Symptom	Potential Cause	Corrective Action
"Empty Pipe" displayed	Empty pipe.	None. Message will clear when pipe is full.
	Electrode failure.	Perform flowtube tests C and D on page 5-5.
	Conductivity less than 5 μmho per cm.	Increase conductivity to $\geq$ 5 μmho per cm.
"Coil Open Ckt" displayed.	Damaged coils.	Check flowtube coils. Perform flowtube Test A–Flowtube Coil on page 5-5.
	Electronics failure.	Replace Model 8732C electronics.
Flowtube will not Autozero ("Autozero Failure" can be cleared by cycling power).	Flow is not set to zero.	Force flow to zero, re-perform autozero.
LOI is blank.	Model 8732C is ranged improperly.	Correct ranging with HART-based Communicator.
	LOI failure.	Replace LOI.
	Electronics failure.	Replace electronics.
LOI blinks, scrolls, or displays scrambled letters.	Unit experienced large transient.	Recycle power. If problem persists replace electronics.
LOI does not respond to key press.	LOI failure.	Replace LOI. Use the HART Communicator in the interim.
	Electronics failure.	Replace the electronics.
	LOI Glass is dirty.	Clean the LOI glass.

Section **4**

Transmitter Functions

INTRODUCTION

The Model 8732C features a full range of software functions for configuration of output from the transmitter. Software functions are accessed through the LOI (see **Section 3: Local Operator Interface**), a HART-based communicator (see **Appendix A: HART Communicator**), or a control system. Configuration variables may be changed at any time, and specific instructions are provided through on-screen instructions.

SAFETY MESSAGES

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

⚠WARNING

Explosions could result in death or serious injury:

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

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

- Make sure only qualified personnel perform these procedures.
- Do not perform any service other than those contained in this manual unless qualified.

⚠WARNING

High voltage that may be present on leads could cause electrical shock:

- Avoid contact with leads and terminals.

REVIEW VARIABLES

Before operating the Model 8732C in an actual installation, review all of the factory set configuration data to ensure that they reflect the current application.

Review

HART Fast Keys	1, 5

Review the flowmeter configuration parameters set at the factory to ensure accuracy and compatibility with your particular application of the flowmeter.

NOTE
If you are using the LOI to review variables, each variable must be accessed as if you were going to change its setting. The value displayed on the LOI screen is the configured value of the variable.

If you need to make any changes to flowmeter configuration data, see **Basic Configuration** on page 4-4 for additional information.

CHECK OUTPUT VARIABLES

Next, check the transmitter output. Model 8732C digital outputs include: flow rate (PV), pulse output, measure gross total, measure net total, and measure reverse total. The settings should be reviewed to ensure that the flowmeter is operating properly.

Process Variables

HART Fast Keys	1, 1
LOI	Display Setup

The **Process Variables** for the Model 8732C provide the flowmeter output. They measure flow in several ways that reflect your needs and the configuration of your flowmeter.

When commissioning a flowmeter, review each process variable, its function, and output. If you suspect a problem with the digital outputs, you may need to reconfigure the transmitter or check the troubleshooting table in **Section 5: Troubleshooting**.

PV – **Process Variable** is the actual configured flow rate in the line. On the bench, the PV value should be zero. Check the units on the PV to make sure they are configured correctly. If the units format is not correct, see **Units** on page 4-4.

Puls Out – **Pulse Output** provides the actual pulse reading from the meter if your transmitter is configured for pulse output.

Measure gross totl – **Measure Gross Total** provides a reading of the total forward flow since the totalizer was last reset. The totalizer value should be zero during commissioning on the bench, and the units should reflect the volume units of the flow rate. If the totalizer value is not zero, it may need to be reset (see **Totalizer Display** on page 4-11).

Measure net totl – **Measure Net Total** provides a reading of the net totalized flow in the forward direction. The net totalize value can be reset using the HART Communicator (1, 1, 4, 6) or the LOI.

Measure reverse totl – **Measure Reverse Total** provides a reading of the total flow of process fluid in the reverse direction.

BASIC CONFIGURATION

The basic configuration functions of the Model 8732C must be set for all applications of the transmitter in a magnetic flowmeter system. If your application requires the advanced functionality features of the Model 8732C, see **Special Units Configuration** on page 4-5.

Units

HART Fast Keys	1, 3, 2
LOI	Basic Setup

Units variable specifies the format in which the flow rate will be displayed. Units should be selected to meet your particular metering needs. The choices are shown below:

Choices

• Gal/Min	• Ft/Sec
• Liters/Min	• Meters/Sec
• ImpGal/Min	• Liters/Sec
• CuMeter/Min	• Special

The maximum flow rate information is not updated as the available units appear, but only after the data are entered. The maximum flow rate on the second line of the display is for informational purposes, and cannot be changed directly by the user.

If the transmitter is totalizing, the numerator of the unit of measure is used by the transmitter as the volumetric unit for totalization and pulse output scaling. For example, if gal/min is selected, the Model 8732C totalizes and provides a pulse output in gallons.

Line Size

HART Fast Keys	1, 3, 5
LOI	Basic Setup

Line Size (tube size) must be set to match the actual flowtube connected to the transmitter. The size is set at the factory before the flowtube is shipped. If a value is entered from a control system or HART Communicator that does not match one of these figures, the value will be rounded to match the nearest choice.

The tube size choices available are as follows:

0.15, 0.30, 0.50, 1, 1.5, 2, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, 36, 42, 48, 54, 60 (inches).

NOTE
The second line on the LOI screen, **MAX FLOW**, is strictly for informational purposes and indicates the maximum flow rate for a given line size.

Tube Cal. Number

HART Fast Keys	1, 3, 6
LOI	Basic Setup

The tube calibration number is a 16-digit number used to identify flowtubes calibrated at the Rosemount factory. It provides detailed calibration information to the Model 8732C. This number is set at the factory before the flowmeter is shipped.

Upper Range Value

HART Fast Keys	1, 3, 3
LOI	Basic Setup

Upper Range Value (URV) is preset to 30 ft/s at the factory. The units that appear will be the same as those selected under the units parameter.

The URV (20 mA point) can be set for any forward or reverse flow rate. Flow in the forward direction is represented by positive values; flow in the reverse direction is represented by negative values. The URV can be any value from –30 ft/s to +30 ft/s, as long as it is at least 1 ft/s from the Lower Range Value (LRV)(4 mA point). The URV can also be set to a value less than the LRV, which would cause the transmitter analog output to operate in reverse, with the electrical current increasing for lower (or more negative) flow rates.

SPECIAL UNITS CONFIGURATION

The Model 8732C provides a selection of standard units configurations that meet the needs of most applications (see **Units** on page 4-4). If, however, your application has special needs and the standard configurations do not apply, the Model 8732C provides the flexibility to configure the transmitter in a custom-designed units format.

NOTE
For flowtubes larger than 36 inches (900 mm), line size must be selected prior to configuration of special units. If special units are configured first, the communication interface may not display the correct flow rate.

To configure a special unit, set values for each function listed below.

Volume Unit

HART Fast Keys	1, 3, 2, 2, 4
LOI	Detailed Setup

Volume Units enables you to display the volume unit format to which you have converted the base volume units. For example, if the special units are abc/min, the special volume variable is abc. This variable is also used in totalizing the special units flow.

Base Volume Unit

HART Fast Keys	1, 3, 2, 2, 1
LOI	Detailed Setup

Base Volume Unit is the unit from which the conversion is being made. Set this variable to the appropriate option.

Conversion Number

HART Fast Keys	1, 3, 2, 2, 3
LOI	Detailed Setup

Conversion Number is used to convert 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 you are converting from gallons to barrels and there are 31 gallons in a barrel, the conversion factor is 31.

Base Time Unit

HART Fast Keys	1, 3, 2, 2, 2
LOI	Detailed Setup

Base Time Unit provides the time unit from which to calculate the special units. For example, if your special units is a volume per minute, select minutes.

Flow Rate Unit

HART Fast Keys	1, 3, 2, 2, 5
LOI	Detailed Setup

Flow Rate Unit is a format variable that provides a record of the units to which you are converting. The HART Communicator and Model 8732C will display a special units designator as the units format for your primary variable. The actual special units setting you define will not appear. There are four characters available to store the new units designation.

Example

Suppose you work for a brewery, and want the Model 8732C to display flow in barrels per hour. One barrel of beer is equal to 31.0 gallons. You would set the following:

Volume Unit = *BARL*.
Base Volume Unit = *Gallons*.
Input Conversion Number = *31*.
Time Base = *Hour*.
Rate Unit = *BR/H*.

ANALOG OUTPUT CONFIGURATION

The standard 4–20 mA analog output can be configured to meet the special requirements of your application. In the standard configuration, a 4 mA output (LRV) corresponds to 0.0 ft/s in the line, while a 20 mA output (URV) corresponds to a maximum flow of 30 ft/s. The 4 and 20 mA output points can be changed to any value between –30 ft/s and 30 ft/s. The minimum allowable range between them is 1 ft/s.

Upper Range Value (URV)

HART Fast Keys	1, 3, 3
LOI	Basic Setup

Reset the **Upper Range Value** (URV) to change the size of the range (or span) between the URV and LRV. Under normal circumstances, the URV should be set to a value near the maximum expected flow rate and must be between –30 ft/s to 30 ft/s.

NOTE
The minimum span between the analog output range (URV) and analog output zero (LRV) is 1 ft/s.

Lower Range Value (LRV)

HART Fast Keys	1, 3, 4
LOI	Basic Setup

Reset the **Lower Range Value** (LRV) to change the size of the range (or span) between the URV and LRV. Under normal circumstances, the LRV should be set to a value near the minimum expected flow rate to maximize resolution. LRV must be between –30 ft/s to 30 ft/s.

NOTE
The LRV can be set to a value greater than the URV, which will cause the analog output to operate in reverse. In this mode, the analog output will increase with lower (more negative) flow rates.

Example

If the URV is greater than the LRV, the analog output becomes 3.9 mA when the flow rate falls below the selected 4 mA point.

If the URV is less than the LRV, the analog output becomes 3.9 mA when the flow rate rises above the selected 4 mA point.

The minimum allowable span between the URV and LRV is 1 ft/s. Do not set the LRV within 1 ft/s of the 20 mA point. For example, if the URV is set to 15.67 ft/s and if the desired URV is greater than the LRV, then the highest allowable LRV would be 14.67 ft/s. If the desired URV is less than the LRV, then the lowest allowable analog zero setting would be 16.67 ft/s.

4–20 mA Output Trim

HART Fast Keys	1, 2, 4, 1
LOI	Transmitter Trim

For maximum accuracy, the analog output should be calibrated and, if necessary, trimmed for your system loop. The **4–20 mA Output Trim** procedure alters the conversion of the digital signal into an analog 4–20 mA output.

Use the following steps to complete this function.

1. Set the loop to manual, if necessary.
2. Connect a precision ammeter to the 4–20 mA loop.
3. Initiate the Output Trim function with the LOI or HART Communicator.
4. Enter the 4 mA meter value when prompted to do so.
5. Enter the 20 mA meter value when prompted to do so.
6. Return the loop to automatic control, if necessary.

The 4–20 mA trim is now complete. You may repeat the 4–20 mA trim to check the results, or use the analog output test.

Loop Test

HART Fast Keys	1, 2, 2
LOI	Transmitter Test

The **Loop Test** allows you to drive the transmitter output to a desired electric current output on the 4–20 mA terminals. This capability allows you to check the entire current loop prior to start-up. The test will terminate after five minutes if the transmitter is not returned to normal operation manually.

DIGITAL OUTPUT

Pulse Output Scaling equates one transistor switch closure pulse to a selectable number of volume units. The volume unit used for scaling pulse output is taken from the numerator of the configured flow units. For example, if gal/min had been chosen when selecting the flow rate unit, the volume unit displayed would be gallons.

NOTE
The scaled pulse output is designed to operate between 0 and 1000 Hz. The electronics will not accept a conversion factor that would result in a pulse frequency outside that range. The minimum conversion factor value is found by dividing the upper range value (in units of volume per second) by 1000 Hz.

When selecting pulse output scaling, remember that the maximum pulse rate is 1000 Hz. With the 110 percent overrange capability, the absolute limit is 1100 Hz. For example, if you want the Model 8732C to pulse every time 0.01 gallons pass through the flowtube, and the flow rate is 1000 gal/min, you will exceed the 1000 Hz full-scale limit:

$$\frac{1000 \text{ gal/min}}{60 \text{ sec/min} \times 0.01 \text{ gal/pulse}} = 1666.65 \text{ Hz}$$

The best choice for this parameter depends upon the required resolution, the number of digits in the totalizer, the extent of range required, and the maximum counter input frequency.

NOTE
When totalizing on the LOI, the maximum total value is 1,000,000,000.

Auxiliary Output Control

HART Fast Keys	1, 4, 3, 2
LOI	Detailed Setup

In lieu of the pulse output on the digital terminals, an **Auxiliary Output Control** is available to indicate a reverse flow or zero flow condition. The two terminals are actually a transistor switch closure, which must be externally powered.

Reverse Flow Enable

This choice activates the switch closure with a reverse flow. A forward flow is defined by the flow direction arrow on the flowtube. This also enables the totalizer to count in the reverse direction.

No Flow Enable

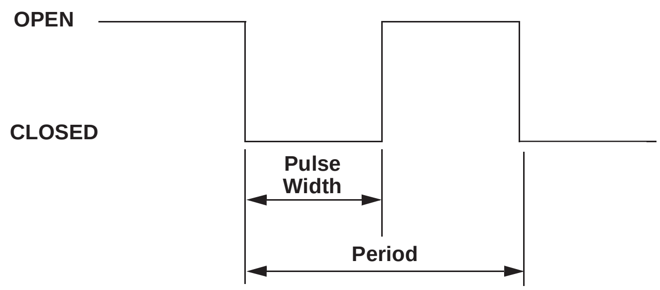
This choice activates the switch closure whenever the flow rate drops below the low flow cutoff.

Pulse Width

HART Fast Keys	1, 4, 3, 3, 2
LOI	Detailed Setup

Pulse Width, or duration, of the frequency output pulse can be adjusted to match the requirements of different counters or controllers (See Figure 4-1). The pulse width adjusts the time that the switch is closed.

FIGURE 4-1. Pulse Output.



Example

For example, if pulse width is set to 100 ms, the maximum output is 5 Hz; for a pulse width of 0.5 ms, the maximum output would be 1000 Hz. (At the maximum frequency output there is a 50 percent duty cycle.)

PULSE WIDTH	MINIMUM PERIOD (50% duty cycle)	MAXIMUM FREQUENCY
100 ms	200 ms	$\frac{\text{1 Cycle}}{\text{200 ms}} = \text{5 Hz}$
0.5 ms	1.0 ms	$\frac{\text{1 Cycle}}{\text{1.0 ms}} = \text{1000 Hz}$

To achieve the greatest maximum frequency output, set the pulse width to the lowest value that is consistent with the requirements of the pulse output power source, pulse driven external totalizer, or other peripheral equipment.

Example

The external counter is ranged for 350 gpm. You want to set 1 pulse for every gallon of flow. What is the maximum frequency output? (Assume the pulse width = 0.5 ms.)

$$\text{Frequency} = \frac{\text{Flow Rate (gpm)}}{\text{(60 s/min)(Pulse Scaling gal/pulse)}}$$

$$= \frac{\text{350 gpm}}{\text{(60 s/min)(1 gal/pulse)}}$$

$$= \text{5.833 Hz}$$

Example

Set the pulse output scaling to get the most accurate reading from the totalizer (highest resolution). The 20 mA point = 3,000 gpm.
(Hint: Range 1000 Hz to full scale analog reading.)

$$\text{Pulse Scaling} = \frac{\text{Flow Rate (gpm)}}{\text{(60 s/min)(Frequency)}}$$

$$= \frac{\text{3000 gpm}}{\text{(60 s/min)(1000Hz)}}$$

$$= \text{0.05 gal/pulse}$$

$$\text{1 Pulse} = \text{0.05 gallon}$$

TOTALIZER CONFIGURATION

The totalizer tracks total flow in the process line. You can start, stop, or reset the totalizer as well as configure it to present the data specific to your application on the LOI display.

Totalizer Display

HART Fast Keys	1, 1, 4
LOI	Display Setup

On the LOI, the **Totalizer Display** allows you to choose the desired format for indicating the totalized values. You may choose either forward-reverse or net-gross for displaying totalized values.
On the HART Communicator, Gross, Net, and Reverse values are always available.

Forward-Reverse

Forward-Reverse shows both the forward and reverse totalized values, updating continuously. You must choose *reverse flow enable* to allow totalizing in the reverse direction.

These values cannot be reset by using the totalizer reset button. Reset them by doing one of the following:

- Change the pulse scaling.
- Change the tube size.
- Change the units.
- Power down a transmitter that is not equipped with the non-volatile totalizer option.

Net-Gross

Net-Gross shows both net and gross total values. It updates continuously. The net value can be reset by the operator. The gross value cannot be reset by using the → button. Reset it indirectly by doing one of the following:

- Change the pulse scaling.
- Change the tube size.
- Change the units.
- Power down a transmitter that is not equipped with the non-volatile totalizer option.

To prevent an operator from accidentally resetting the gross value, the *Software Protect* jumper on the electronics board should be in the ON position. This action does not block the functions of the **E** ← and → buttons for starting and stopping or reading and resetting the totals.

Example

If you had a batch-type process, you would use the net value to measure each batch and then have the operator reset it. In addition, the gross value would keep track of a period of production (e.g., eight hour shift, day, week, month). The gross value could be reset by cycling power to the unit (if not equipped with a backed totalizer battery) or changing one of the parameters described above.

NOISE REDUCTION

Damping

HART Fast Keys	1, 3, 7
LOI	Basic Setup

Damping allows selection of a response time, in seconds, to a step change in flow rate. It is most often used to smooth fluctuations in output.

Coil Frequency

HART Fast Keys	1, 4, 4, 3
LOI	Detailed Setup

Coil Frequency allows pulse-rate selection of the flowtube coils.

6 Hz

The standard coil pulse mode is 6 Hz, which is sufficient for nearly all applications.

30 Hz

If the process fluid causes a noisy or unstable output, increase the coil pulse mode to 30 Hz. If the 30 Hz mode is selected, perform the Auto Zero function as shown below.

Auto Zero

HART Fast Keys	1, 2, 4, 4
LOI	Transmitter Trim

Auto Zero initializes the transmitter for use with the 30 Hz coil drive mode only. Run this function only with the transmitter and flowtube installed in the process. The flowtube must be filled with process fluid at zero flow. Before running the auto zero function, be sure the coil drive mode is set to 30 Hz.

Set the loop to manual if necessary. Then, begin the auto zero procedure. The transmitter completes the procedure automatically in about two minutes. A symbol appears in the lower right-hand corner of the display to indicate that the procedure is running.

Low Flow Cutoff

HART Fast Keys	1, 4, 4, 1
LOI	Detailed Setup

Low Flow Cutoff allows you to specify the flow rate, between 0.001 and 1.0 foot per second, below which the outputs are driven to zero flow. The units format for low flow cutoff cannot be changed. It is always displayed as feet per second regardless of the format selected. The low cutoff value applies to both forward and reverse flows.

Signal Processing

HART Fast Keys	1, 4, 4
LOI	Detailed Setup

Signal Processing is a software algorithm that examines the quality of the electrode signal against user-specified tolerances. If spurious noise spikes are detected, they are automatically rejected. There are three parameters associated with this function:

- Number of samples (0 to 125)
- Maximum percent limit (0 to 100 percent of running average)
- Time limit (0 to 256 seconds)

Signal Processing Control

HART Fast Keys	1, 4, 4, 4
LOI	Detailed Setup

Signal Processing Control — On/Off

When ON is selected, the Model 8732C output is derived using a running average of the individual flow inputs. This average is updated at the rate of 12 samples per second regardless of the selected coil drive mode. The three parameters that make up **Signal Processing Control**: *Number of samples, maximum percent limit, and time limit*. They are described individually below.

Number of Samples

HART Fast Keys	1, 4, 4, 5
LOI	Detailed Setup

0 to 125 Samples

The number of samples function sets the number of previous inputs used to calculate the average value. Because the output stage of the Model 8732C circuit is updated twelve times each second, regardless of 6 or 30 Hz coil drive mode, the factory preset value of 90 samples equates to 7.5 seconds. For example, if you select a sample number of 120, the response time of the system will be 10 seconds (120 samples ÷ 12 samples per second). A suggested nominal number of 90 samples is a good starting point for most applicable process fluids.

Maximum Percent Limit

HART Fast Keys	1, 4, 4, 6
LOI	Detailed Setup

0 to 100 Percent

The maximum percent limit is a tolerance band set up on either side of the running average. The percentage value refers to deviation from the running average. For example, if the running average is 100 gal/min, and a 2 percent maximum limit is selected, then the acceptable range is from 98 to 102 gal/min.

Values within the limit are accepted while values outside the limit are analyzed to determine if they are a noise spike or an actual flow change.

Time Limit

HART Fast Keys	1, 4, 4, 7
LOI	Detailed Setup

0 to 256 Seconds

This parameter forces the output and running average values to the new value of an actual flow rate change that is outside the percent limit boundaries. It thereby limits response time to flow changes to the time limit value rather than the length of the running average.

