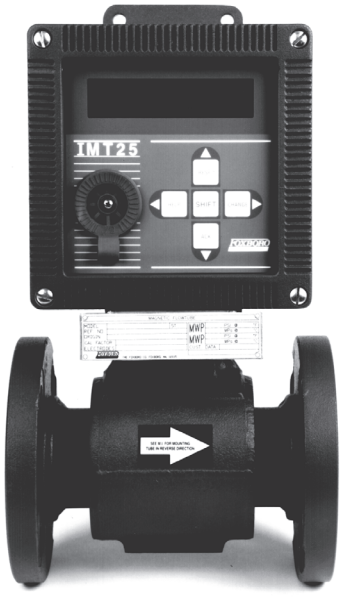
Instruction

MI 021-386
December 2016

9300A Series
Flanged Magnetic Flowtubes
PFA-Lined, 1- through 12-inch Sizes
PTFE-Lined, 1/2- through 16-inch Sizes
or Polyurethane-Lined, 8- through 16-inch Sizes

Installation



FLANGED BODY FLOWTUBE
WITH FLOWTUBE-MOUNTED TRANSMITTER

FLANGED BODY FLOWTUBE
WITH REMOTE TRANSMITTER

Foxboro®
by Schneider Electric

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1. Introduction

The 9300A Series Flanged Magnetic Flowtube, in conjunction with an IMT25 Magnetic Flow Transmitter, form a magnetic flowmeter system. The flowtube can be used with most common fluids, from everyday conductive liquids to very difficult-to-handle conductive liquids.

The flowtubes are available in PFA-lined 25 to 300 mm (1 to 12 in), polyurethane-lined 200 to 400 mm (8 to 16 in) sizes, and PTFE-lined 15 to 400 mm (1/2 to 16 in) sizes.The transmitter can mount directly to the 15 to 150 mm (1/2 to 6 in) wafer-body flowtube. The transmitter can mount directly to the flowtube, or can be mounted in a remote location to a surface or pipe. In remote transmitter applications, the allowable cable length, up to a maximum length of 300 m (1000 ft), is a function of the cable type, process fluid conductivity, and whether the cables are in the same or separate conduits.

The transmitter uses a pulsed-dc technique to energize the flux-producing coils of the flowtube. As the process liquid passes through the magnetic field in the flowtube, low-level voltage pulses are developed across a pair of electrodes. The voltage level of these pulses is directly proportional to the average velocity of the liquid. The transmitters convert the voltage pulse to both a standard 4 to 20 mA and pulse output signal. The 4 to 20 mA signal is used with a suitable receiver to indicate, record, and/or control a variable. The proportional pulse output can be used for totalization, and can be configured for either a high-rate or low-rate pulse. A digital output signal (HART or FOUNDATION Fieldbus communication protocol) is also provided for flowmeters serving as a primary device in an I/A Series system. Details of the output signals are given in the transmitter instruction.

This instruction (MI 021-386) relates to the installation of the flowtube portion of a magnetic flowmeter system. For installation, wiring, operation, configuration, and maintenance details relating to the flowmeter system, refer to the applicable transmitter documents.

Reference Documents

Table 1. Reference Documents

Document	Description
DP 021-364	Dimensional Print - 9300A Series Flanged Magnetic Flowtube
MI 021-387	IMT25 Series Transmitters, Installation and Wiring
MI 021-391	IMT25 Series Transmitters, System Maintenance
TI 27-71f	Magnetic Flowtube Materials Selection Guide
TI 027-072	Magnetic Flowmeter Liquid Conductivity Tables
PL 008-742	Parts List - 9300A Series Flanged Magnetic Flowtube

Standard Specifications

Minimum and Maximum Upper Range Values (URV) and Nominal Calibration Factors

In Table 2, the minimum upper range value is **not** the flow rate that the flowtube can measure; it is the lowest flow rate that can correspond to the 4 to 20 mA signal. For example, for the 930HA, the minimum range is 0 to 1.0 U.S. gpm. This will generate 4 to 20 mA.