For example, if the number of samples selected is 120, then the response time of the system is 10 seconds. In some cases this may be unacceptable. By setting the time limit, you can force the Model 8732C to clear the value of the running average and re-establish the output and average at the new flow rate once the time limit has elapsed. This parameter limits the response time added to the loop. A suggested time limit value of 2 seconds is a good starting point for most applicable process fluids. The selected signal processing configuration may be turned ON or OFF to suit your needs.

CALIBRATION

Gain (Electronics) Trim

HART Fast Keys	1, 2, 4, 3
LOI	Transmitter Trim

The Model 8732C offers the calibration functions described below.

Gain Trim is the function by which the factory calibrates the transmitter. This procedure is rarely needed by customers. It is only necessary if you believe the Model 8732C is no longer accurate. It must be performed with the coil drive mode set to 6 Hz and with a nominal flowtube calibration number stored in the memory.

Attempting an electronics trim without a Model 8714D may result in an inaccurate transmitter, or a "DIGITAL TRIM FAILURE" message may appear. If this message occurs, no values were changed in the transmitter. Simply power down the Model 8732C to clear the message. If the trim was completed or no error message appears, correction requires a Model 8714D.

To simulate a nominal flowtube with the Model 8714D, you must change the following parameters in the Model 8732C:

- Tube Calibration Number: *1000015010000000*
- Units: *ft/s*
- Upper Range Value: *20 mA = 30.00 ft/s*
- Lower Range Value: *4 mA = 0 ft/s*
- Coil Frequency: *6 Hz*

The instructions for changing these parameters are located in the parameter descriptions in this section. Set the loop to manual, if necessary, before you begin. Complete the following steps:

1. Power down the transmitter.
2. Connect the transmitter to a Model 8714D Flowtube Simulator.
3. Power up the transmitter with the Model 8714D connected and read the flow rate. The electronics need about a 30-minute warm-up time to stabilize.
4. The flow rate reading after warm-up should be between 29.97 and 30.03 ft/s.
5. If the reading is within the range, return the transmitter to the original configuration parameters.
6. If the reading is not within this range, initiate an electronics trim with the LOI or HART Communicator. The gain trim takes about 6 minutes to complete. No transmitter adjustments are required.

TRANSMITTER INFORMATION CONFIGURATION

This function allows you to view and change identification data and other information about the transmitter and flowtube. This information does not affect the performance or operation of the transmitter; it is strictly for information purposes (exceptions are noted below).

Transmitter Tag

HART Fast Keys	1, 4, 5, 2
LOI	Device Information

Transmitter Tag is the quickest and shortest way of identifying and distinguishing between transmitters. Transmitters can be tagged according to the requirements of your application. The tag may be up to eight characters long and is user-defined.

Software Revision Number

HART Fast Keys	1, 4, 5
LOI	Device Information

The Model 8732C microcontroller will automatically read the **Software Revision Number** and display it under this heading. The software revision number is not user-changeable.

Descriptor

HART Fast Keys	1, 4, 5, 3
LOI	Device Information

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

Message

HART Fast Keys	1, 4, 5, 4
LOI	Device Information

Message Variable 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

HART Fast Keys	1, 4, 5, 5
LOI	Device Information

Date is a user-defined variable that provides a place to save the date of the last revision of configuration information.

Flowtube Tag

HART Fast Keys	1, 4, 5, 8
LOI	Device Information

Flowtube Tag is the quickest and shortest way of identifying and distinguishing between Flowtubes. Flowtubes can be tagged according to the requirements of your application. The tag may be up to eight characters long and is user-defined.

Flowtube Serial Number

HART Fast Keys	1, 4, 5, 7
LOI	Device Information

Flowtube Serial Number is stored in the transmitter configuration for future reference. The number provides easy identification if the flowtube needs servicing or for other purposes.

Liner Material

HART Fast Keys	1, 4, 5
LOI	Device Information

Liner Material enables you to select the liner material for the attached flowtube. This variable needs to be changed only if you have replaced your flowtube.

- PTFE Teflon
- ETFE Tefzel
- Polyurethane
- Natural Rubber
- Neoprene
- Ryton
- Other

Electrode Type

HART Fast Keys	1, 4, 5
LOI	Device Information

Electrode Type enables you to select the electrode type for your magnetic transmitter system. This variable needs to be changed only if you have replaced electrodes in the hardware.

- Standard
- Std and Ground
- Bullet
- Other

Electrode Material

HART Fast Keys	1, 4, 5
LOI	Device Information

Electrode Material enables you to select the electrode material for your magnetic transmitter system. This variable needs to be changed only if you have replaced electrodes in the hardware.

- 316L SST
- Hast-C 276
- Tantalum
- Pt–Ir
- Titanium
- Ryton
- Alloy 20
- Other

Flange Type

HART Fast Keys	1, 4, 5
LOI	Device Information

Flange Type enables you to specify the type of flange on the transmitter for later reference. This variable is preset at the factory but can be changed if necessary.

- ANSI 150
- ANSI 300
- ANSI 600
- ANSI 900
- PN 10
- PN 16
- PN 25
- PN 40
- PN 64
- Flangeless
- Other

Flange Material

HART Fast Keys	1, 4, 5
LOI	Device Information

Flange Material is a factory-set configuration variable that reflects the construction of your flowtube.

- Carbon steel
- 304 SST
- 316L SST
- Flangeless
- Other

For flowtubes without flanges, this screen can be ignored or used to indicate the adjacent pipe flange material.

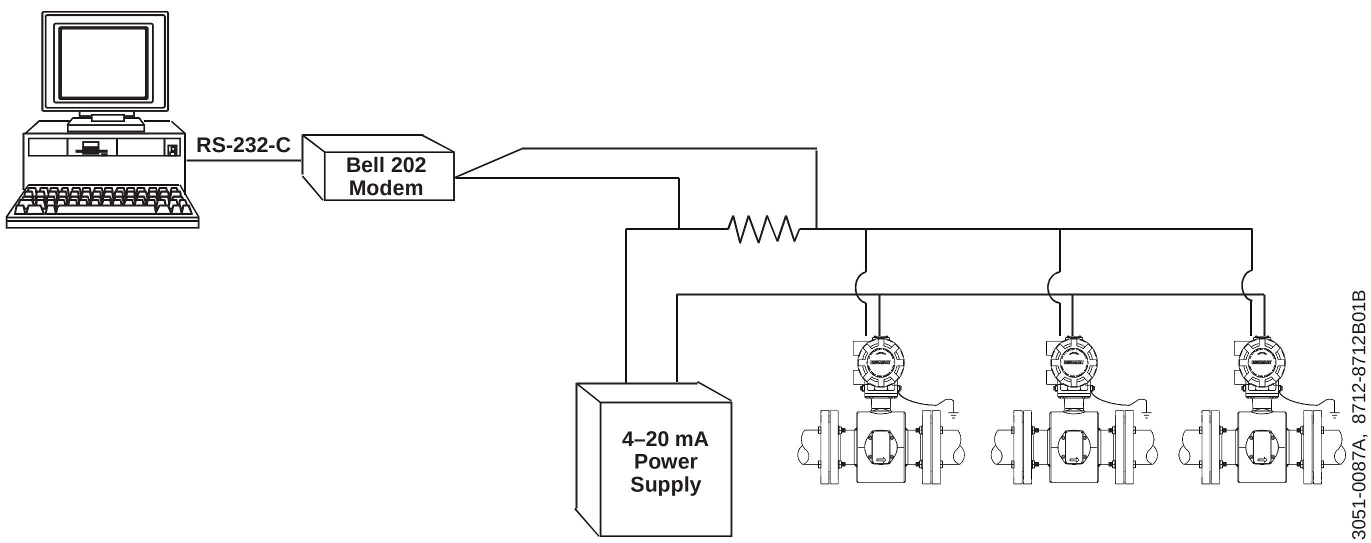
MULTIDROP COMMUNICATIONS

Multidrop configuration refers to the connection of several transmitters to a single communications transmission line. Communication between the HART Communicator and the transmitters takes place digitally with the analog output of the transmitters deactivated. Using the HART communications 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 transmitter, the combination of transmitter models, and the length of the transmission line. Multidrop installations are not recommended where intrinsic safety is a requirement. Communication with the transmitters can be accomplished with commercially available Bell 202 modems and a host implementing the HART protocol. Each transmitter is identified by a unique address (1-15) and responds to the commands defined in the HART protocol.

Figure 4-2 shows a typical multidrop network. This figure is not intended as an installation diagram. Contact Rosemount product support with specific requirements for multidrop applications.

FIGURE 4-2. Typical Multidrop Network.



The HART Communicator can test, configure, and format a multidropped Model 8732C in the same way as it can a Model 8732C in a standard point-to-point installation.

NOTE
The Model 8732C 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, sending it to 4 mA. It also disables the failure mode alarm signal.

Auto Poll

HART Fast Keys	OFF LINE FCN

When the HART Communicator is powered up and auto polling is on, it automatically polls the transmitter addresses to which it is connected. If the address is 0, the HART Communicator enters its normal on-line 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 number. Use the action keys to scroll through the list and select the transmitter with which you need to communicate.

If a single connected device has an address other than zero and auto polling is off, the device will not be found.

Poll Address

HART Fast Keys	1, 4, 4, 3, 1

Poll Address enables you to set the poll address for a multi-dropped meter. The poll address is used to identify each meter on the multi-drop line. Follow the on-screen instructions to set the address at a number from 1 to 15. To set or change the flowmeter address, establish communication with the selected Model 8732C in the loop.

Section 5

Troubleshooting

BASIC TROUBLESHOOTING

Problems in the magnetic flowmeter system are usually indicated by incorrect output readings from the system, error messages, or failed tests. Consider all sources when identifying a problem in your system.

SAFETY MESSAGES

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

⚠WARNING

Explosions could result in death or serious injury:

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

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.
- Do not perform any service other than those contained in this manual unless qualified.

⚠WARNING

High voltage that may be present on leads could cause electrical shock:

- Avoid contact with leads and terminals.

TABLE 5-1. Basic Troubleshooting–Model 8732C.

Symptom	Potential Cause	Corrective Action
Output at 0 mA.	No power to transmitter.	Check power source and connections to the transmitter.
	Analog output improperly configured.	Check the analog power switch. See **Hardware Switches** on page 2-2 for proper settings.
	Electronics failure.	Replace the electronics boards.
Output at 4 mA.	Transmitter in multidrop mode.	Configure Poll Address to 0 to take transmitter out of multidrop mode.
	Low Flow Cutoff set too high.	Configure Low Flow Cutoff to a lower setting or increase flow to a value above the low flow cutoff.
	Flow is in reverse direction.	Enable Reverse Flow function.
	Shorted coil.	Coil check. Perform flowtube test A and B on page 5-5.
	Empty pipe.	Fill pipe.
	Electronics failure.	Replace the electronics boards.
Output at 21.6 mA.	Transmitter not ranged properly.	Reset the transmitter range values. See **Lower Range Value (LRV**) and **Upper Range Value (URV)** on page 4-6. Check tube size setting in transmitter and make sure it matches your actual tube size. See **Line Size** on page 4-4.
Output at alarm level.	Electronics failure.	Cycle power. If alarm is still present, replace the electronics boards.
Pulse output at zero, regardless of flow.	No power to transmitter.	Check power source and connection to the transmitter.
	Wiring error.	Check pulse output wiring at digital output terminals. Refer to wiring diagram for pulse output.
	Reverse flow.	Enable Reverse Flow function.
	Pulse width too wide or too narrow.	Reset Pulse Width. See **Pulse Width** on page 4-9.
	Electronics failure.	Replace the electronics boards.
Communication problems with the HART Communicator.	4–20 mA output configuration.	Check analog power switch (internal/external). HART Communicator requires a 4–20 mA output to function.
	Communication interface wiring problems.	Incorrect load resistance (250 Ω minimum). Check appropriate wiring diagram in Appendix A.
	Low batteries in the HART Communicator.	Replace the batteries in the HART Communicator. See the communicator manual for instructions.
	Old revision of software in the HART Communicator.	Consult your local sales office about updating to the latest revision of software.
Error Messages on LOI or HART Communicator	Many possible causes depending upon the message.	See the Error Messages Table for the LOI (Table 3-3) or the Diagnostic Messages for the HART Communicator (Table A-2).

ADVANCED TROUBLESHOOTING

If your system is experiencing problems and the basic troubleshooting steps do not address your problem, use the following advanced troubleshooting procedures or call your service representative. The procedure for advanced troubleshooting is as follows:

1. Consider symptoms in the basic troubleshooting table.
2. Consider symptoms in the advanced troubleshooting table.
3. Run the software tests, if possible.
4. Perform the flowtube tests to see if flowtube must be removed from the process line.
5. If the problem persists, contact your sales or service representative.

Process Noise

In some circumstances, process conditions themselves can cause the meter output to be unstable. The basic procedure for addressing a noisy process situation is outlined below. Complete them in order. When the output attains the desired stability, no further steps are required.

Noisy Conditions Basic Procedure

1. Change coil drive to 30 Hz.
2. Increase the damping.
3. Activate signal processing.
4. Consult Rosemount Sales Representative about using a High-Signal Magnetic Flowmeter System.

TABLE 5-2. Advanced Troubleshooting–Model 8732C.

Accuracy		
Symptom	**Potential Cause**	**Corrective Action**
Reading doesn't appear to be within rated accuracy.	Transmitter, control system, or other receiving device not configured properly.	Check all configuration variables for the transmitter, flowtube, communicator, and/or control system. See **Process Variables** on page 4-3. Check these other transmitter settings: • Flowtube calibration number • Units • Line size Perform a loop test to check the integrity if the circuit. See **Loop Test** on page 5-4.
	Electrode Coating.	Use replaceable electrodes in Model 8705. Downsize flowtube to increase flow rate above 3 ft/s. Periodically clean flowtube.
	Air in line.	Move the flowtube to another location in the process line to ensure that it is full under all conditions.
	Flow rate is below 1 ft/s (specification issue).	See accuracy specification for specific transmitter and flowtube.
	Auto zero was not performed when the coil drive frequency was changed from 6 Hz to 30 Hz.	Perform the auto zero function. See **Auto Zero** on page 4-12.
	Flowtube failure–Shorted electrode.	Perform flowtube tests C and D on page 5-5.
	Flowtube failure–Shorted or open coil.	Perform flowtube tests A and B on page 5-5.
	Transmitter failure.	Replace the electronics boards.

TABLE 5-2. Advanced Troubleshooting–Model 8732C.

Symptom	Potential Cause	Corrective Action
Noisy Process.	Chemical additives upstream of magnetic flowmeter.	Complete the Noisy Conditions Basic Procedure (page 5-3).
		Move injection point downstream of magnetic flowmeter, or move magnetic flowmeter.
	Sludge flows–Mining/Coal/Sand/ Slurries (other slurries with hard particles).	Decrease flow rate below 10 ft/s.
	Styrofoam or other insulating particles in process.	Complete the Noisy Conditions Basic Procedure (page 5-3).
		Consult factory.
	Electrode coating.	Use replaceable electrodes in Model 8705.
		Use a smaller flowtube to increase flow rate above 3 ft/s.
		Periodically clean flowtube.
	Air in line.	Move the flowtube to another location in the process line to ensure that it is full under all conditions.
Meter output is unstable.	Electrode incompatibility.	Check Magnetic Flowmeter Material Selection Guide (00816-0100- 3033) for chemical compatibility with electrode material.
	Improper grounding.	Check ground wiring. See on page 2-14 for wiring and grounding procedures.
	High local magnetic or electric fields.	Move magnetic flowmeter (20–25 ft. away is usually acceptable).
	Control loop improperly tuned.	Check control loop tuning.
	Sticky valve (look for periodic oscillation of meter output).	Correct valve sticking.
	Flowtube failure.	Perform Flowtube Tests A, B, C, and D on page 5-5.
	Analog output loop problem.	Check that the 4–20 mA loop matches the digital value.
		Perform analog output test.

Software Testing

Loop Test

HART Fast Keys	1, 2, 2
LOI	Transmitter Test

The **Loop Test** drives the transmitter output to a desired electrical current output on the 4–20 mA terminals. This capability allows you to check the entire current loop prior to start-up. On the LOI the test quits after five minutes if the transmitter is not returned to normal operation manually.

Pulse Output Test

HART Fast Keys	1, 2, 3
LOI	Transmitter Test

The **Pulse Output Test** allows you to drive the frequency output at digital output terminals to a desired value. This capability allows you to check auxiliary equipment prior to start-up. On the LOI the test quits after five minutes if the transmitter is not manually returned to normal operation.

Transmitter Test

HART Fast Keys	1, 2, 1, 2

The **Transmitter Test** initiates a series of diagnostic tests that are not performed continuously during normal operation. It performs the following tests:

- Display Test
- RAM Test
- PROM Test

During the entire transmitter test, all outputs are driven to full-scale: 20 mA and 1,000 Hz. The test requires about 10 seconds to complete.

Flowtube Troubleshooting Procedures

The following tests can check Models 8705 or 8711 flowtubes in line and full of process material. The tests allow you to determine whether or not the flowtube needs to be removed from the process. The transmitter must be removed to conduct these tests. Use the following procedure to remove the transmitter:

Transmitter Removal Procedure

1. Remove power to the transmitter.
2. Remove the electronics compartment cover.
3. Carefully unhook the wires at the base of the electronics stack.
4. Remove the four bolts that attach the flowtube to the transmitter.
5. Carefully remove the housing, ensuring not to snag any wires.
6. Leave the wiring harness connected to the flowtube terminal block.

Transmitter Assembly Procedure

Use the following procedure to reassemble the transmitter:

1. Carefully attach the electronics stack to the housing.
2. Secure the four bolts that attach the flowtube to the transmitter.
3. Carefully hook up the wires at the base of the electronics stack.
4. Attach the electronics compartment cover.
5. Restore power to the transmitter.

TABLE 5-3. Magnetic Flowmeter Troubleshooting Chart.

Test A–Flowtube Coil				
Step 1		**Step 2**		**Step 3**
Remove transmitter. Take all readings across flowtube terminals.	➤	Measure the resistance across wires 1 and 2 going to the flowtube, using the lowest ohms scale. The reading should be between 2 and 18 Ω.	➤	A reading outside this range indicates that the coils or cables are open or shorted.
Test B– Coil Shield to Coil				
Step 1		**Step 2**		**Step 3**
Remove transmitter. Take all readings across flowtube terminals.	➤	Measure the resistance from the coil shield (ground) to wires 1 and 2 using the highest ohms scale. Both readings should be overrange.	➤	Any reading on the scale indicates that the coils are shorted to the housing.
Test C– Electrode Shield Resistance				
Step 1		**Step 2**		**Step 3**
Remove transmitter. Take all readings across flowtube terminals. Test with process in the flowtube (either in flowing or non-flowing condition.)	➤	Measure the resistance from wire 17 to 18 and 17 to 19. This reading will change as you hold the leads on the wires, so use the initial reading. These readings should both be close to each other.	➤	A reading less than 100 kΩ indicates a possible shorted electrode. A high reading indicates a possible coated electrode, nonconductive process, or electrode not in contact with the process. A stable reading indicates a shorted electrode.
Test D– Positive to Negative Electrode				
Step 1		**Step 2**		**Step 3**
Remove transmitter. Take all readings across flowtube terminals. Test with process in the flowtube (either in flowing or non-flowing condition.)	➤	Measure the resistance between wires 18 and 19. This reading should be in the range between 100 kΩ and 600 kΩ.	➤	An overrange reading indicates a coated electrode, nonconductive process, or electrode not in contact with the process.

FIGURE 5-1. Model 8705
Flowtube Circuit Diagram.

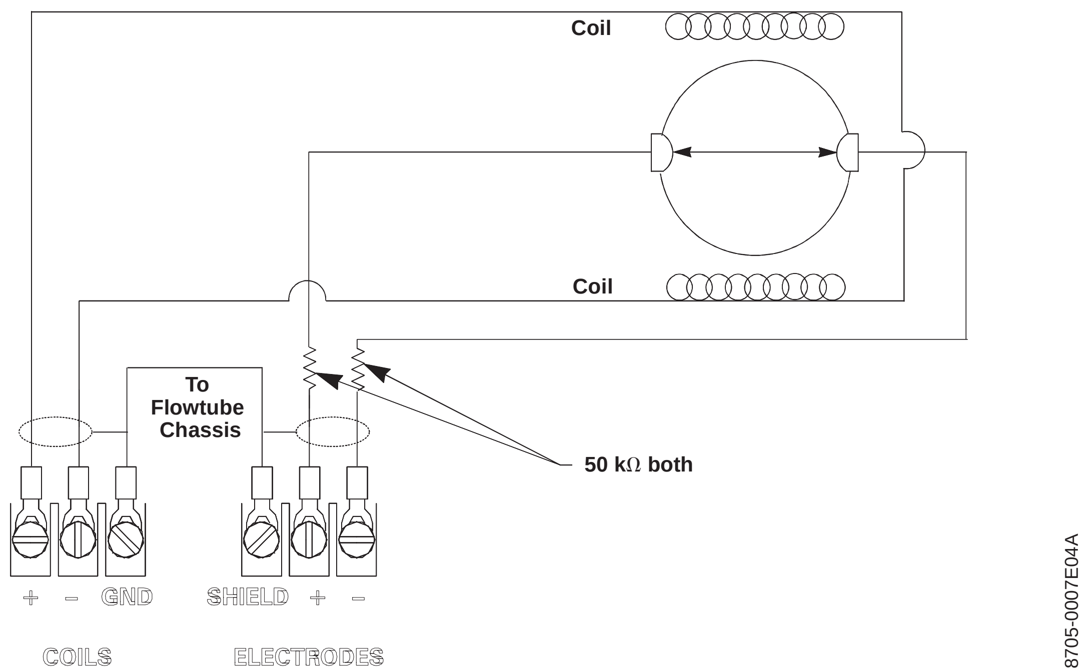
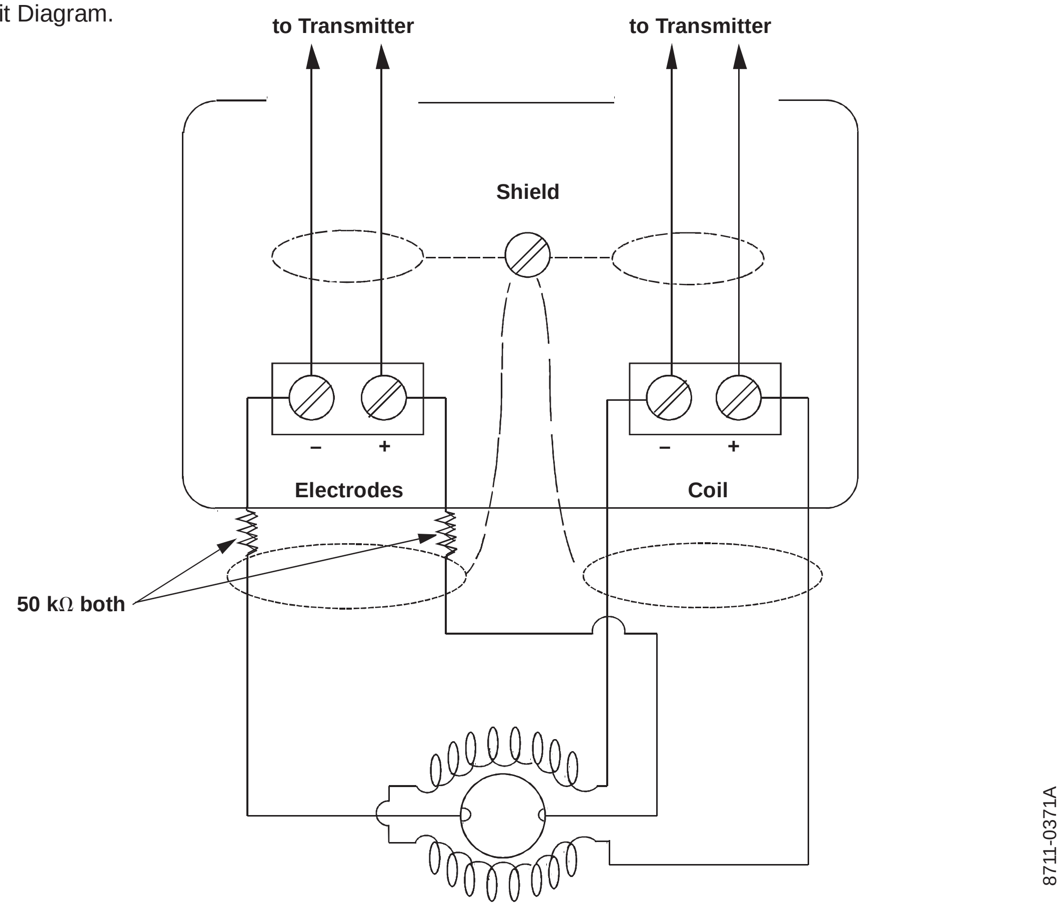


FIGURE 5-2. Model 8711 Magnetic
Flowmeter Flowtube Circuit Diagram.



RETURN OF MATERIALS

To expedite the return process outside the United States, contact the nearest Rosemount representative.

Within the United States and Canada, call the North American Response Center using the 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.

Mishandling products exposed to a hazardous substance may result in death or serious injury. 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 North American Response Center will detail the additional information and procedures necessary to return goods exposed to hazardous substances.

Section 6

Model 8732C Specifications and Reference Data

SPECIFICATIONS

Functional Specifications

Flowtube Compatibility

Compatible with Rosemount Model 8705 or Model 8711 Flowtubes.

Flow Rate Range

Capable of processing signals from fluids that are traveling between 0.04 and 30 ft/s (0.01 to 10 m/s) for both forward and reverse flow in all flowtube sizes. Full scale continuously adjustable between –30 and 30 ft/s (–10 to +10 m/s).

Fluid Conductivity

Fluid must have conductivity of at least 5 microsiemen/cm.

Power Supply

90–250 V ac 50–60 Hz.

15– 50 V dc.

Power Consumption

10 watts maximum.

Ambient Temperature Limits

Operating
–40 to 165 °F (–40 to 74 °C).

Storage
–40 to 185 °F (–40 to 85 °C).

Output Signals

4–20 mA, switch-selectable as internally or externally powered; 0 to 1000 ohm load.

On the digital output terminals, a scalable frequency output is available, 0 to 1000 Hz; transistor switch closure up to 5.75 W, externally powered, 5 to 24 V ac or dc.

HART Communications, digital flow signal, superimposed on 4–20 mA signal, available for control system interface. 250 ohms required for HART Communications.

Analog Output Adjustment

Engineering units, lower and upper range values are user-selected. Output automatically scaled to provide 4 mA at selected lower range value, 20 mA at the selected upper range value. Full scale continuously adjustable between –30 and +30 ft/s (–10 to +10 m/s), 1 ft/s (0.3 m/s) minimum span. 4 mA also continuously adjustable.

Scalable Frequency Adjustment

Pulse Value
Value of one pulse can be set to equal desired volume in selected engineering units.

Pulse Width
Adjustable from 0.5 to 100 ms. Local Operator Interface option automatically calculates and displays maximum allowable output frequency.

Software Lockout

Security switch on electronics can be set for deactivation of all LOI and HART-based communicator functions that affect the transmitter input/output.

Auxiliary Output Function

In lieu of a scalable frequency output, an auxiliary output is available using the digital output terminals. Transistor switch closure up to 5.75 W, externally powered, 5 to 24 V ac or dc, to indicate either:

Reverse Flow

Activates switch closure output when reverse flow is detected. The reverse flow rate is displayed.

Zero Flow

Activates switch closure output when flow goes to 0 ft/s.

Output Testing

Current Source

Transmitter can be commanded to supply a specified current between 3.75 and 23.25 mA.

Frequency Source

Transmitter can be commanded to supply a specified frequency between 1 and 1000 Hz.

Turn-on Time

30 minutes to rated accuracy from power up; 5 seconds from power interruption.

Start-up Time

0.2 seconds from zero flow.

Low Flow Cutoff

Adjustable between 0.001 and 1 ft/s (0.003 and 0.3 m/s). Below selected value, output is driven to the zero flow rate signal level.

Humidity Limits

0–100% RH to 150 °F (65 °C).

Overrange Capability

Signal output continues to 110% of upper range value setting, then remains constant. Out of range message displayed on LOI and the HART Communicator.

Damping

Adjustable between 0.2 and 256 seconds.

Flowtube Compensation

Rosemount flowtubes are flow-calibrated and assigned a calibration factor at the factory. The calibration factor is entered into the transmitter, enabling interchangeability of flowtubes without calculations or a compromise in accuracy.

Standard Hazardous Locations Certifications

Factory Mutual (FM) Approval

Approved for Class I, Division 2, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III hazardous locations.

Canadian Standards Association (CSA) Approval

Approved for Class I Division 2, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III hazardous locations.

Optional Hazardous Locations Certifications

FM Approval (E5)

Approved for Explosion-Proof Class I, Division 1, Groups C and D.

KEMA/CENELEC Approval (ED)

EEx d IIB T6.

Special Conditions

If the Magnetic Flowmeter Transmitter Type 8732C is used integrally with certified Magnetic Flowmeter Types 8705 or 8711, it shall be assured that the mechanical contact areas of the 8705 or 8711 and the 8732C comply with the requirements for flanged joints, EN 50018-1877, clause 4.1.

Performance Specifications

(System specifications are given using the frequency output and with the unit at reference conditions.)

Accuracy

With Model 8705 Flowtube:

System accuracy is ±0.5% of rate from 1 to 30 ft/s (0.3 to 10 m/s); below 1.0 ft/s (0.3 m/s), the system has an accuracy of ±0.005 ft/s (0.0015 m/s). Analog output has the same accuracy as frequency output plus an additional 0.05% of span.

With Model 8711 Flowtube:

System accuracy is ±0.5% of rate from 3 to 30 ft/s (0.9 to 10 m/s); below 3 ft/s (0.9 m/s), the system has an accuracy of ±0.015 ft/s (0.045 m/s). Analog output has the same accuracy as frequency output plus an additional 0.05% of span.

Repeatability

±0.1% of reading.

Response Time

0.2 seconds maximum response to step change in input.

Stability

±0.1% of rate over six months.

Ambient Temperature Effect

±0.25% change over operating temperature range.

EMC Compliance

Complies with the increased requirements from the NAMUR Recommendations: May 1993, Part 1. Electromagnetic compatibility (EMC) for process and laboratory apparatus.

Vibration Effect

Meets IEC 770 Pipeline Installation Conditions.

Physical Specifications

Electrical Connections

¾–14 NPT connections provided on the transmitter housing. PG13.5 and CM20 adapters are available. Screw terminals provided for all connections. Power wiring connected to transmitter only. Integrally mounted transmitters are factory wired to the flowtube.

Mounting

Transmitter is mounted integrally with the flowtube.

Materials of Construction

Housing

Low copper aluminum, NEMA 4X, CSA Type 4X, and IEC 529 IP66.

Paint

Polyurethane.

Cover Gasket

Rubber.

Weight

Approximately 7 pounds (3.2 kg). Add 1 pound (0.5 kg) for the M4 option.

ORDERING INFORMATION

Model	Description
8732C	Magnetic Flowmeter Transmitter
Code	**Transmitter Style**
T	Integral (mounted to Model 8705, 8711 flowtubes)
Code	**Power Supply Voltage**
12	90–250 V ac, 50–60 Hz
03	15–50 V dc
Code	**Options**
M4	Local Operator Interface
C1(1)	Custom Configurations
T1(2)	Non-volatile Totalizer
L1	Transient Protection Circuitry
E5	Factory Mutual (FM) Approvals, Class I. Division 1
ED	KEMA/CENELEC Approvals, Group IIB
J1	CM20 Conduit Adapters
J2	PG13.5 Conduit Adapters
Typical Model Number:	**8732C T 12 M4**

(1) *Custom Configuration (C1 Option)—When specifying custom configuration code C1, refer to Configuration Data Sheet 00806-0100-4668 and provide the additional information as requested.*

(2) *Non-volatile Totalizer—Non-volatile totalizer will retain totalizer data during power interruption. When power resumes, totalizing will continue.*

FIGURE 6-1. Model 8732C
Exploded Parts Drawing

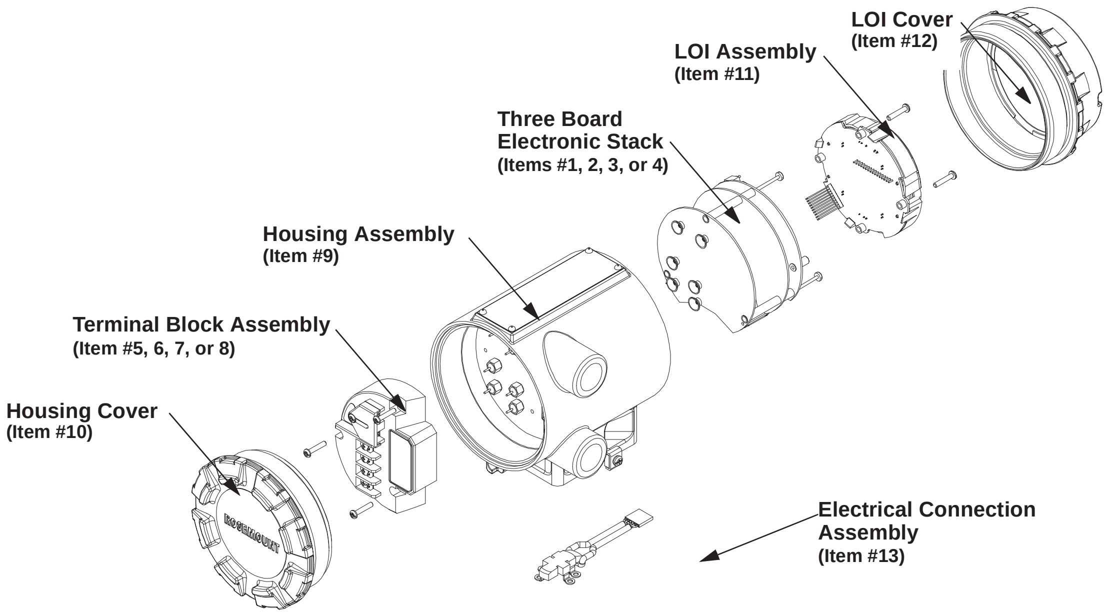


FIGURE 6-1. Model 8732C Exploded Parts Drawing.

MODEL 8732C SPARE PARTS

Part Description	Item Number	Part Number
Model 8732C Electronics, 90–250 V ac (includes mounting hardware)	1	08732-0001-0001
Model 8732C Electronics with Non-volatile Totalizer, 90–250 V ac (includes mounting hardware)	2	08732-0001-0003
Model 8732C Electronics, 15-30V dc (Includes mounting hardware)	3	08732-0001-0002
Model 8732C Electronics with non-volatile totalizer, 15-30V dc (Includes mounting hardware)	4	08732-0001-0004
Standard Terminal Block Assembly (includes mounting hardware)	5	08732-0002-0001
Transient Protection Terminal Block Assembly (includes mounting hardware)	6	08732-0002-0002
DC Terminal Block Assembly (Includes mounting hardware)	7	08732-0002-0003
DC Transient Protection Terminal Block Assembly (Includes mounting hardware)	8	08732-0002-0004
Integral Mount Housing Assembly (does not include terminal block assembly)	9	08732-0004-0001
Standard Housing Cover (without glass for LOI)	10	08732-0005-0001
Local Operator Interface (LOI) Assembly (does not include LOI cover)	11	08732-0006-0002
LOI Cover	12	08732-0007-0002
Electrical Connection Assembly (Flowtube to transmitter)	13	08732-0133-0001
Model 8732C Non-Volatile Totalizer Chip	–	C53641-0003
Transmitter and Flowtube Accessories		
Multi-Point Reference Calibration Standard (for use with Model 8712C, 8712U, or 8732C Transmitters)	—	Model 8714D
Spare Model 8714D Cable (for Model 8732C Transmitters)	—	08714-0205-0001
UMB Tube to 8732C Transmitter Conversion Bracket	—	08732-0160-0001
UMB Tube to 8732C Transmitter Conversion Cable (Three-position cable assembly)	—	08732-0161-0003
UMB Tube to 8732C Transmitter Conversion Cable (Four-position cable assembly)	—	08732-0161-0004

NOTE
When removing or replacing the transmitter housing, refer to **Transmitter Removal Procedure** on page 5-5.

Section 7

Model 8705 Specifications and Reference Data

SPECIFICATIONS

Functional Specifications

Service

Conductive liquids and slurries.

Line Sizes

½, 1, 1½, 2, 3, 4, 6, 8, 10, 12, 14, 16, 18, 20, 24, 30, and 36 inch (15, 25, 40, 50, 80, 100, 150, 200, 250, 300, 350, 400, 450, 500, 600, 750, and 900 mm).

Interchangeability

All Model 8705 Flowtubes and Series 8712 or 8732C Transmitters are completely interchangeable. System accuracy is maintained regardless of line size or optional features. Each flowtube nameplate has a multi-digit calibration number that can be entered into any Series 8712 or 8732C Transmitter through the local operator interface (LOI) or the HART Communicator. No further calibration is necessary.

Upper Range Limit

30 ft/s (10 m/s).

Process Temperature Limits

Special Conditions

At process temperatures > X °F (100 °C), the flowmeter must be used with heat resistant cables with a temperature rating ≥ X °F (120 °C).

PTFE Teflon Lining

–20 to 350 °F (–29 to 177 °C).

ETFE Tefzel Lining

–20 to 300 °F (–29 to 149 °C).

Polyurethane Lining

0 to 140 °F (–18 to 60 °C).

Neoprene Lining

0 to 185 °F (–18 to 85 °C).

Natural Rubber Lining

0 to 185 °F (–18 to 85 °C).

Ambient Temperature Limits

–30 to 150 °F (–34 to 65 °C).

TABLE 7-1. Relation Between Ambient Temperature, Process Temperature, and Temperature Class.

Meter Size (inches)	Maximum Ambient Temperature	Maximum Process Temperature	Temperature Class
½	149 °F (65 °C)	240 °F (116 °C)	T3
1	149 °F (65 °C)	248 °F (120 °C)	T3
1	95 °F (35 °C)	95 °F (35 °C)	T4
1½	149 °F (65 °C)	257 °F (125 °C)	T3
1½	140 °F (60 °C)	140 °F (60 °C)	T4
2	149 °F (65 °C)	257 °F (125 °C)	T3
2	149 °F (65 °C)	167 °F (75 °C)	T4
2	104 °F (40 °C)	104 °F (40 °C)	T5
3 to 4	149 °F (65 °C)	266 °F (130 °C)	T3
3 to 4	149 °F (65 °C)	167 °F (75 °C)	T4
3 to 4	131 °F (55 °C)	194 °F (90 °C)	T5
3 to 4	104 °F (40 °C)	104 °F (40 °C)	T6
6	149 °F (65 °C)	175 °F (79 °C)	T3
6	149 °F (65 °C)	167 °F (75 °C)	T4
6	149 °F (65 °C)	230 °F (110 °C)	T5
6	140 °F (60 °C)	140 °F (60 °C)	T6
8 to 60	149 °F (65 °C)	284 °F (140 °C)	T3
8 to 60	149 °F (65 °C)	240 °F (116 °C)	T4
8 to 60	149 °F (65 °C)	176 °F (80 °C)	T5
8 to 60	149 °F (65 °C)	149 °F (65 °C)	T6

Submergence Protection

Continuous to 30 feet (10 meters). IP 68.

Standard Hazardous Locations Certifications

Factory Mutual (FM) Approvals

Approved for Class I, Division 2, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III hazardous locations.
NEMA 4X.

Canadian Standards (CSA) Approval

Approved for Class I, Division 2, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III hazardous locations,
CSA enclosure 4.

Optional Hazardous Locations Certifications

KEMA/CENELEC

KD EEx e ia IIC T3...T6. See Table 7-1.

Conductivity Limits

Process liquid must have a conductivity of 5 microsiemens/cm (5 micromhos/cm) or greater. Excludes the effect of interconnecting cable length in remote mount transmitter installations.

Pressure Limits

See Table 7-2

.

TABLE 7-2. Flowtube Temperature vs. Pressure Limits.

ANSI Class Flanges: ½ – 24 inch Line Sizes(1) Pressure in psi						
Flange Rating	**All Liners (@ 100 °F, 37.8 °C)**	**PTFE *Teflon* Liner (@ 350 °F, 177 °C)**	**ETFE *Tefzel* Liner (@ 300 °F, 149 °C)**	**Natural Rubber Liner (@ 185 °F, 85 °C)**	**Neoprene Liner (@ 185 °F, 85 °C)**	**Polyurethane Liner (@ 150 °F, 66 °C)**
Class 150 Carbon Steel	285	215	230	260	260	270
Class 150 Stainless Steel	275	190	205	240	240	255
Class 300 Carbon Steel	740	645	655	685	685	705
DIN Flanges: Line Sizes 15–80 mm Pressure in Bars						
Flange Rating	**All Liners (@ 100 °F, 37.8 °C)**	**PTFE Teflon Liner (@ 350 °F, 177 °C)**	**ETFE *Tefzel* Liner (@ 300 °F, 149 °C)**	**Natural Rubber Liner (@ 185 °F, 85 °C)**	**Neoprene Liner (@ 185 °F, 85 °C)**	**Polyurethane Liner (@ 150 °F, 66 °C)**
PN 10–40	29.5	24.8	27.7	29.5	29.5	29.5
DIN Flanges: Line Sizes 100–600 mm(1) Pressure in Bars						
Flange Rating	**All Liners (@ 100 °F, 37.8 °C)**	**PTFE Teflon Liner (@ 350 °F, 177 °C)**	**ETFE *Tefzel* Liner (@ 300 °F, 149 °C)**	**Natural Rubber Liner (@ 185 °F, 85 °C)**	**Neoprene Liner (@ 185 °F, 85 °C)**	**Polyurethane Liner (@ 150 °F, 66 °C)**
PN 10	7.3	6.1	6.8	7.3	7.3	7.3
PN 16	11.8	9.9	11	11.8	11.8	11.8
PN 40	29.5	24.8	27.7	29.5	29.5	29.5

(1) Consult factory for larger line sizes.
Tefzel only available through 16" (400mm)

Performance Specifications

(System specifications at reference conditions with frequency output and flowtube in new condition.)