Table 2. Minimum and Maximum Upper Range Values and Nominal Calibration Factors

Nominal Flowtube Size		Flowtube Model Codes (a)	Minimum and Maximum Upper Range Values		Nominal Calibration Factor
mm	in		L/m	U.S. gpm	Unitless
15	1/2	930HA	3.8 and 76	1.0 and 20	220
25	1	9301A	13.2 and 265	3.5 and 70	60
40	1-1/2	931HA	34.1 and 643	9.0 and 170	17
50	2	9302A	49 and 946	13 and 250	12
80	3	9303A	117 and 2366	31 and 625	5.8
100	4	9304A	208 and 4164	55 and 1100	3.0
150	6	9306A	462 and 9235	122 and 2440	1.1
200	8	9308A-..BA/BB-P 9308A-..ZD/ZE-P 9308A-..ZL/ZM-P	1003 and 20060	265 and 5300	0.39
		9308A-..BD/BC-P 9308A-..ZF/ZG-P 9308A-..ZN/ZP-P	927 and 18546	245 and 4900	0.39
		9308A-....-T	965 and 19303	255 and 5100	0.39
		9308A-....-A	890 and 17790	235 and 4700	0.39
250	10	9310A-..BA/BB-P 9310A-..ZD/ZE-P 9310A-..ZL/ZM-P	1590 and 31794	420 and 8400	0.24
		9310A-..BD/BC-P 9310A-..ZF/ZG-P 9310A-..ZN/ZP-P	1476 and 29523	390 and 7800	0.24
		9310A-....-T	1552 and 31037	410 and 8200	0.24
		9310A-....-A	1438 and 28766	380 and 7600	0.24
300	12	9312A-..BA/BB-P 9312A-..ZD/ZE-P 9312A-..ZL/ZM-P	2270 and 45420	600 and 12000	0.13
		9312A-..BD/BC-P 9312A-..ZF/ZG-P 9312A-..ZN/ZP-P	2120 and 42392	560 and 11200	0.13
		9312A-....-T	2215 and 44285	585 and 11700	0.13
		9312A-....-A	2082 and 41635	550 and 11000	0.13
350	14	9314A-....-T 9314A-....-A	2763 and 55261 2555 and 51098	730 and 14600 675 and 13500	0.090
400	16	9316A-....-T 9316A-....-A	3634 and 72672 3407 and 68130	960 and 19200 900 and 18000	0.057

a. Lining code: P = PFA, T = PTFE, A = Polyurethane.

Maximum Signal Cable Length

The maximum allowable cable length is a function of the cable type, process fluid conductivity, and whether the cables are in the same or separate conduits. Standard system accuracy will be maintained when the installations are in accordance with Table 3.

Table 3. Cable Requirements

Maximum Cable Length (a)	Minimum Fluid Conductivity (b)	Signal and Coil Drive Cables
300 m (1000 ft)	5 μS/cm	Signal and Coil Drive Cables in separate conduit. Signal Cable to be Foxboro Part No. R0101ZS (feet) or B4017TE (meters).
225 m (750 ft)	5 μS/cm	Signal and Coil drive cables in same conduit. Signal Cable to be Foxboro Part No. R0101ZS (feet) or B4017TE (meters).
150 m (500 ft)	20 μS/cm	Signal cable may be in same conduit as coil drive cable. Signal cable to be good quality twisted shielded pair, preferable no smaller than 1.0 mm^2 (or 18 AWG) for mechanical considerations (Belden 8760 or 9318, Alpha 5610/1801 or 5611/1801, or equivalent).

a. Values in table are fluid conductivity minimums, and maximum distance between transmitter and flowtube.

b. Refer to TI 27-072 for conductivities of various process liquids.

Power Consumption

Less than 24 W when used with IMT25 at reference voltage and frequency.

Materials

Flowtube Housing	(1/2 to 6 in) Ductile Iron with epoxy coating
	(8 to 16 in) Carbon Steel
Junction Box	Cast Aluminum
Junction Box/Cover Gasket	Silicone Sponge Rubber
Junction Box/Housing Gasket	Cork/Silicone Rubber
Flowtube Material	
15 mm (1/2 in)	Cast 304 ss (CF8) or 305 ss, exceeds Schedule 10 wall thk.
25 to 150 mm (1 to 6 in)	Cast 304 ss (CF8) or 305 ss, exceeds Schedule 10 wall thk.
200 to 400 mm (8 to 16 in)	Cast 304 ss, schedule 10 or 40 wall thickness.
Flowtube Liner	PFA, PTFE, or polyurethane
Electrodes (PFA or PTFE)	316L ss, Platinum-Iridium, Hastelloy C, Titanium, Tantalum-Tungsten. Also Conical 316L ss and Hastelloy C
Electrodes (Polyurethane	316L ss
Gaskets	No special gasket required, customer to supply.