Accuracy (with Model 8712C, Model 8712U or Model 8732C)

±0.5% of rate from 1 to 30 ft/s (0.3 to 10 m/s). Includes combined effects of linearity, hysteresis, repeatability, and calibration uncertainty. Accuracy is ±0.005 ft/s (±0.0015 m/s) from low-flow cutoff to 1.0 ft/s (0.3 m/s).

Vibration Effect

Meets IEC 770 Pipeline Installation Conditions.

Mounting Position Effect

None when installed to ensure flowtube remains full.

Physical Specifications

Non-Wetted Materials

Flow Tube

AISI Type 304 SST.

Flanges

Carbon steel or AISI Type 304 SST.

Housing

Welded steel.

Paint

Polyurethane.

Process Wetted Materials

Lining

PTFE Teflon, ETFE Tefzel, polyurethane, neoprene, or natural rubber.

Electrodes

316L SST, Hastelloy C-276, tantalum, platinum-10% iridium, titanium.

Process Connections

AISI Type 304 SST – includes ANSI Class 150 flange to Tri-Clover Tri-Clamp 3-A quick-disconnect ferrule.

Process Connections

ANSI Class 150 or ANSI Class 300

½ through 24 inch.

AWWA Class 125

30- and 36-inch.

DIN PN 10, 16, 25, and 40

PN40 Standard Flange for 15–80 mm.

PN16 Standard Flange for 100–150 mm.

PN10 Standard Flange for 200–600 mm.

Electrical Connections

Two ¾–14 NPT connections are provided in the terminal enclosure for electrical wiring.

Grounding Rings

Grounding rings are installed between the flange and the tube face on both ends of the flowtube. They have an I.D. slightly larger than the flowtube I.D. and an external tab to attach ground wiring. Grounding rings are available in 316L stainless steel, Hastelloy C-276, titanium, and tantalum.

Grounding Electrode

A grounding electrode is installed similarly to the measurement electrodes through the flowtube lining. It is available in 316L stainless steel, Hastelloy C-276, titanium, tantalum or platinum.

Flowtube Dimensions

See Tables 7-3 and 7-4; Figures 7-1 and 7-2.

TABLE 7-3. Model 8705 Dimensions with ANSI Flanges in Inches (Millimeters).

Line Size(1) and Flange Rating	Liner Face Diameter "A"	Process Flange Rad. "B"	Overall Flowtube Length "L"(2)	Body Height "C"	Body Widest' with Port "D"	Centerline to Conduit "E"	Bolt Hole Circle Diameter	Bolt Hole Diameter	Number and Size of Bolts
0.5 inch–150 lb	1.38 (35)	1.75 (44)	7.88 (200)	8.75 (222)	6.88 (175)	5.16 (131)	2.38 (60)	0.62 (16)	4–½
0.5 inch–300 lb	1.38 (35)	1.88 (48)	7.88 (200)	8.75 (222)	6.88 (175)	5.16 (131)	2.62 (67)	0.62 (16)	4–½
1 inch–150 lb	2.00 (51)	2.13 (54)	7.88 (200)	8.75 (222)	7.34 (186)	5.16 (131)	3.12 (79)	0.62 (16)	4–½
1 inch–300 lb	2.00 (51)	2.44 (62)	7.88 (200)	8.75 (222)	7.34 (186)	5.16 (131)	3.50 (89)	0.75 (19)	4–5/8
1.5 inch–150 lb	2.88 (73)	2.50 (64)	7.88 (200)	9.52 (242)	7.05 (179)	5.57 (141)	3.88 (99)	0.62 (16)	4–½
1.5 inch–300 lb	2.88 (73)	3.06 (78)	7.88 (200)	9.52 (242)	7.05 (179)	5.57 (141)	4.50 (114)	0.88 (22)	4–¾
2 inch–150 lb	3.62 (92)	3.00 (76)	7.88 (200)	9.52 (242)	7.47 (190)	5.57 (141)	4.75 (121)	0.75 (19)	4–5/8
2 inch–300 lb	3.62 (92)	3.25 (83)	7.88 (200)	9.52 (242)	7.47 (190)	5.57 (141)	5.00 (127)	0.75 (19)	8–5/8
3 inch–150 lb	5.00 (127)	3.75 (95)	7.88 (200)	11.52 (293)	9.57 (243)	6.57 (167)	6.00 (152)	0.75 (19)	4–5/8
3 inch–300 lb	5.00 (127)	4.13 (105)	8.63 (219)	11.52 (293)	9.57 (243)	6.57 (167)	6.62 (168)	0.88 (22)	8–¾
4 inch–150 lb	6.19 (157)	4.50 (114)	9.84 (250)	12.22 (310)	10.01 (254)	6.92 (176)	7.50 (191)	0.75 (19)	8–5/8
4 inch–300 lb	6.19 (157)	5.00 (127)	10.88 (276)	12.22 (310)	10.01 (254)	6.92 (176)	7.88 (200)	0.88 (22)	8–¾
6 inch–150 lb	8.50 (216)	5.50 (140)	11.81 (300)	14.39 (366)	10.41 (264)	8.05 (204)	9.50 (241)	0.88 (22)	8–¾
6 inch–300 lb	8.50 (216)	6.25 (159)	13.06 (332)	14.39 (366)	10.41 (264)	8.05 (204)	10.62 (270)	0.88 (22)	12–¾
8 inch–150 lb	10.62 (270)	6.75 (171)	13.78 (350)	16.33 (415)	11.38 (289)	9.02 (229)	11.75 (298)	0.88 (22)	8–¾
8 inch–300 lb	10.62 (270)	7.50 (191)	15.60 (396)	16.33 (415)	11.38 (289)	9.02 (229)	13.00 (330)	1.00 (25)	12–7/8
10 inch–150 lb	12.75 (324)	8.00 (203)	15.00 (381)	19.11 (485)	17.00 (432)	10.44 (265)	14.25 (362	1.00 (25)	12–7/8
10 inch–300 lb	12.75 (324)	8.75 (225)	17.13 (435)	19.11 (485)	17.00 (432)	10.44 (265)	15.25 (387)	1.12 (28)	16–1
12 inch–150 lb	15.00 (381)	9.50 (241)	18.00 (457)	21.27 (540)	19.16 (487)	11.52 (293)	17.00 (432)	1.00 (25)	12–7/8
12 inch–300 lb	15.00 (381)	10.25 (260)	20.14 (512)	21.27 (540)	19.16 (487)	11.52 (293)	17.75 (451)	1.25 (32)	16–1 1/8
14 inch–150 lb	16.25 (413)	10.50 (267)	21.00 (533)	23.39 (594)	21.28 (541)	12.58 (320)	18.75 (476)	1.12 (28)	12–1
14 inch–300 lb	16.25 (413)	11.50 (292)	23.25 (591)	23.39 (594)	21.28 (541)	12.58 (320)	20.25 (514)	1.25 (32)	20–1 1/8
16 inch–150 lb	18.50 (470)	11.75 (298)	24.00 (610)	25.41 (645)	23.30 (592)	13.59 (345)	21.25 (540)	1.12 (28)	16–1
16 inch–300 lb	18.50 (470)	12.75 (324)	26.25 (667)	25.41 (645)	23.30 (592)	13.59 (345)	22.50 (572)	1.38 (35)	20–1¼
18 inch–150 lb	21.00 (533)	12.50 (318)	27.00 (686)	27.93 (709)	25.82 (656)	14.85 (377)	22.75 (578)	1.25 (32)	16–1 1/8
18 inch–300 lb	21.00 (533)	14.00 (356)	30.12 (765)	27.93 (709)	25.82 (656)	14.85 (377)	24.75 (629)	1.38 (35)	24–1¼
20 inch–150 lb	23.00 (584)	13.75 (349)	30.00 (762)	29.95 (761)	27.84 (707)	15.86 (403)	25.00 (635)	1.25 (32)	20–1 1/8
20 inch–300 lb	23.00 (584)	15.25 (387)	33.25 (845)	29.95 (761)	27.84 (707)	15.86 (403)	27.00 (686)	1.38 (35)	24–1¼
24 inch–150 lb	27.25 (692)	16.00 (406)	36.00 (914)	34.50 (876)	32.39 (823)	18.14 (461)	29.50 (749)	1.37 (35)	20–1¼
24 inch–300 lb	27.25 (692)	18.00 (457)	39.64 (1007)	34.50 (876)	32.39 (823)	18.14 (461)	32.00 (813)	1.62 (41)	24–1½
30 inch–150 lb	33.80 (859)	19.38 (492)	37.25 (946)	40.41 (1026)	38.50 (928)	21.31 (541)	36.00 (914)	1.38 (35)	28–1 3/8
36 inch–150 lb	40.27 (1023)	23.00 (584)	40.75 (1035)	48.29 (1227)	46.38 (1178)	25.25 (641)	42.75 (1086)	1.63 (41)	32–1½

(1) Consult factory for larger line sizes.
(2) When grounding rings (2 rings per meter) are specified, add 0.25 inch (6.35 mm) for ½- through 14-inch (15 through 350 mm) flowtubes, 0.50 inch (12.7 mm) for 16-inch (400 mm) and larger. When lining protectors are specified, add 0.25 inch (6.35 mm) for ½- through 12-inch (15 through 300 mm) flowtubes, 0.50 inch (12.7 mm) for 14- through 36-inch (350 through 900 mm) flowtubes.

TABLE 7-4. Flowtube Dimensions with DIN Flanges in Millimeters (Inches).

Line Size[1] and Flange Rating	Liner Face Diameter "A"	Process Flange Rad. "B"	Overall Flowtube Length "L"[2]	Body Height "C"	Body Width "D" with Port	Centerline to Conduit "E"	Bolt Hole Circle Diameter	Bolt Hole Diameter	Number of Bolts
15 mm PN 10–40	45 (1.77)	47 (1.87)	200 (7.88)	222 (8.75)	175 (6.88)	131 (5.16)	65 (2.56)	14 (0.55)	
25 mm PN 10–40	68 (2.68)	58 (2.27)	200 (7.88)	222 (8.75)	186 (7.34)	131 (5.16)	85 (3.35)	14 (0.55)	4
40 mm PN 10–40	88 (3.46)	75 (2.96)	200 (7.87)	242 (9.52)	179 (7.05)	141 (5.57)	110 (4.33)	18 (0.71)	4
50 mm PN 10–40	102 (4.02)	83 (3.25)	200 (7.87)	242 (9.52)	190 (7.47)	141 (5.57)	125 (4.92)	18 (0.71)	4
80 mm PN 10–40	138 (5.43)	100 (3.94)	200 (7.87)	293 (11.52)	243 (9.57)	167 (6.57)	160 (6.30)	18 (0.71)	8
100 mm PN 10–16	158 (6.22)	110 (4.33)	250 (9.84)	310 (12.22)	254 (10.01)	176 (6.92)	180 (7.09)	18 (0.71)	8
100 mm PN 25–40	162 (6.38)	117 (4.63)	250 (9.84)	310 (12.22)	254 (10.01)	176 (6.92)	190 (7.48)	22 (0.87)	8
150 mm PN 10–16	212 (8.35)	142 (5.61)	300 (11.81)	366 (14.39)	264 (10.41)	204 (8.05)	240 (9.45)	22 (0.87)	8
150 mm PN 25	218 (8.58)	150 (5.91)	300 (11.81)	366 (14.39)	264 (10.41)	204 (8.05)	240 (9.45)	22 (0.87)	8
150 mm PN 40	218 (8.58)	150 (5.91)	332 (13.06)	366 (14.39)	264 (10.41)	204 (8.05)	240 (9.45)	22 (0.87)	8
200 mm PN 10	268 (10.55)	170 (6.70)	351 (13.81)	415 (16.33)	289 (13.38)	229 (9.02)	295 (11.61)	22 (0.87)	8
200 mm PN 16	268 (10.55)	170 (6.70)	351 (13.81)	415 (16.33)	289 (13.38)	229 (9.02)	295 (11.61)	22 (0.87)	8
200 mm PN 25	278 (10.94)	180 (7.09)	350 (13.78)	415 (16.33)	289 (13.38)	229 (9.02)	310 (12.20)	26 (1.02)	12
200 mm PN 40	285 (11.22)	187 (7.38)	396 (15.60)	415 (16.33)	289 (13.38)	229 (9.02)	320 (12.60)	30 (1.18)	12
250 mm PN 10	320 (12.60)	197 (7.70)	381 (15.00)	485 (19.11)	432 (17.00)	265 (10.44)	350 (13.78)	22 (0.87)	12
250 mm PN 16	320 (12.60)	202 (7.97)	381 (15.00)	485 (19.11)	432 (17.00)	265 (10.44)	355 (13.98)	26 (1.02)	12
250 mm PN 25	335 (13.19)	213 (8.39)	381 (15.00)	485 (19.11)	432 (17.00)	265 (10.44)	370 (14.67)	30 (1.18)	12
250 mm PN 40	345 (13.58)	225 (8.86)	435 (17.13)	485 (19.11)	432 (17.00)	265 (10.44)	385 (15.16)	33 (1.30)	12
300 mm PN 10	370 (14.57)	223 (8.76)	457 (18.00)	540 (21.27)	487 (19.16)	265 (10.44)	400 (15.75)	22 (0.87)	12
300 mm PN 16	378 (14.88)	230 (9.06)	457 (18.00)	540 (21.27)	487 (19.16)	293 (11.52)	410 (16.14)	26 (1.02)	12
300 mm PN 25	395 (15.55)	242 (9.55)	457 (18.00)	540 (21.27)	487 (19.16)	293 (11.52)	430 (16.93)	30 (1.18)	16
300 mm PN 40	410 (16.14)	258 (10.12)	512 (20.14)	540 (21.27)	487 (19.16)	293 (11.52)	450 (17.72)	33 (1.30)	16
350 mm PN 10	430 (16.93)	252 (9.94)	534 (21.03)	594 (23.39)	541 (21.28)	293 (11.52)	460 (18.11)	22 (0.87)	16
350 mm PN 16	438 (17.24)	260 (10.24)	534 (21.03)	594 (23.39)	541 (21.28)	320 (12.58)	470 (18.50)	26 (1.02)	16
350 mm PN 25	450 (17.72)	277 (10.93)	534 (21.03)	594 (23.39)	541 (21.28)	320 (12.58)	490 (19.29)	33 (1.30)	16
350 mm PN 40	465 (18.31)	290 (11.42)	591 (23.25)	594 (23.39)	541 (21.28)	320 (12.58)	510 (20.08)	36 (1.42)	16
400 mm PN 10	482 (18.98)	282 (11.12)	610 (24.00)	645 (25.04)	592 (23.30)	345 (13.59)	515 (20.28)	26 (1.02)	16
400 mm PN 16	490 (19.29)	290 (11.42)	610 (24.00)	645 (25.04)	592 (23.30)	345 (13.59)	525 (20.67)	30 (1.18)	16
400 mm PN 25	505 (19.88)	310 (12.21)	610 (24.00)	645 (25.04)	592 (23.30)	345 (13.59)	550 (21.65)	36 (1.42)	16
400 mm PN 40	535 (21.06)	330 (12.99)	667 (26.25)	645 (25.04)	592 (23.30)	345 (13.59)	585 (23.03)	39 (1.54)	16
450 mm PN 10	532 (20.94)	308 (12.13)	686 (27.00)	709 (27.93)	656 (25.82)	377 (14.85)	565 (22.24)	26 (1.02)	20
450 mm PN 16	550 (21.65)	320 (12.60)	686 (27.00)	709 (27.93)	656 (25.82)	377 (14.85)	585 (23.03)	30 (1.18)	20
450 mm PN 40	560 (22.05)	343 (13.50)	765 (30.12)	709 (27.93)	656 (25.82)	377 (14.85)	610 (24.02)	30 (1.18)	20
500 mm PN 10	585 (23.03)	335 (13.19)	762 (30.00)	761 (29.95)	707 (27.84)	403 (15.86)	620 (24.41)	26 (1.02)	20
500 mm PN 16	610 (24.02)	358 (14.08)	762 (30.00)	761 (29.95)	707 (27.84)	403 (15.86)	650 (25.59)	33 (1.30)	20
500 mm PN 25	615 (24.21)	365 (14.37)	762 (30.00)	761 (29.95)	707 (27.84)	403 (15.86)	660 (25.98)	36 (1.42)	20
500 mm PN 40	615 (24.21)	378 (14.88)	845 (33.25)	761 (29.95)	707 (27.84)	403 (15.86)	670 (26.38)	42 (1.65)	20
600 mm PN 10	685 (26.97)	390 (15.36)	914 (36.00)	885 (34.85)	823 (32.39)	461 (18.14)	725 (28.54)	30 (1.18)	20
600 mm PN 16	725 (28.54)	420 (16.54)	914 (36.00)	877 (34.51)	823 (32.39)	461 (18.14)	770 (30.31)	36 (1.42)	20
600 mm PN 25	720 (28.35)	423 (16.64)	914 (36.00)	877 (34.51)	823 (32.39)	461 (18.14)	770 (30.31)	39 (1.54)	20
600 mm PN 40	735 (18.94)	445 (17.52)	1,007 (39.64)	886 (34.88)	823 (32.39)	461 (18.14)	795 (31.30)	48 (1.88)	20

(1) Consult factory for larger line sizes.

(2) When grounding rings (2 rings per meter) are specified, add 6.35 mm (0.25 in.) for 15 mm through 350 mm (½- through 14 in.) flowtubes or 12.7 mm (0.50 in.) for 400 mm (16 in.) and larger. When lining protectors are specified, add 6.35 mm (0.25 in.) for 15 mm through 300 mm (½- through 12-in.) flowtubes, 12.7 mm (0.50 in.) for 350 mm through 900 mm (14- through 36-in.) flowtubes.

TABLE 7-5. Flowtube Dimensions with ANSI Flanges and Tri-Clamp Adaptors (A3) in Inches (Millimeters)

Line Size and Flange Rating	Nominal Tri-Clamp Diameter	Process Flange Rad. "B"	Body Height "C" Max	Centerline to Conduit "E"	Overall Flowtube Length "L"
0.5–150 lb.	1.00 (25)	1.75 (44)	8.38 (213)	5.16 (131)	13.78 (350)
1–150 lb.	1.50 (40)	2.13 (54)	8.38 (213)	5.16 (131)	13.78 (350)
1.5–150 lb.	2.00 (50)	2.50 (64)	9.00 (229)	5.56 (141)	13.78 (350)
2–150 lb.	3.00 (80)	3.00 (76)	9.00 (229)	5.56 (141)	13.78 (350)
3–150 lb.	4.00 (100)	3.75 (95)	12.00 (305)	6.57 (167)	13.78 (350)

TABLE 7-6. Flowtube Weight

Nominal Line Size(1) Inches (mm)	Flowtube Flange Rating		Flowtube Weight lb (kg)
	ANSI	DIN	
½ (15) ½ (15)	150 300	PN 40	20 (9) 22 (10)
1 (25) 1 (25)	150 300	PN 40	20 (9) 22 (10)
1½ (40) 1½ (40)	150 300	PN 40	22 (10) 24 (11)
2 (50) 2 (50)	150 300	PN 40	26 (12) 28 (13)
3 (80) 3 (80)	150 300	PN 40	40 (18) 47 (21)
4 (100) 4 (100)	150 300	PN 16	48 (22) 65 (30)
6 (150) 6 (150)	150 300	PN 16	81 (37) 93 (42)
8 (200) 8 (200)	150 300	PN 10	110 (50) 162 (74)
10 (250) 10 (250)	150 300	PN 10	220 (98) 300 (136)
12 (300) 12 (300)	150 300	PN 10	330 (150) 435 (197)
14 (350) 16 (400)	150 150	PN 10 PN 10	370 (168) 500 (227)
18 (450) 20 (500)	150 150	PN 10 PN 10	600 (272) 680 (308)
24 (600)	150	PN 10	1,000 (454)
30 (750) 36 (900)	125 125	PN 10 PN 10	1,400 (637) 1,975 (898)

(1) Consult factory for larger line sizes.

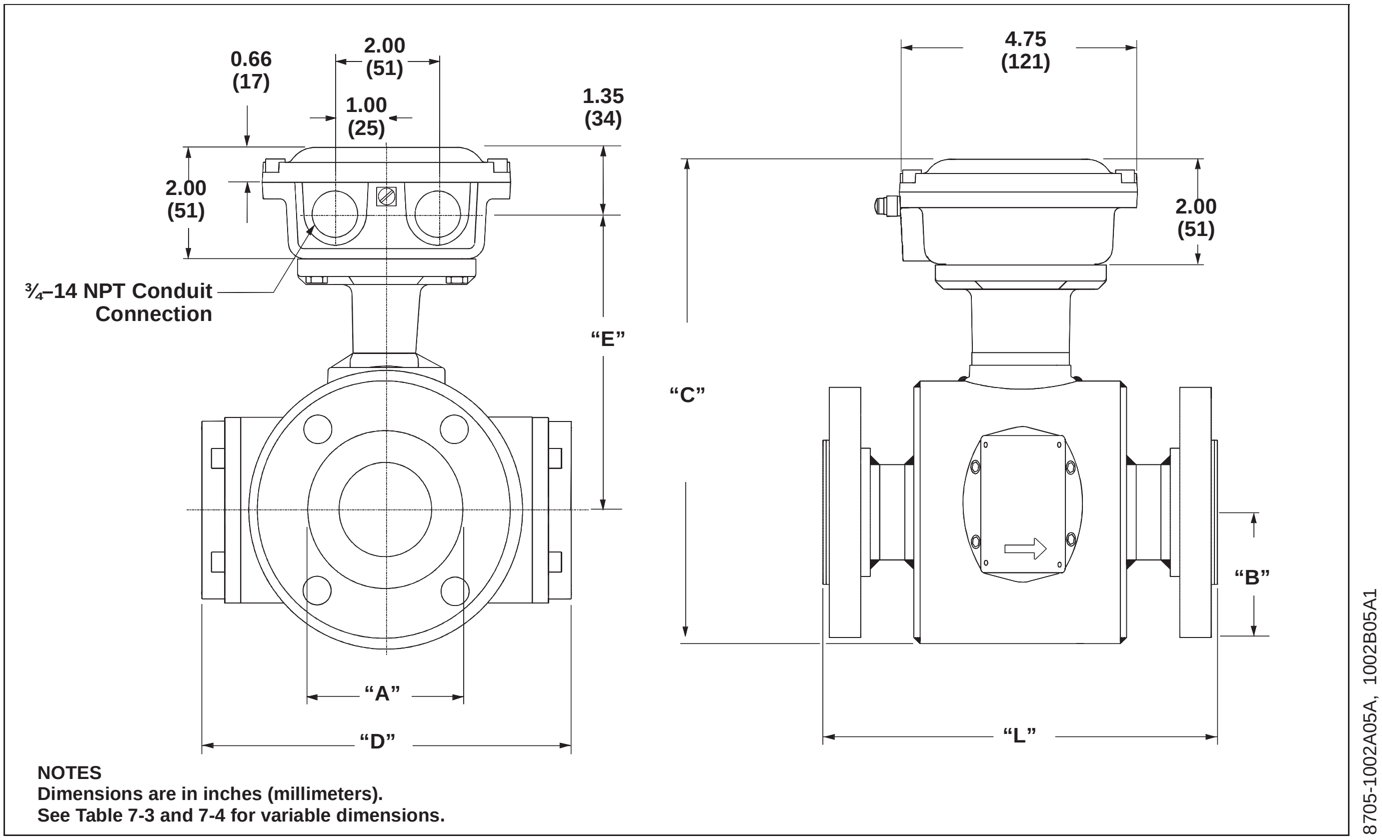


FIGURE 7-1. Dimensional Drawing of Model 8705 Flowtubes, Typical of ½- through 4-inch (15–100 mm) Line Sizes.

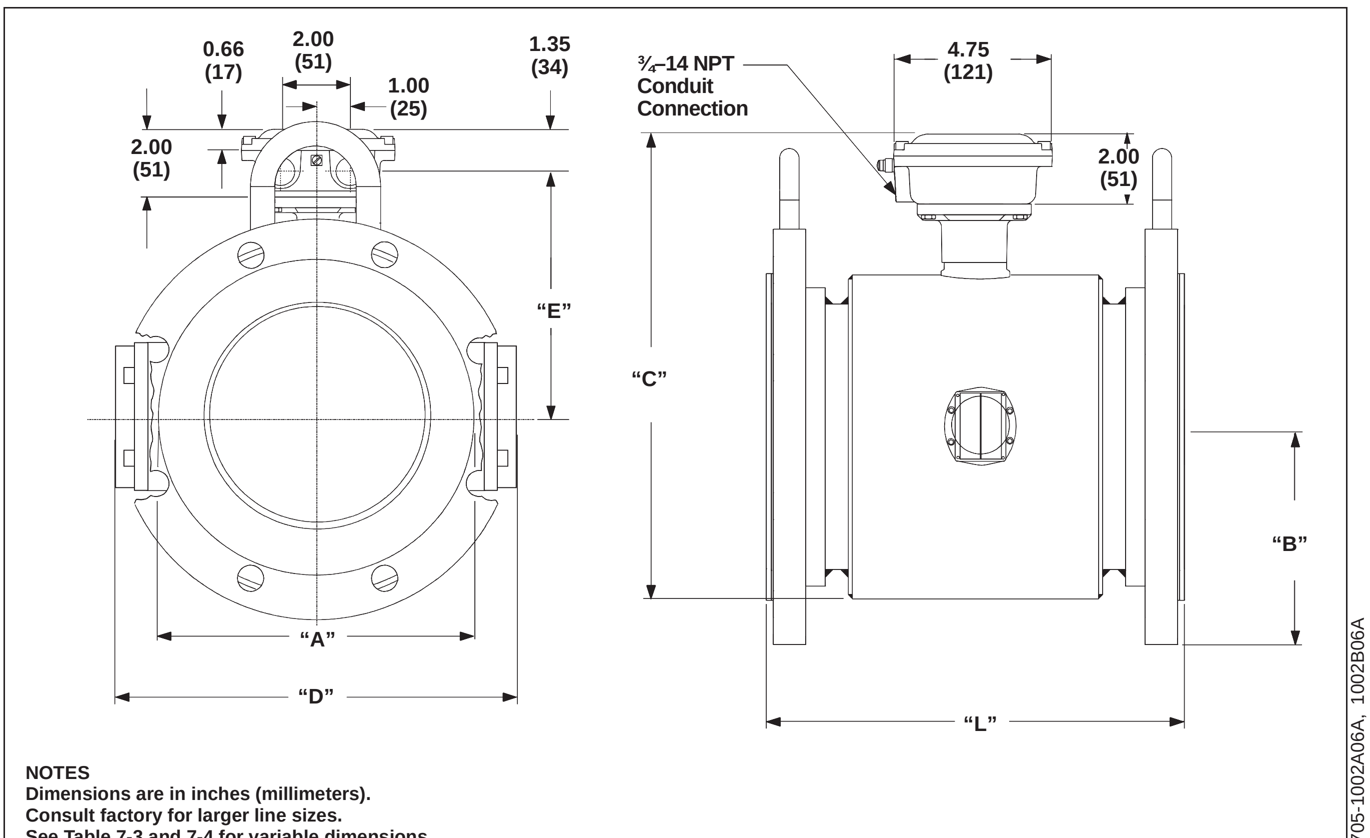


FIGURE 7-2. Dimensional Drawing of Model 8705 Flowtubes, Typical of 6- through 36-inch (150–900 mm) Line Sizes.

ORDERING INFORMATION

Model	Product Description
8705	Magnetic Flowmeter Flowtube

Code	Lining Material
T	PTFE *Teflon*
F	ETFE *Tefzel*
P	Polyurethane (Available in 1½- through 36-inch (40–900 mm) line sizes.)
N	Neoprene (Available in 1½- through 36-inch (40–900 mm) line sizes.)
G	Natural Rubber (Available in 1½- through 36-inch (40–900 mm) line sizes.)

		ELECTRODE TYPE (see below)		
Code	Electrode Material	Code A (Add)	Code E (Add)	Code R (Add)
S	316L Stainless Steel	•	•	•
H	*Hastelloy C-276*	•	•	•
T	Tantalum (Available with PTFE lining only.)	•	•	—
P	Platinum – 10% Iridium (Available with PTFE lining only.)	•	•	—
N	Titanium (Available with PTFE lining only.)	•	•	—

Code	Electrode Type
A	Standard, Two Measurement Electrodes
E	Two Measurement Electrodes plus Third Grounding Electrode
R	Two Field-removable Electrodes (Electrode Material Codes S and H only.) (Not available in ½- and 1-inch (13-25mm) line sizes.) On 1½- to 4-inch (40 to 100 mm), field removable electrodes are not available with sealed electrode compartments. Access only available.

		LINING MATERIAL				
Code	Line Size	Code T PTFE *Teflon*	Code F ETFE *Tefzel*	Code P Polyurethane	Code N Neoprene	Code G Natural Rubber
005	½ inch (15 mm)	•	•	—	—	—
010	1 inch (25 mm)	•	•	—	—	—
015	1½ inch (40 mm)	•	•	•	•	•
020	2 inch (50 mm)	•	•	•	•	•
030	3 inch (80 mm)	•	•	•	•	•
040	4 inch (100 mm)	•	•	•	•	•
060	6 inch (150 mm)	•	•	•	•	•
080	8 inch (200 mm)	•	•	•	•	•
100	10 inch (250 mm)	•	•	•	•	•
120	12 inch (300 mm)	•	•	•	•	•
140	14 inch (350 mm)	•	•	•	•	•
160	16 inch (400 mm)	•	•	•	•	•
180	18 inch (450 mm)	•	—	•	•	•
200	20 inch (500 mm)	•	—	•	•	•
240	24 inch (600 mm)	•	—	•	•	•
300	30 inch (750 mm)	•	—	•	•	•
360	36 inch (900 mm)	•	—	•	•	•

Code	Flange Material, Type and Rating
C1	Carbon Steel, ANSI Class 150 (AWWA Class 125–30 and 36 inch)
C3	Carbon Steel, ANSI Class 300
S1	304 Stainless Steel, ANSI Class 150 (AWWA Class 125–30 and 36 inch)
S3	304 Stainless Steel, ANSI Class 300
CD	Carbon Steel, DIN PN 10 (Standard size flange for sizes 200 through 900 mm)
CE	Carbon Steel, DIN PN 16 (Standard size flange for sizes 100 and 150 mm)
CF	Carbon Steel, DIN PN 25
CH	Carbon Steel, DIN PN 40 (Standard size flange for sizes 15 through 80 mm)
SD	Stainless Steel, DIN PN 10 (Standard size flange for sizes 200 through 900 mm)
SE	Stainless Steel, DIN PN 16 (Standard size flange for sizes 100 and 150 mm)
SF	Stainless Steel, DIN PN 25
SH	Stainless Steel, DIN PN 40 (Standard size flange for sizes 15 through 80 mm)

Code	Optional Grounding Rings and Lining Protection	
G L	Grounding Ring Lining Protectors } Grounding rings and lining protectors cannot be used together. Both options provide the same fluid grounding function. Lining protectors available with PTFE liners only.	
Code	**Grounding Rings, Lining Protector Wetted Material**	
1	316L SST	
2	*Hastelloy C-276* (Available in ½-through 12-inch (15 - 300mm) sizes only.)	
3	Titanium (Available in ½-through 12-inch (15 - 300mm) sizes only.)	
4	Tantalum (Available in ½- through 8-inch (15 - 200 mm) sizes only.) (Not available with option code L.)	
Code	**Options**	
W1	Standard sealed, welded housing without sealed electrode compartments(1) Not available with field-removable electrodes (Option Code R)	
H1	Flowtube with Model 8701 lay length (Available for ½ through 16-inch (15–400 mm) line sizes) (For ½ through 4-inch (15–100 mm) sizes, the flowtube is shipped with a spool piece)	
B1	Integral Mount with Model 8712C Transmitter	
B3	Integral Mount with Model 8732C Transmitter	
KD	KEMA/CENELEC Approval	
Q4	Calibration Data Sheet	
Q5	Hydrostatic Test Certificate	
Q8	Material Traceability Certificate per DIN 3.1B	
Q9	Material Traceability Certificate (Electrodes only) per DIN 3.1B	
A3	Sanitary 3-A for ANSI 150 to Tri-Clamp (½- to 3-inches (15-80 mm) sizes only)(2)	
Typical Model Number:	**8705 T S A 040 C1 G 1**	

(1) W1 is shipped with a 5 psi housing relief valve.

(2) Teflon (T) liner only. W1 option required. Only Stainless Steel Tri-Clamp Adapters available. Available with Stainless Steel, Hastelloy, and Platinum – 10% Iridium type electrodes.

Section 8

Model 8711 Specifications and Reference Data

SPECIFICATIONS

Functional Specifications

Service

Conductive liquids and slurries.

Line Sizes

0.15, 0.30, 0.5, 1, 1.5, 2, 3, 4, 6, and 8 inches (4, 8, 15, 25, 40, 50, 80, 100, 150, 200 mm).

Upper Range Limit

30 ft/s (10 m/s).

Interchangeability

All Model 8711 Flowtubes and Series 8712 or 8732 Transmitters are interchangeable. Each flowtube nameplate has a multi-digit calibration number that can be entered into any Series 8712 or 8732 Transmitter through the Local Operator Interface (LOI) or a HART-based communicator. No further calibration is necessary.

Process Temperature Limits

ETFE Tefzel Lining

–20 to 300 °F (–29 to 149 °C) for ½ through 8-inch (15–200 mm) line sizes.

–20 to 200 °F (–29 to 93 °C) for 0.15 and 0.3-inch (4 and 8 mm) line sizes.

TABLE 8-1. Relation Between Ambient Temperature, Process Temperature, and Temperature Class.

Meter Size (inches)	Maximum Ambient Temperature	Maximum Process Temperature	Temperature Class
½	149 °F (65 °C)	240 °F (116 °C)	T3
1	149 °F (65 °C)	248 °F (120 °C)	T3
1	95 °F (35 °C)	95 °F (35 °C)	T4
1½	149 °F (65 °C)	257 °F (125 °C)	T3
1½	140 °F (60 °C)	140 °F (60 °C)	T4
2	149 °F (65 °C)	257 °F (125 °C)	T3
2	149 °F (65 °C)	167 °F (75 °C)	T4
2	104 °F (40 °C)	104 °F (40 °C)	T5
3 to 4	149 °F (65 °C)	266 °F (130 °C)	T3
3 to 4	149 °F (65 °C)	167 °F (75 °C)	T4
3 to 4	131 °F (55 °C)	194 °F (90 °C)	T5
3 to 4	104 °F (40 °C)	104 °F (40 °C)	T6
6	149 °F (65 °C)	175 °F (79 °C)	T3
6	149 °F (65 °C)	167 °F (75 °C)	T4
6	149 °F (65 °C)	230 °F (110 °C)	T5
6	140 °F (60 °C)	140 °F (60 °C)	T6
8 to 60	149 °F (65 °C)	284 °F (140 °C)	T3
8 to 60	149 °F (65 °C)	240 °F (116 °C)	T4
8 to 60	149 °F (65 °C)	176 °F (80 °C)	T5
8 to 60	149 °F (65 °C)	149 °F (65 °C)	T6

Standard Hazardous Locations Certifications

Factory Mutual (FM) Approval

Approved for Class I, Division 2, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III hazardous locations.
NEMA 4X.

Canadian Standards Association (CSA) Approval

Approved for Class I, Division 2, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III hazardous locations,
CSA enclosure 4.

Optional Hazardous Locations Certifications

E5 Factory Mutual (FM) Approval

Explosion Proof for Class I, Division 1, Groups C and D. Available for remote mount Series 8712 or integral mount 8732C Transmitters.

KEMA/CENELEC Approval

CD EEx e ia IIC T3...T6. See Table 8-1.

Maximum Safe Working Pressure at 100 °F (38 °C)

Tefzel Lining

Full vacuum to 740 psi (5.1 MPa) for ½ through 8-inch (15–200 mm) flowtubes.

285 psi (1.96 MPa) for 0.15- and 0.30-inch (4 and 8 mm) flowtubes.

Performance Specifications

(System specifications are given using the frequency output and with the unit at referenced conditions.)

Accuracy (with Model 8712C/U or Model 8732C Transmitters)

±0.5% of rate from 3 to 30 ft/s (1 to 10 m/s).

±0.015 ft/s (0.005 m/s) from low-flow cutoff to 3 ft/s (1 m/s).

Vibration Effect

Meets IEC 770 Pipeline Installation Conditions.

Mounting Position Effect

No effect when installed to ensure flowtube remains full.

Physical Specifications

Non-Wetted Materials

Flowtube

303 SST (ASTM A-743).

Coil Housing

Investment cast steel (ASTM A-27).

Paint

Polyurethane.

Process-Wetted Materials

Lining

Tefzel.

Electrodes

316L SST, titanium, tantalum, Hastelloy C-276, or platinum—10% iridium.

Process Connections

Mounts between these Flange Configurations

ANSI: Class 150, 300.vv

DIN: PN 10 and 25.

BS: 10 Table D, E, and F.

Mounting Studs

0.15, 0.30, 0.5, and 1 inch (4, 8, 15, 25 mm):
316 SST, ASTM A-193, Grade B7.

1.5, 2, 3, 4, 6, and 8 inch (40, 50, 80, 100, 150 and 200 mm):
CRS, ASTM A-193, Grade B7.

Electrical Connections

Two ¾–14 NPT connections are provided in the terminal enclosure for electrical wiring.

Grounding Rings

Grounding rings are installed between the flange and the tube face on both ends of the flowtube. They have an ID slightly larger than the flowtube ID and an external tab for attaching ground wiring. Grounding rings are available in 316L stainless steel, Hastelloy C-276, titanium, and tantalum.

Grounding Electrode

A grounding electrode is installed similarly to the measurement electrodes through the flowtube lining. It is available in 316L stainless steel, Hastelloy C-276, titanium, tantalum or platinum.

Weight

See Table 8-2.

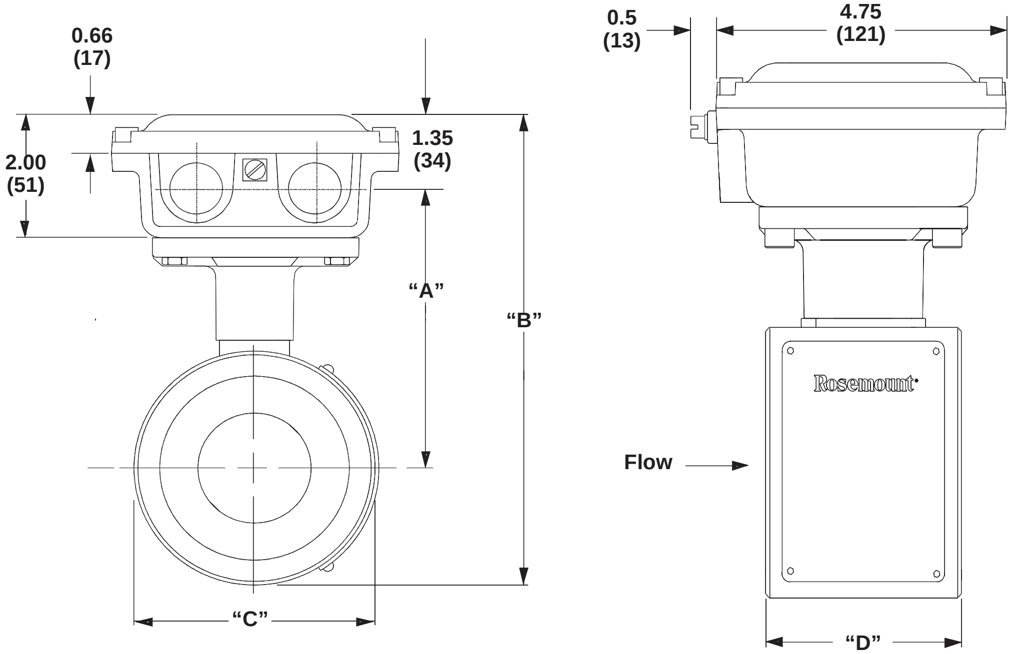
TABLE 8-2. Flowtube Dimensions and Weight.