Enclosure

The enclosure is finished with epoxy powder coat (15 - 150 mm [1/2 - 6 in] sizes) and with polyurethane paint (200 - 400 mm [8 - 16 in] sizes). It is designed to meet the requirements of IEC IP66, and to provide the watertight and corrosion-resistant protection of NEMA 4X for all tubes except NEMA 4 for 15 - 150 mm (1/2 - 6 in) sizes with PTFE-lining.

End Connections

Metric PN 10, 16, 25, or 40 flanges; or ANSI Class 150 or 300 flanges in either steel or stainless steel as specified.

Approximate Mass

Table 4. Approximate Mass

Flowtube Size		Flowtube Mass with ANSI Class 150 Flanges (a)	
mm	in	kg	lb
15	1/2	2.8	6.2
25	1	5.1	11.3
40	1-1/2	8.0	17.5
50	2	10.5	23.2
80	3	14.2	31.3
100	4	22.7	50.0
150	6	34.0	74.7
200	8	47.6	105
250	10	65.3	144
300	12	90.7	200
350	14	128	283
400	16	154	339

a. Mass represents that of flowtube only. When mounted to IMT25 Transmitter, add 2.9 kg (6.5 lb) for a single compartment transmitter and 3.9 kg (8.7 lb) for a dual compartment transmitter.

Lining Application Guide

PFA

PFA provides excellent corrosion, chemical, stress crack, thermal shock and hydrolysis resistance. It is also suitable for applications requiring high/low temperatures, anti-stick and high purity properties. Refer to TI 27-71f for liner material recommendations for common process fluids.

NOTE

The PFA liner may be non-uniform in appearance, having dark and light shading. This condition is inherent in the natural PFA molding process and does not in any way affect the durability or performance of the tube. There is no coloring or fillers that could leach into the process.

PTFE

PTFE withstands effects of severely corrosive and mildly abrasive fluids. Refer to TI 27-71f for detailed liner recommendations for common process fluids.

Polyurethane

Polyurethane withstands effects of highly abrasive fluids. Refer to TI 27-71f for detailed liner recommendations for common process fluids.

Temperature and Pressure Limits

See Tables 5 through 10 for ambient temperature and process pressure/temperature limits of flowtubes with various linings.

See Table 11 for process/temperature limits of flowtubes with various end connections.

Transmitter Remote Mounted PFA-Lined Flowtubes

Table 5. Transmitter Remote Mounted PFA-Lined Flowtubes

Influence	Reference Operating Conditions	Normal Operating Conditions	Operating Limits
Ambient Temperature	25°C 77°F	-40 to +70°C (a) -40 to +158°F (a)	-40 and +70°C (a) -40 and +158°F (a)
Process Temperature			
1 to 6 in	25°C 77°F	-40 to +180°C (a) -40 to +356°F (a)	-40 and +180°C (a) -40 and +356°F (a)
8 to 12 in		-40 to +120°C (a) -40 to +250°F (a)	-40 to +120°C (a) -40 to +250°F (a)
Process Pressure			
1 to 6 in	0.525 MPa 75 psi	Full Vacuum to 5.1 MPa at 38°C (740 psi at 100°F) Full Vacuum to 4.4 MPa at 180°C (645 psi at 356°F)	5.1 MPa at 38°C (740 psi at 100°F) 4.4 MPa at 180°C (645 psi at 356°F)
8 to 12 in		Full Vacuum to 5.1 MPa at 38°C (740 psi at 100°F) Full Vacuum to 4.7 MPa at 120°C (665 psi at 250°F)	5.1 MPa at 38°C (740 psi at 100°F) 4.7 MPa at 100°C (665 psi at 250°F)

a. For temperatures below -29°C (-20°F), stainless steel flanges must be used.

Table 6. Transmitter Remote Mounted PTFE-Lined Flowtubes

Influence	Reference Operating Conditions	Normal Operating Conditions	Operating Limits
Ambient Temperature	25°C 77°F	-40 to +70°C (a) -40 to +158°F (a)	-40 and +70°C (a) -40 and +158°F (a)
Process Temperature	25°C 77°F	-40 to +180°C (a) -40 to +356°F (a)	-40 and +180°C (a) -40 and +356°F (a)
Process Pressure	0.525 MPa 75 psi	No vacuum to 2.0 MPa at 38°C (285 psi at 100°F)	2.0 MPa at 38°C (285 psi at 100°F)
		No vacuum to 1.5 MPa at 180°C (213 psi at 356°F)	1.5 MPa at 180°C (213 psi at 356°F)

a. For temperatures below -29°C (-20°F), stainless steel flanges must be used.