Nominal Line Size Inches (mm)		Flowtube Housing Dimensions						Flowtube Length		Weight lb (kg)	
		"A" Max.		"B"		"C"		"D"			
0.15[1]	(4)	5.85	(149)	6.79	(172)	3.56	(90)	2.15	(55)	4	(2)
0.30[1]	(8)	5.85	(149)	6.79	(172)	3.56	(90)	2.15	(55)	4	(2)
0.5	(15)	5.85	(149)	6.79	(172)	3.56	(90)	2.15	(55)	4	(2)
1	(25)	6.16	(157)	7.41	(188)	4.50	(114)	2.15	(55)	5	(2)
1.5	(40)	6.16	(157)	7.30	(185)	3.25	(83)	2.73	(69)	5	(2)
2	(50)	6.47	(165)	7.91	(201)	3.88	(99)	3.26	(83)	7	(3)
3	(80)	7.09	(180)	9.14	(232)	5.13	(130)	4.68	(119)	13	(6)
4	(100)	7.78	(198)	10.53	(267)	6.50	(165)	5.88	(149)	22	(10)
6	(150)	8.81	(224)	12.59	(320)	8.56	(218)	6.87	(175)	35	(16)
8	(200)	9.87	(251)	14.72	(374)	10.69	(272)	8.86	(225)	60	(27)

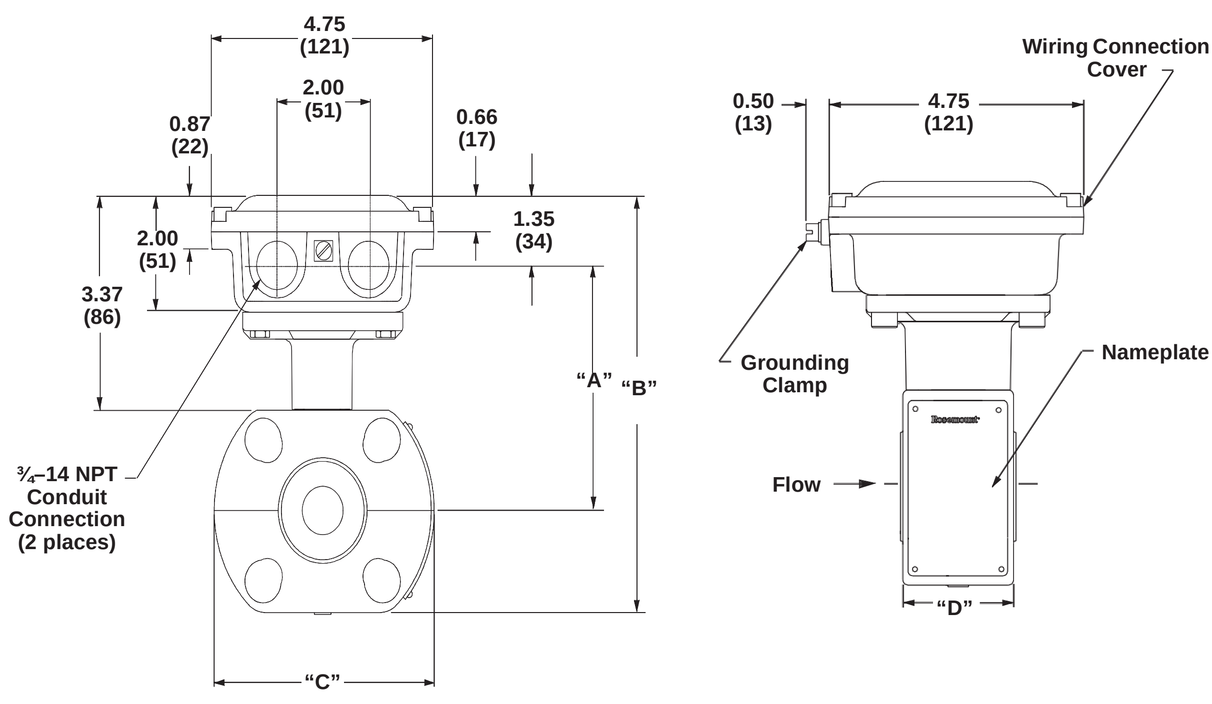
(1) 0.15 and 0.30 inch (4 and 8 mm) flowtubes mount between ½-inch (13 mm) flange.

FIGURE 8-1. Model 8711
Dimensional Drawings

1.5- THROUGH 8-INCH LINE SIZES



0.15- THROUGH 1-INCH LINE SIZES



8711-1012B04A, A04A, B03A, A03A

NOTES
Dimensions are in inches (millimeters).
See Table 8-2 for variable dimensions.

ORDERING INFORMATION

Model	Product Description
8711	Magnetic Flowmeter Flowtube (Flangeless Construction)
Code	**Lining Material**
T	*ETFE Tefzel*
Code	**Electrode Material**
S	316L SST
H	*Hastelloy C-276*
T	Tantalum
P	Platinum – 10% Iridium
N	Titanium
Code	**Electrode Construction**
A	Standard Measurement Electrodes (no grounding electrode)
E	Measurement Electrodes and Grounding Electrode
Code	**Line Size, Inches (mm)**
15F	0.15 (4)
30F	0.30 (8)
005	0.5 (15)
010	1.0 (25)
015	1.5 (40)
020	2.0 (50)
030	3.0 (80)
040	4.0 (100)
060	6.0 (150)
080	8.0 (200)
Code	**Transmitter Mounting Configuration**
R	Remote (2-inch Pipe or Surface Mount)
S	Integral with Model 8712C Transmitter
U	Integral with Model 8732C Transmitter
Code	**Mounting Kit**
1	ANSI Class 150
2	DIN PN 10/16 (8 inch (200mm) has a PN 10 Mounting Kit Only.)
3	ANSI Class 300
4	DIN PN 25/40 (8 inch (200mm) has a PN 25 Mounting Kit Only.)
Code	**Option**
E5	Factory Mutual (FM) Explosion Proof Approvals
G1	Grounding Rings, 316L SST
G2	Grounding Rings, *Hastelloy C-276*
G3	Grounding Rings, Titanium
G4	Grounding Rings, Tantalum
CD	KEMA/CENELEC Flameproof Approvals
Q4	Calibration Data Sheet
Q8	Material Traceability Certificate per DIN 3.1B
Q9	Material Traceability Certificate (Electrodes only) per DIN 3.1B
Typical Model Number:	**8711 T S A 040 R 1 G1**

Appendix A

HART Communicator

INTRODUCTION

This appendix provides basic communicator information on the HART Communicator Model 275 when used with a Model 8732C Integral Mount Magnetic Flowmeter System.

Included in this appendix are a menu tree, a table of fast key sequences, and information on using the HART communicator.

For more complete information on the HART Communicator, refer to the HART Communicator Product Manual 00809-0100-4275.

This brief appendix will familiarize you with the HART Communicator but is not meant to replace the HART Communicator product manual.

SAFETY MESSAGES

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

⚠WARNING

Explosions could result in death or serious injury:

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

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

- Make sure only qualified personnel perform these procedures.
- Do not perform any service other than those contained in this manual unless qualified.

FIGURE A-1. HART Communicator Menu Tree.

On-line Menu

- **1 DEVICE SETUP**
  - **1 PROCESS VARIABLE**
    - 1 Flow Rate
    - 2 Percent of Range
    - 3 Analog Output
    - **4 TOTALIZER**
      - 1 Gross Totalized Value
      - 2 Net Totalized Value
      - 3 Reverse Totalized Value
      - 4 Start Totalizer
      - 5 Stop Totalizer
      - 6 Reset Totalizer
    - 5 Pulse Output
  - **2 DIAGNOSTICS & SERVICE**
    - **1 SELF TEST/STATUS**
      - 1 View Status
      - 2 Self Test
    - 2 Loop Test
    - 3 Pulse Output Test
    - **4 CALIBRATION**
      - 1 D/A Trim
      - 2 Scaled D/A Trim
      - 3 Electronics Trim
      - 4 Auto Zero Trim
  - **3 BASIC SETUP**
    - 1 Tag
    - **2 PV UNITS**
      - 1 Flow Rate Units
      - **2 SPECIAL UNITS**
        - 1 User Defined Vol Unit
        - 2 Base Vol Unit
        - 3 Conversion Number
        - 4 Base Time Unit
        - 5 User Defined Flow Unit
    - 3 Upper Range Value
    - 4 Lower Range Value
    - 5 Line Size
    - 6 Calibration Number
    - 7 Damping
  - **4 DETAILED SETUP**
    - **1 CHARACTERIZE METER**
      - 1 Line Size
      - 2 Calibration Number
      - 3 Coil Drive Freq.
      - 4 Upper Spec. Limit (view)
      - 5 Lower Spec Limit (view)
      - 6 PV Min Span
    - **2 PV UNITS**
      - 1 Flow Rate Units
      - **2 SPECIAL UNITS**
        - 1 Base Vol Unit
        - 2 Base Time Unit
        - 3 Conversion Number
        - 4 User Defined Vol Unit
        - 5 User Defined Flow Unit
    - **3 CONFIGURE OUTPUTS**
      - **1 ANALOG OUTPUT**
        - 1 Upper Range Value
        - 2 Lower Range Value
        - 3 Analog Output
        - 4 Alarm Type
        - 5 Loop Test
      - 2 Aux/Pulse Output Control
      - **3 PULSE OUTPUT**
        - 1 Pulse Output Scaling
        - 2 Pulse Width
        - 3 Pulse Output Test
      - **4 AUX. OUTPUT**
        - 1 Reverse Flow Enable
        - 2 Zero Flow Enable
      - **5 TOTALIZER**
        - 1 Gross Totalized Value
        - 2 Net Totalized Value
        - 3 Reverse Totalized Value
        - 4 Start Totalizer
        - 5 Stop Totalizer
        - 6 Reset Totalizer
      - **6 HART OUTPUT**
        - 1 Poll Address
        - 2 # Preambles
        - 3 Burst Mode Control
        - 4 Burst Option
    - **4 SIGNAL PROCESSING**
      - 1 Low Flow Cutoff
      - 2 Damping
      - 3 Coil Drive Freq.
      - 4 Signal Processing Status
      - 5 # of Samples
      - 6 Max % Limit
      - 7 Time Limit
    - **5 DEVICE INFO**
      - 1 Manufacturer
      - 2 Tag
      - 3 Descriptor
      - 4 Message
      - 5 Date
      - 6 Device ID
      - 7 Flowtube S/N
      - 8 Flowtube Tag
      - 9 Write Protect
      - **– REV NUMBER**
        - 1 Univ. Rev
        - 2 Xmtr Rev
        - 3 Software Rev
      - **– CONSTRUCTION MAT'L**
        - 1 Fig Type
        - 2 Flange Material
        - 3 Electrode Type
        - 4 Electrode Material
        - 5 Liner Material
  - **5 REVIEW**
- 2 PV
- 3 AO
- 4 LRV
- 5 URV

NOTE
The Review menu lists all of the information stored in the Model 8732C. This includes device information, measuring element, signal condition, output condition, and software revision.

TABLE A-1. HART Fast Key Sequences for the Model 8732C.

Function	HART Fast Key
AO Alarm Type	1, 4, 3, 1, 4
Analog Output	1, 1, 3
Analog Output Range (URV)	1, 3, 3
Analog Output Zero (LRV)	1, 3, 4
Analog Output Test	1, 2, 2
Auto Zero	1, 2, 4, 4
Auxiliary Output Control	1, 4, 3, 2
Base Time Unit	1, 3, 2, 2, 4
Base Volume Unit	1, 3, 2, 2, 2
Burst Mode Control	1, 4, 3, 6, 3
Burst Mode Options	1, 4, 3, 6, 4
Calibration	1, 2, 4
Calibration Number	1, 3, 6
Coil Frequency	1, 4, 4, 3
Conversion Number	1, 3, 2, 2, 3
Damping	1, 3, 7
D/A Trim	1, 2, 4, 1
Date	1, 4, 5, 5
Descriptor	1, 4, 5, 3
Device ID	1, 4, 5, 6
Digital/Electronics Trim	1, 2, 4, 3
Flow Rate Unit	1, 3, 2, 2, 5
Flowtube Serial Number	1, 4, 5, 7
Flow Units	1, 4, 2
Gross Totalized Value	1, 4, 1
Line Size	1, 3, 5
Loop Test	1, 2, 2
Low Flow Cutoff	1, 4, 4, 1
Lower Range Value	1, 3, 4

Function	HART Fast Key
Message	1, 4, 5, 4
Net Totalized Value	1, 4, 2
Number Requested Preams	1, 4, 3, 6, 2
Poll Address	1, 4, 3, 6, 1
Process Variables–PV	1, 1
Pulse Output	1, 1, 5
Pulse Output Loop Test	1, 2, 3
Pulse Scaling	1, 4, 3, 3, 1
Pulse Width	1, 4, 3, 3, 2
PV Percent Range	1, 1, 2
PV Unit	1, 3, 2
Reverse Totalized Value	1, 4, 3
Review	1, 5
Scaled D/A Trim	1, 2, 4, 2
Self Test	1, 2, 1, 2
Sensor–PV	1, 1, 1
Signal Processing	1, 4, 4
Signal Processing–Percent Limit	1, 4, 4, 6
Signal Processing–Samples	1, 4, 4, 5
Signal Processing–Status	1, 4, 4, 4
Signal Processing–Time Limit	1, 4, 4, 7
Special Units	1, 4, 2, 2
Tag Number	1, 3, 5, 2
Totalize Reset	1, 1, 4, 6
Totalize Start	1, 1, 4, 4
Totalize Stop	1, 1, 4, 5
Upper Range Value	1, 3, 3
Volume Unit	1, 3, 2, 2, 1
Write Protect	1, 4, 5, 9

CONNECTIONS AND HARDWARE

The HART Communicator exchanges information with the transmitter from the control room, the instrument site, or any wiring termination point in the loop. The HART Communicator should be connected in parallel with the transmitter. Use the loop connection ports on the rear panel of the HART Communicator (see Figure A-2). The connections are non-polarized.

Do not make connections to the serial port or NiCad recharger jack in an explosive atmosphere. Before connecting the HART Communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or nonincendive field wiring practices.

FIGURE A-2. Rear Connection Panel with Optional NiCad Recharger Jack.

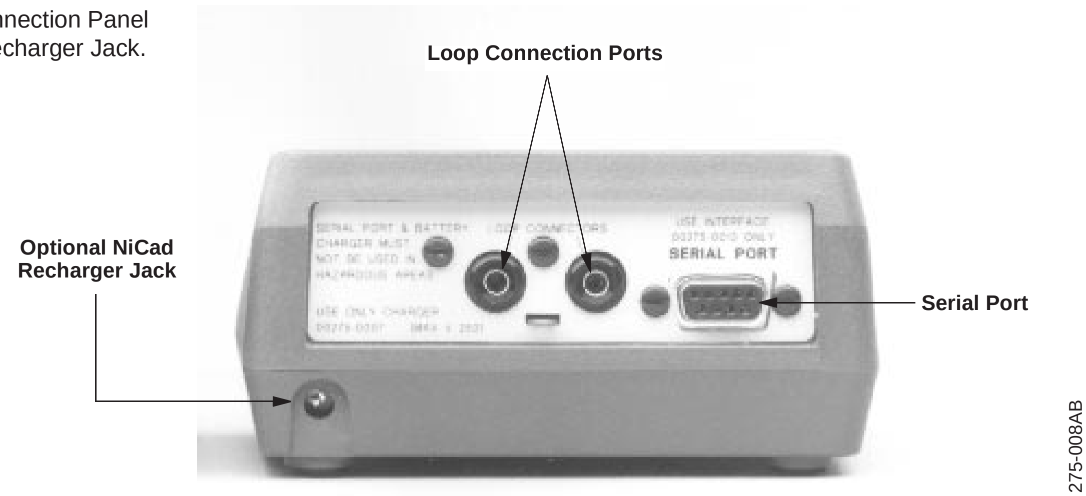
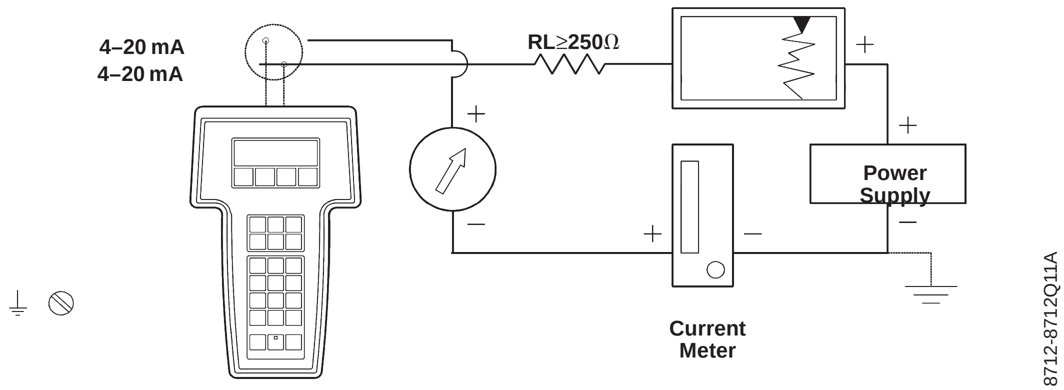


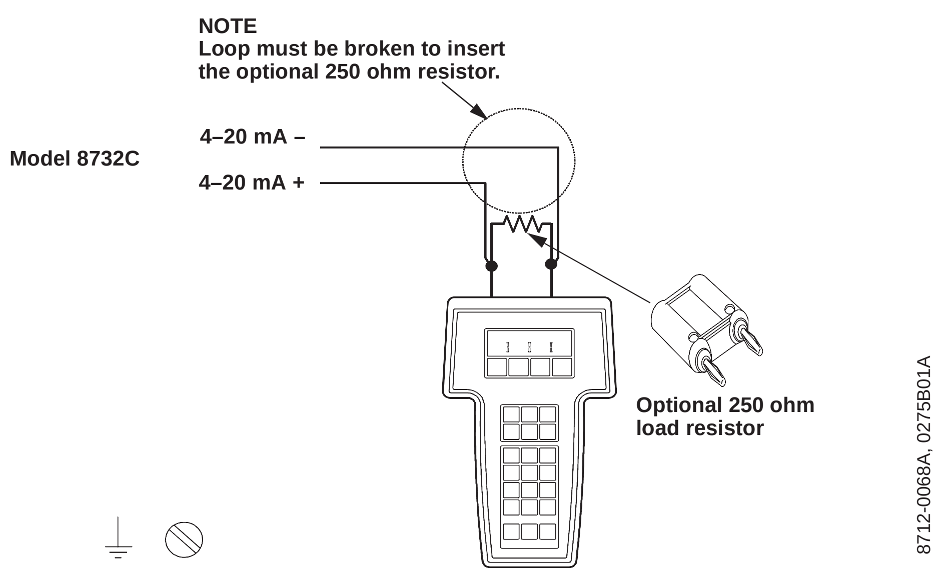
FIGURE A-3. Connecting the HART Communicator to a Transmitter Loop.



NOTE

The HART Communicator needs a minimum of 250 ohms resistance in the loop to function properly. The HART Communicator does not measure loop current directly.

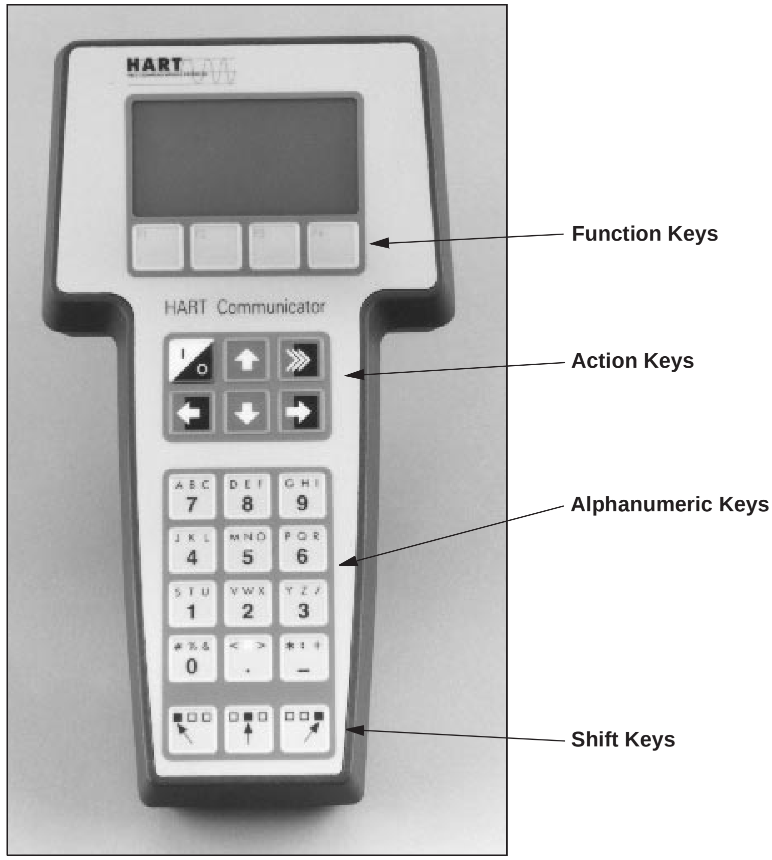
FIGURE A-4. Connecting the HART Communicator with the Optional Load Resistor.



BASIC FEATURES

The basic features of the HART Communicator include Action Keys, Function Keys, and Alphanumeric and Shift Keys.

FIGURE A-5. The HART Communicator.



Action Keys

The Action Keys

As shown in Figure A-5, the action keys are the six blue, white, and black keys located above the alphanumeric keys. The function of each key is described as follows:

ON/OFF Key

Use this key to power the HART Communicator. When the communicator is turned on, it searches for a transmitter on the 4–20 mA loop. If a device is not found, the communicator displays the message, "No Device Found. Press OK."

If a HART-compatible device is found, the communicator displays the Online Menu with device ID and tag.

Directional Keys

Use these keys to move the cursor up, down, left, or right. The right arrow key also selects menu options, and the left arrow key returns to the previous menu.

HOT Key

Use this key to quickly access important, user-defined options when connected to a HART-compatible device. Pressing the Hot Key turns the HART Communicator on and displays the Hot Key Menu. See Customizing the Hot Key Menu in the HART Communicator manual for more information.

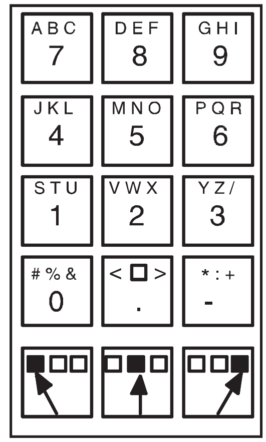
Function Keys

Use the four software-defined function keys, located below the LCD, to perform software functions. On any given menu, the label appearing above a function key indicates the function of that key for the current menu. As you move among menus, different function key labels appear over the four keys. For example, in menus providing access to on-line help, the HELP label may appear above the F1 key. In menus providing access to the Home Menu, the HOME label may appear above the F3 key. Simply press the key to activate the function. See your HART Communicator manual for details on specific Function Key definitions.

Alphanumeric and Shift Keys

The Alphanumeric keys perform two functions: the fast selection of menu options and data entry.

FIGURE A-6. HART Communicator Alphanumeric and Shift Keys.

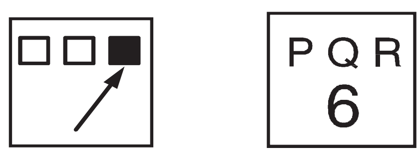


Data Entry

Some menus require data entry. Use the Alphanumeric and Shift keys to enter all alphanumeric information into the HART Communicator. If you press an Alphanumeric key alone from within an edit menu, the bold character in the center of the key appears. These large characters include the numbers zero through nine, the decimal point (.), and the dash symbol (–).

To enter an alphabetic character, first press the Shift key that corresponds to the position of the letter you want on the alphanumeric key. Then press the alphanumeric key. For example, to enter the letter R, first press the right Shift key, then the “6” key (see Figure A-7). Do not press these keys simultaneously, but one after the other.

FIGURE A-7. Data Entry Key Sequence.



HART Fast Key Feature

The HART Fast Key feature provides quick on-line access to transmitter variables and functions. Instead of stepping your way through the menu structure using the Action Keys, you can press a HART Fast Key Sequence to move from the Online Menu to the desired variable or function. On-screen instructions guide you through the rest of the screens.

HART Fast Key Example

The HART Fast Key sequences are made up of the series of numbers corresponding to the individual options in each step of the menu structure. For example, from the Online Menu you can change the **Date**. Following the menu structure, press 1 to reach **Device Setup**, press 4 for **Detailed Setup**, press 5 for **Device Info**, press 5 for **Date**. The corresponding HART Fast Key sequence is 1,4,5,5.

HART Fast Keys are operational only from the Online Menu. If you use them consistently, you will need to return to the Online Menu by pressing HOME (F3) when it is available. If you do not start at the Online Menu, the HART Fast Keys will not function properly.

Use Table A-1, an alphabetical listing of every on-line function, to find the corresponding HART Fast Keys. These codes are applicable only to the transmitter and the HART Communicator.

MENUS AND FUNCTIONS

The HART Communicator is a menu driven system. Each screen provides a menu of options that can be selected as outlined above, or provides direction for input of data, warnings, messages, or other instructions.

Main Menu

When the HART Communicator is turned on, one of two menus will appear. If the HART Communicator is connected to an operating loop, the communicator will find the device and display the Online Menu (see below). If it is not connected to a loop, the communicator will indicate that no device was found. When you press OK (F4), it will display the Main Menu.

The Main Menu provides the following options:

- *Offline*–The Offline option provides access to offline configuration data and simulation functions.
- *Online*–The Online option checks for a device and if it finds one, brings up the Online Menu.
- *Transfer*–The Transfer option provides access to options for transferring data either from the HART Communicator (Memory) to the transmitter (Device) or vice versa. Transfer is used to move off-line data from the HART Communicator to the flowmeter, or to retrieve data from a flowmeter for off-line revision.

NOTE
Online communication with the flowmeter automatically loads the current flowmeter data to the HART Communicator. Changes in on-line data are made active by pressing SEND (F2). The transfer function is used only for off-line data retrieval and sending.

- *Frequency Device*–The Frequency Device option displays the frequency output and corresponding pressure output of current-to-pressure transmitters.
- *Utility*–The Utility option provides access to the contrast control for the HART Communicator LCD screen and to the autopoll setting used in multidrop applications.

Once you have selected a Main Menu option, the HART Communicator provides the information you need to complete the operation. If further details are required, consult the HART Communicator manual.

Online Menu

The Online Menu can be selected from the Main Menu as outlined above, or it may appear automatically if the HART Communicator is connected to an active loop and can detect an operating flowmeter.

NOTE
The Main Menu can be accessed from the Online Menu. Press the left arrow action key to deactivate the on-line communication with the flowmeter and to activate the Main Menu options.

When configuration variables are reset in the on-line mode, the new settings are not activated until the data are sent to the flowmeter. Press SEND (F2) when it is activated to update the process variables of the flowmeter.

On-line mode is used for direct evaluation of a particular meter, re-configuration, changing parameters, maintenance, and other functions.

Diagnostic Messages

The following is a list of messages used by the HART Communicator (HC) and their corresponding descriptions.

TABLE A-2. Diagnostic Messages.

Message	Description
Add item for ALL device types or only for this ONE device type.	Asks the user whether the hot key item being added should be added for all device types or only for the type of device that is connected.
Command Not Implemented	The connected device does not support this function.
Communication Error	Either a device sends back a response indicating that the message it received was unintelligible, or the HC cannot understand the response from the device.
Configuration memory not compatible with connected device	The configuration stored in memory is incompatible with the device to which a transfer has been requested.
Device Busy	The connected device is busy performing another task.
Device Disconnected	Device fails to respond to a command.
Device write protected	Device is in write-protect mode. Data can not be written.
Device write protected. Do you still want to shut off?	Device is in write-protect mode. Press YES to turn the HC off and lose the unsent data.
Display value of variable on hotkey menu?	Asks whether the value of the variable should be displayed adjacent to its label on the hotkey menu if the item being added to the hotkey menu is a variable.
Download data from configuration memory to device	Prompts user to press SEND softkey to initiate a memory to device transfer.
Exceed field width	Indicates that the field width for the current arithmetic variable exceeds the device- specified description edit format.
Exceed precision	Indicates that the precision for the current arithmetic variable exceeds the device- specified description edit format.
Ignore next 50 occurrences of status?	Asked after displaying device status. Softkey answer determines whether next 50 occurrences of device status will be ignored or displayed.
Illegal character	An invalid character for the variable type was entered.
Illegal date	The day portion of the date is invalid.
Illegal month	The month portion of the date is invalid.
Illegal year	The year portion of the date is invalid.
Incomplete exponent	The exponent of a scientific notation floating point variable is incomplete.
Incomplete field	The value entered is not complete for the variable type.
Looking for a device	Polling for multidropped devices at addresses 1–15.
Mark as read only variable on hotkey menu?	Asks whether the user should be allowed to edit the variable from the hotkey menu if the item being added to the hotkey menu is a variable.
No device configuration in configuration memory	There is no configuration saved in memory available to re-configure off-line or transfer to a device.
No Device Found	Poll of address zero fails to find a device, or poll of all addresses fails to find a device if auto-poll is enabled.
No hotkey menu available for this device.	There is no menu named “hotkey” defined in the device description for this device.
No offline devices available.	There are no device descriptions available to be used to configure a device offline.
No simulation devices available.	There are no device descriptions available to simulate a device.
No UPLOAD_ VARIABLES in ddl for this device	There is no menu named “upload_variables” defined in the device description for this device. This menu is required for offline configuration.
No Valid Items	The selected menu or edit display contains no valid items.

Message	Description
OFF KEY DISABLED	Appears when the user attempts to turn the HC off before sending modified data or before completing a method.
Online device disconnected with unsent data. RETRY or OK to lose data.	There is unsent data for a previously connected device. Press RETRY to send data, or press OK to disconnect and lose unsent data.
Out of memory for hotkey configuration. Delete unnecessary items.	There is no more memory available to store additional hot key items. Unnecessary items should be deleted to make space available.
Overwrite existing configuration memory	Requests permission to overwrite existing configuration either by a device-to-memory transfer or by an offline configuration. User answers using the softkeys.
Press OK...	Press the OK softkey. This message usually appears after an error message from the application or as a result of HART communications.
Restore device value?	The edited value that was sent to a device was not properly implemented. Restoring the device value returns the variable to its original value.
Save data from device to configuration memory	Prompts user to press SAVE softkey to initiate a device-to-memory transfer.
Saving data to configuration memory.	Data is being transferred from a device to configuration memory.
Sending data to device.	Data is being transferred from configuration memory to a device.
There are write only variables which have not been edited. Please edit them.	There are write-only variables which have not been set by the user. These variables should be set or invalid values may be sent to the device.
There is unsent data. Send it before shutting off?	Press YES to send unsent data and turn the HC off. Press NO to turn the HC off and lose the unsent data.
Too few data bytes received	Command returns fewer data bytes than expected as determined by the device description.
Transmitter Fault	Device returns a command response indicating a fault with the connected device.
Units for <variable label> has changed. Unit must be sent before editing, or invalid data will be sent.	The engineering units for this variable have been edited. Send engineering units to the device before editing this variable.
Unsent data to online device. SEND or LOSE data.	There is unsent data for a previously connected device which must be sent or thrown away before connecting to another device.
Use up/down arrows to change contrast. Press DONE when done.	Gives direction to change the contrast of the HC display.
Value out of range	The user-entered value is either not within the range for the given type and size of variable or not within the min/max specified by the device.
<message> occurred reading/writing <variable label>	Either a read/write command indicates too few data bytes received, transmitter fault, invalid response code, invalid response command, invalid reply data field, or failed pre- or post-read method; or a response code of any class other than SUCCESS is returned reading a particular variable.
<variable label> has an unknown value. Unit must be sent before editing, or invalid data will be sent.	A variable related to this variable has been edited. Send related variable to the device before editing this variable.

Appendix **B**

Operation Planning

INTRODUCTION

Operation planning is necessary for successful installation. Process fluid conductivity should be 5 microsiemens/cm (5 micromhos/cm) or greater. All options available to the Model 8732C Integral Mount Magnetic Flowmeter System should be carefully reviewed before selection.

Flowtube site and process fluid characteristics are also important considerations. Proper flowtube orientation, sizing, and bypass piping minimize the effects of corrosive, fatty, or abrasive process fluids. Careful installation reduces start-up delays, facilitates maintenance, and ensures optimum performance.

SAFETY MESSAGES

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

⚠WARNING

Explosions could result in death or serious injury:

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

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

- Make sure only qualified personnel perform these procedures.
- Do not perform any service other than those contained in this manual unless qualified.

Flowtube Site Selection

Site planning reduces process down-time, prevents connection problems, and simplifies maintenance. The allowable distance between flowtube and transmitter is the length of the cable run, not the distance between their physical locations.

Requirements for a satisfactory flowtube site depend on the exact installation configuration. Consider the following when planning a site.

Line Power Access

A Model 8732C Integral Mount Magnetic Flowmeter System requires a supply of ac power only at the transmitter, and not at the flowtube. Check the power service requirements on the transmitter identification tag.

Bypass Piping

Bypass piping may be desirable to allow isolating the flowtube for servicing, cleaning, and replacement. Two configurations are shown in Figures B-1 and B-2.

Figure B-2 illustrates a conventional bypass useful for flowtube isolation.

Figure B-1 illustrates bypass piping with a cleanout tee. A cleanout tee is recommended when measuring greasy or insulating process fluids that may coat the flowtube wall.

FIGURE B-1. Bypass Piping with Cleanout Tee.

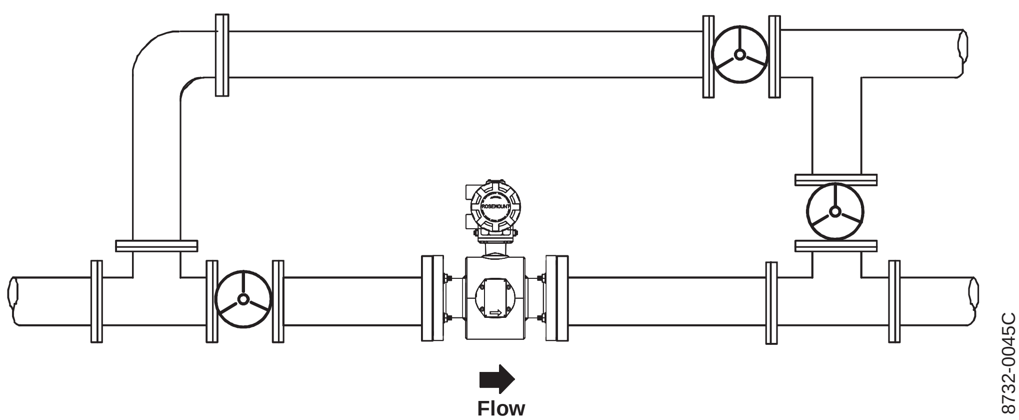
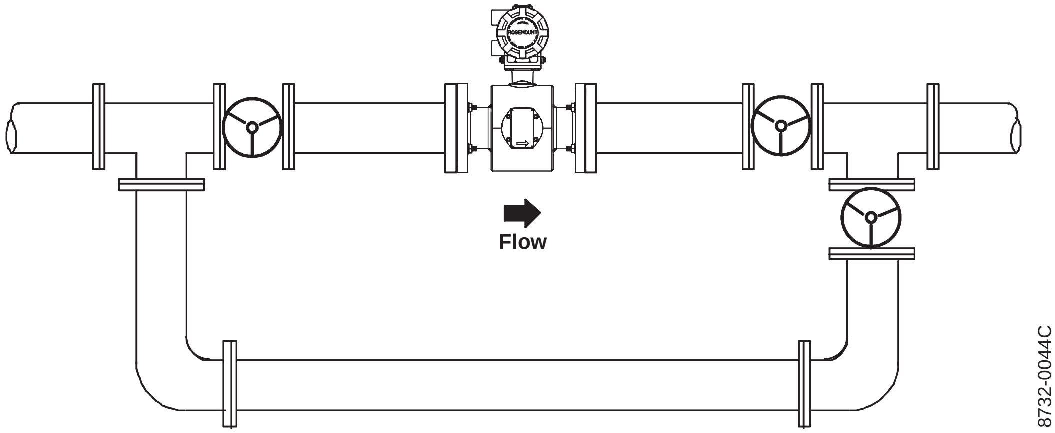


FIGURE B-2.
Typical Bypass Piping Configuration.



Process Conditions

Process conditions and loop elements must be considered during site selection to ensure an accurate, noise-free output signal. Avoid placement near pumps (especially positive displacement pumps) or flow variations may appear in the output signal.

Also, keep slurries as homogeneous as possible to prevent damage to the flowtube electrodes and liner. Homogeneity can often be achieved by locating the flowtube five straight pipe diameters downstream of loop pumps, with additives upstream of the pumps.

Finally, design the process loop conditions to ensure that the flowtube always remains full, with no entrapped air.

Adequate Space

Allow space for the flowtube, bypass piping, and equipment maneuverability during installation and removal. Note that integrally mounted transmitters require more space at the flowtube site.

Earth Ground

Specification accuracy and safety considerations require flowtube grounding.

Low-Noise Environment

Although a pulsed dc coil design reduces flowtube susceptibility to extraneous noise, some environments are more suitable than others. Avoid a close proximity to devices that may produce high intensity electromagnetic and electrostatic fields. Such devices include electric welding equipment, large electric motors and transformers, motor devices or controls, and communication transmitters.

Conductivity

Process fluid conductivity should be 5 microsiemens/cm (5 micromhos/cm) or greater. For low conductivity fluids, 5–20 micromhos/cm, cable length should be less than 25 feet and unshielded cable ends should be maintained.

Flowtube Orientation

Upstream Piping Length

Magnetic flowmeters are less sensitive to liquid velocity profile variation than most other flowmeters. However, to ensure specification accuracy over widely varying process conditions, install the flowtube with a minimum of five straight pipe diameters upstream and two straight pipe diameters downstream from the electrode plane. This will allow disturbances to settle out prior to measurement. This procedure is usually adequate to allow for disturbances created by elbows, valves, and reducers.

Vertical Installation

Vertical installation allows upward process fluid flow and is generally preferred. Upward flow keeps the cross-sectional area full, regardless of flow rate. Orientation of the electrode plane is unimportant in vertical installations.

NOTE
Avoid downward vertical flows where back pressure is inadequate to ensure that the flowtube remains full.

Horizontal Installation

Horizontal installation should be restricted to low piping sections that are normally full. Orient the electrode plane to within 45 degrees of horizontal in horizontal installations. A deviation of more than 45 degrees of horizontal would place an electrode at or near the top of the flowtube–making it more susceptible to insulation by air or entrapped gas at the top of the flowtube.

Magnetic Flowmeter Sizing

The flowtube size is a very important consideration because it affects flow velocity. It is often necessary to select a magmeter that is larger or smaller than the adjacent piping to ensure the fluid velocity is in the range of 1 to 30 ft/s (0.3 to 9.1 m/s). Table B-1 shows guidelines for sizing normal velocities for magmeters in different types of applications (operation outside these guidelines may also give acceptable performance).

TABLE B-1. Sizing Guidelines.

Application	Velocity Range (ft/s)	Velocity Range (m/s)
Normal Service	2–20	0.6–6.1
Abrasive Slurries	3–10	0.9–3.1
Non-Abrasive Slurries	5–15	1.5–4.6

To convert flow rate to velocity, use the appropriate factor listed in Table B-2 and the following equation:

$$\text{Velocity} = \frac{\text{Flow Rate}}{\text{Factor}}$$

Example: English Units

Magmeter Size: 4 inch **(factor from Table B-2 = 39.679)**
Normal Flow Rate: 300 gpm

$$\text{Velocity} = \frac{300\ \text{(gpm)}}{39.679}$$

Velocity = 7.56 ft/s

Example: SI Units

Magmeter Size: 100 mm **(factor from Table B-2 = 495.73)**
Normal Flow Rate: 800 l/min

$$\text{Velocity} = \frac{800\ \text{(l/min)}}{495.73}$$

Velocity = 1.61 m/s

TABLE B-2. Line Size vs. Conversion Factor.

Nominal Line Size Inches (mm)	Gallons Per Minute Factor	Liters Per Minute Factor
0.15 (4)	0.055	0.687
0.30 (8)	0.220	2.750
½ (15)	0.947	11.834
1 (25)	2.693	33.657
1½ (40)	6.345	79.297
2 (50)	10.459	130.67
3 (80)	23.042	287.88
4 (100)	39.679	495.73
6 (150)	90.048	1,125.0
8 (200)	155.94	1,948.3
10 (250)	245.78	3,070.7
12 (300)	352.51	4,437.2
14 (350)	421.70	5,268.8
16 (400)	550.80	6,881.5
18 (450)	697.19	8,875.7
20 (500)	866.51	10,826
24 (600)	1,253.2	15,657
30 (750)	2,006.0	25,036
36 (900)	2,935.0	36,670

FIGURE B-3. Fluid Velocity vs. Rate Curves for Model 8705.

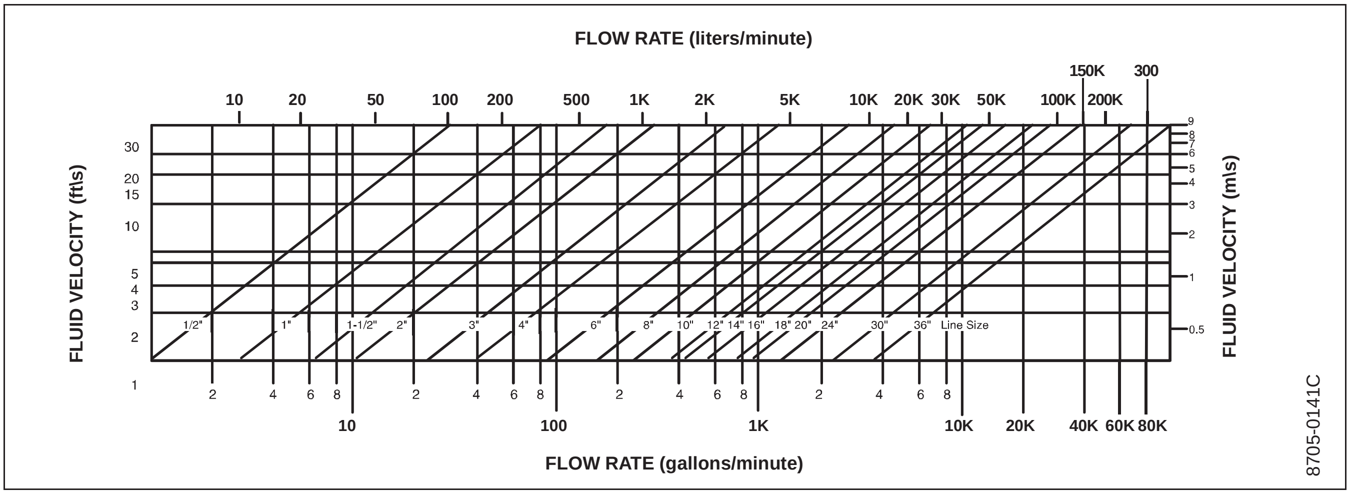


FIGURE B-4. Fluid Velocity vs. Rate Curves for Model 8711

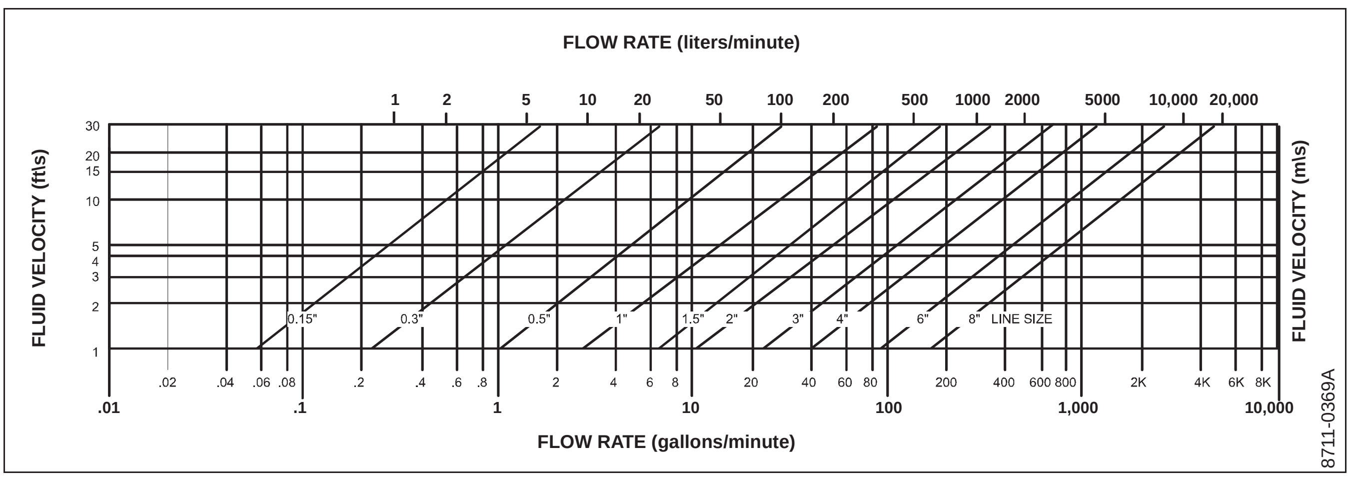


TABLE B-3. Line Size vs. Fluid Velocity/Rate

Nominal Line Size in Inches (mm)	Minimum/Maximum Flow Rate					
	Gallons per Minute			Liters per Minute		
	at 0.04 ft/s (Low-flow Cutoff)	at 1 ft/s (Min. Range Setting)	at 30 ft/s (Max Range Setting)	at 0.012 m/s (Low-flow Cutoff)	at 0.3 m/s (Min. Range Setting)	at 10 m/s (Max Range Setting)
0.15 (4)	0.002	0.055	1.65	0.008	0.209	6.27
0.30 (8)	0.009	0.220	6.60	0.033	0.834	25.02
½ (15)	0.038	0.947	28.412	0.144	3.568	107.55
1 (25)	0.108	2.694	80.813	0.408	10.199	305.91
1½ (40)	0.254	6.345	190.36	0.962	24.024	720.36
2 (50)	0.418	10.459	313.77	1.582	39.598	1,187.7
3 (80)	0.922	23.042	691.26	3.490	87.237	2,616.7
4 (100)	1.588	36.679	1,190.4	6.010	150.22	4,506.0
6 (150)	3.600	90.048	2,701.4	13.620	340.92	10,226
8 (200)	6.240	155.94	4,677.8	23.620	590.39	17,707
10 (250)	9.840	245.78	7,373.4	37.240	930.52	27,911
12 (300)	14.200	352.51	10,575	53.400	1,344.6	40,031
14 (350)	16.800	421.70	12,651	62.800	1,596.6	47,890
16 (400)	22.000	550.80	16,524	82.000	2,085.3	62,551
18 (450)	27.800	697.19	20,916	104.00	2,689.6	79,192
20 (500)	34.600	866.51	25,995	129.20	3,280.6	98,412
24 (600)	50.200	1,253.2	37,596	186.80	4,744.6	142,338
30 (750)	80.200	2,006.0	60,180	303.60	7,595.0	227,840
36 (900)	117.40	2,935.0	88,050	444.40	11,112	333,360

Appendix **C**

Transmitter Output Instability

SAFETY MESSAGES

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

Warnings

⚠WARNING

Explosions could result in death or serious injury:

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

⚠WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury:

- Make sure only qualified personnel perform the installation.
- Do not perform any service other than those contained in this manual unless qualified.

⚠WARNING

Process leaks could result in death or serious injury:

- The electrode compartment may contain line pressure; it must be depressurized before the cover is removed.

⚠WARNING

High voltage that may be present on leads could cause electrical shock:

- Avoid contact with leads and terminals.

PROCEDURES

If the output of your Model 8732C is unstable, first check the wiring and grounding associated with the magnetic flowmeter system (see the **Installation Check and Guide** on page 2-23).Ensure that the following conditions are met:

- Ground straps are attached to the adjacent flange or ground ring?
- Grounding rings, lining protectors, or grounding electrodes are being used in lined or nonconductive piping?
- Both of the shields attached at both ends?

The causes of unstable transmitter output can usually be traced to extraneous voltages on the measuring electrodes. This "process noise" can arise from several causes including electrochemical reactions between the fluid and the electrode, chemical reactions in the process itself, free ion activity in the fluid, or some other disturbance of the fluid/electrode capacitive layer. In such noisy applications, an analysis of the frequency spectrum reveals process noise that typically becomes significant below 15 Hz.

In some cases, the effects of process noise may be sharply reduced by elevating the coil drive frequency above the 15 Hz region. The Model 8732C coil drive mode is selectable between the standard 6 Hz and the noise-reducing 30 Hz. See **Noise Reduction (Damping** on page 4-12) for instructions on how to change the coil drive mode to 30 Hz.

Auto Zero

To ensure optimum accuracy when using 30 Hz coil drive mode, there is an auto zero function that must be initiated during start-up. The auto zero operation is also discussed in the start-up and configuration sections. When using 30 Hz coil drive mode it is important to zero the system for the specific application and installation.

The auto zero procedure should be performed only under the following conditions:

1. With the transmitter and flowtube installed in their final positions. This procedure is not applicable on the bench.
2. With the transmitter in 30 Hz coil drive mode. Never attempt this procedure with the transmitter in 6 Hz coil drive mode.
3. With the flowtube full of process fluid at zero flow.

These conditions should cause an output equivalent to zero flow.

Signal Processing

If the 30 Hz coil drive mode has been set, and the output is still unstable, the damping and signal processing function should be used. It is important to set the coil drive mode to 30 Hz first, so the loop response time is not increased.

The Model 8732C provides for a very easy and straightforward start-up, and also incorporates the capability to deal with difficult applications that have previously manifested themselves in a noisy output signal. In addition to selecting a higher coil drive frequency (30 Hz vs. 6 Hz) to isolate the flow signal from the process noise, the Model 8732C microprocessor can actually scrutinize each input based on three user-defined parameters to reject the noise specific to the application.

This software technique, known as signal processing, "qualifies" individual flow signals based on historic flow information and three user-definable parameters, plus and on/off control. These parameters are:

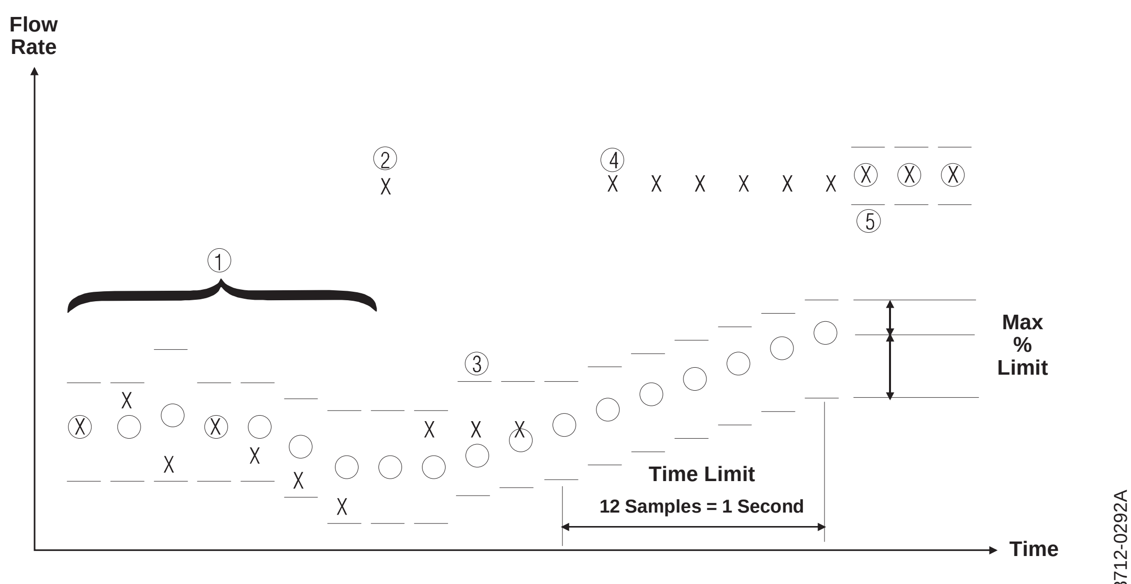
1. Number of samples: The number of samples or discrete input values included in the running average. Adjustable between 0 and 125 samples, it is this number of previous inputs that are averaged together to arrive at the average value. Because the output stage of the 8732C circuit is updated twelve times each second, regardless of coil drive mode, twelve samples equals one second (i.e., 0 to 120 samples = 0 to 10 seconds). Factory Preset Value = 90 samples (7.5 seconds).
2. Maximum Percent Limit: The tolerance band set up on either side of the running average, referring to percent deviation from the average. Values within the limit are accepted while value outside the limit are scrutinized to determine if they are a noise spike or an actual flow change. Factory Preset Value = 2 percent.
3. Time Limit: Forces the output and running average values to the new value of an actual flow rate change that is outside the percent limit boundaries, thereby limiting response time to real flow changes to the time limit value rather than the length of the running average. Factory Preset Value = 2 seconds.

How Does It Really Work?

The best way to explain this is with the help of an example, plotting flow rate versus time

.

FIGURE C-1. Signal Processing.



X: Input flow signal from flowtube.

O: Average flow signals and transmitter output, determined by the "number of samples" parameter.

Tolerance band, determined by the "percent limit" parameter.
– Upper value = average flow + [(percent limit/100) average flow]
– Lower value = average flow – [(percent limit/100) average flow]

① This scenario is that of a typical non-noisy flow. The input flow signal is within the percent limit tolerance band, therefore qualifying itself as a good input. In this case the new input is added directly into the running average and is passed on as a part of the average value to the output.

② This signal is outside the tolerance band and therefore is held in memory until the next input can be evaluated. The running average is provided as the output.

③ The previous signal currently held in memory is simply rejected as a noise spike since the next flow input signal is back within the tolerance band. This results in complete rejection of noise spikes rather than allowing them to be "averaged" with the good signals as occurs in the typical analog damping circuits.

④ As in Number 2 above, the input is outside the tolerance band. This first signal is held in memory and compared to the next signal. The next signal is also outside the tolerance band (in the same direction), so the stored value is added to the running average as the next input and the running average begins to slowly approach the new input level.

⑤ To avoid waiting for the slowly incrementing average value to catch up to the new level input, a shortcut is provided. This is the "time limit" parameter. The user can set this parameter to eliminate the slow ramping of the output toward the new input level.

When Should Signal Processing Be Used?

The Model 8732C offers three separate functions that can be used in series for improving a noisy output. The first step is to toggle the coil drive to the 30 Hz mode and initialize with an auto zero. If the output is still noisy at this stage, signal processing should be actuated and, if necessary, tuned to match the specific application. Finally, if the signal is still too unstable, the traditional damping function can be used.

Appendix **D**

Magnetic Flow Operating Principles

OPERATING PRINCIPLE

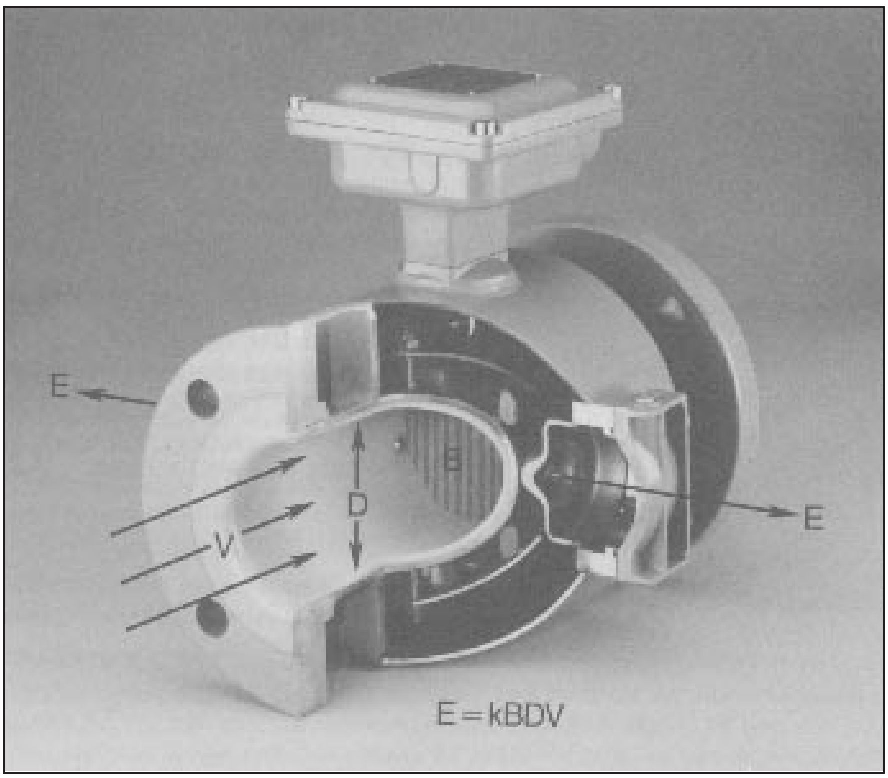
The operating principle of the magnetic flowtube is based on Faraday's law of electromagnetic induction, which states that a voltage will be induced in a conductor moving through a magnetic field.

Faraday's law: $E = kBDV$

The magnitude of the induced voltage **E** is directly proportional to the velocity of the conductor **V**, conductor width **D**, and the strength of the magnetic field **B**.

Figure D-1 illustrates the relationship between the physical components of the magnetic flowmeter and Faraday's law. Field coils placed on opposite sides of the pipe generate a magnetic field. As the conductive process liquid moves through the field with average velocity **V**, electrodes sense the induced voltage. The width of the conductor is represented by the distance between electrodes. An insulating liner prevents the signal from shorting to the pipe wall. The only variable in this application of Faraday's law is the velocity of the conductive liquid **V**, because field strength is a controlled constant and electrode spacing is fixed. Therefore, the output voltage **E** is directly proportional to liquid velocity, resulting in the inherently linear output of the Rosemount Magnetic Flowmeter System.

FIGURE D-1. Flowtube Cross Section.



PRIMARY AND SECONDARY DEVICES

The Series 8700 System consists of primary and secondary devices. The primary Series 8700 Flowtube is a pipe section with coils and electrodes. The secondary Series 8700 Transmitter generates the coil drive signal. The drive signal creates a magnetic field in the flowtube. The Series 8700 interprets the voltage generated at the electrodes and transmits a standardized signal to the readout or control system.

Series 8700 Magnetic Flowmeter Flowtube

The primary flowtube function is to produce a voltage proportional to the velocity of the liquid being measured. The field coils, energized by a pulsed dc current, develop the magnetic field. The process fluid functions as a moving conductor. Voltage is induced in the liquid as it flows through the magnetic field. The electrodes make a direct electrical connection with the conductive process fluid and detect voltages present. The liquid must be contained in an insulated material so that the voltage is not shorted. This is accomplished with a nonconductive flowtube material, or with a nonconductive lining for metal flowtubes. Because the magnetic field is typically created outside the flowtube, both the flowtube and flowtube liner must be nonmagnetic to prevent interference with the field.

Series 8712 Magnetic Flowmeter Transmitter

Signal conversion, conditioning, and transmission are principle Series 8700 System functions. The transmitter translates the millivolt flowtube output detected on the electrodes into a usable signal for process control or monitoring. The pulsed dc design of the Series 8700 System makes this signal particularly resistant to electrical interference. For a remote-mounted transmitter, this design allows the coil drive and electrode cables to share a single, dedicated conduit. The conductivity of the process fluid is a factor in specifying a cable run of up to 1,000 feet between the flowtube and a remote-mounted transmitter.

ELECTRICAL DESIGN

The pulsed dc design of the Series 8700 System represents an advanced application of Faraday's law. Because ideal environments (free from extraneous voltage and noise) seldom exist, this design primarily avoids conflict rather than compensates for it.

Unwanted noise has many sources. These include:

- Electrochemical voltage resulting from electrolytic reaction between the metal electrode and the ion-conducting process fluid.
- Inductive coupling of the magnetic field to the internal electrode wiring and the process fluid (commonly called quadrature voltage with ac systems).
- Capacitive coupling of the coil voltage or outside power systems to the electrode circuit.
- Transmission losses or phase shifts resulting from fluid impedance and transmission cable capacitance.
- Stray voltage or current loops within the process fluid.

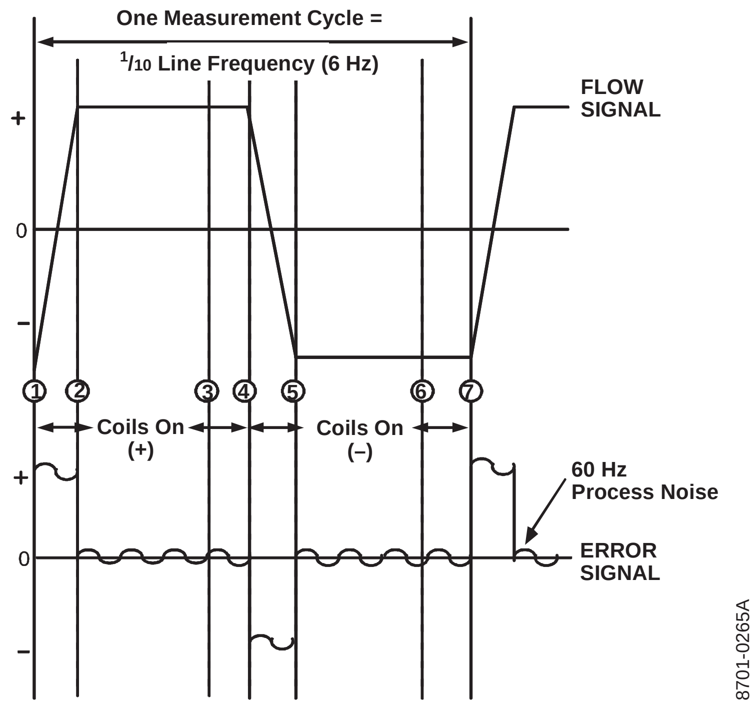
Pulsed dc Field Coil Advantages

Pulsed dc systems are immune to electrochemical noise without associated quadrature and other induced voltages inherent in an ac design. Pulsed dc systems power the coils with a controlled amplitude low frequency square wave. The flow signal is a matching square wave with an amplitude proportional to velocity of the liquid conductor. There is no need to compensate for voltage and frequency variations on the ac power line.

Although stray noise may be picked up with induced flow voltage at the electrodes, it is easily separated by the following procedure:

1. Measure voltage with the magnetic field high and note the amount.
2. Measure voltage with magnetic field low and note the amount.
3. Subtract the measured voltage in step 2 from that in step 1. This difference is the actual flow voltage.

FIGURE D-2.
Pulsed dc Operation Sequence.



EVENT SEQUENCE

① **Magnetic Field Transition Begins.**
①–② **Transients Present Due to Transition of Magnetic Field.**
②–③ **Magnetic Field and Flow Signal Stabilize.**
③–④ **Flow Signal Sampled.**
④ **Magnetic Field Transition Begins.**
④–⑤ **Transients Present Due to Transition of Magnetic Field.**
⑤–⑥ **Magnetic Field and Flow Signal Stabilize.**
⑥–⑦ **Flow Signal Sampled; Difference Taken from Previous Sample. Flow Rate Calculated.**

Figure D-2 illustrates events associated with the pulse event sequence. In this sequence, the circuitry samples and corrects for noise-induced flowtube voltage several times a second. The flow signal to the transmitter is also safe from stray 50 or 60 Hz noise in the environment because the sample period is equal in length to one power line cycle (60 Hz). This allows the coil drive and signal wires to share the same conduit using standard cables. The issues of reference voltage, quadrature voltage, phase detection, and zero controls are not applicable to pulsed dc systems.

The pulsed dc field coil design has the following advantages:

- Automatic Zeroing — A new reference is established with each sample of the flow signal, several times a second. This eliminates the need to zero the system under a no-flow condition that requires process shutdown.
- Low Power Consumption — The field coils are energized with a controlled amplitude current; thereby, reducing the power requirements of pulse dc systems.
- Simplified Installation – Fewer electrical connections and conduit runs are required in comparison to most ac systems. In addition, special power-shielded cables are eliminated because the dc signal is immune to most of the noise sources that affect ac systems.

Index