Table 7. Transmitter Remote Mounted Polyurethane-Lined Flowtubes

Influence	Reference Operating Conditions	Normal Operating Conditions	Operating Limits
Ambient Temperature	25°C 77°F	-29 to +70°C -20 to +158°F	-29 and +70°C -20 and +158°F
Process Temperature	25°C 77°F	-29 to +71°C -20 to +160°F	-29 and +71°C -20 and +160°F
Process Pressure	0.525 MPa 75 psi	Full Vacuum to 2.0 MPa at 38°C (285 psi at 100°F)	2.0 MPa at 38°C (285 psi at 100°F)
		Full Vacuum to 1.9 MPa at 71°C (270 psi at 160°F)	1.9 MPa at 71°C (270 psi at 160°F)

Table 8. Transmitter Integrally Mounted PFA-Lined Flowtubes

Influence	Reference Operating Conditions	Normal Operating Conditions	Operating Limits
Ambient Temperature	25°C 77°F	-20 to +55°C -4 to +131°F	-30 and +70°C (a) -22 and +158°F (a)
Process Temperature	25°C 77°F	-40 to +120°C (a) -40 to +250°F (a)	-40 and +120°C (a) -40 and +250°F (a)
Process Pressure	0.525 MPa 75 psi	Full Vacuum to 5.1 MPa at 38°C (740 psi at 100°F)	5.1 MPa at 38°C (740 psi at 100°F)
		Full Vacuum to 4.7 MPa at 120°C (665 psi at 250°F)	4.7 MPa at 120°C (665 psi at 250°F)

a. For temperatures below -29°C (-20°F), stainless steel flanges must be used.

Table 9. Transmitter Integrally Mounted PTFE-Lined Flowtubes

Influence	Reference Operating Conditions	Normal Operating Conditions	Operating Limits
Ambient Temperature	25°C 77°F	-20 to +55°C -4 to +131°F	-30 and +70°C (a) -22 and +158°F (a)
Process Temperature	25°C 77°F	-40 to +120°C (a) -40 to +250°F (a)	-40 and +120°C (a) -40 and +250°F (a)
Process Pressure	0.525 MPa 75 psi	No vacuum to 2.0 MPa at 38°C (285 psi at 100°F)	2.0 MPa at 38°C (285 psi at 100°F)
		No vacuum to 1.7 MPa at 120°C (245 psi at 250°F)	1.7 MPa at 120°C (245 psi at 250°F)

a. For temperatures below -29°C (-20°F), stainless steel flanges must be used.

Table 10. Transmitter Integrally Mounted Polyurethane-Lined Flowtubes

Influence	Reference Operating Conditions	Normal Operating Conditions	Operating Limits
Ambient Temperature	25°C 77°F	-20 to +55°C -4 to +131°F	-30 and +70°C (a) -22 and +158°F (a)
Process Temperature	25°C 77°F	-20 to +71°C -4 to +160°F	-20 and +71°C -4 and +160°F
Process Pressure	0.525 MPa 75 psi	Full Vacuum to 2.0 MPa at 38°C (285 psi at 100°F)	2.0 MPa at 38°C (285 psi at 100°F)
		Full Vacuum to 1.9 MPa at 71°C (270 psi at 160°F)	1.9 MPa at 71°C (270 psi at 160°F)

a. For temperatures below -29°C (-20°F), stainless steel flanges must be used.

Table 11. Flange Pressure-Temperature Limits for PFA-Lined/PTFE-lined Flowtubes

DIN Flange Rating	Maximum Permissible Operating Pressure at Temperature Listed							
	316 ss Stainless Steel				Carbon Steel (ASME/ANSI Group No. 1.1)			
	–40°C	50°C	100°C	180°C	–28°C	50°C	100°C	180°C
PN 10	9.0 bar	9.0 bar	7.8 bar	7.1 bar	10.0 bar	10.0 bar	10.0 bar	8.4 bar
PN 16	14.2 bar	14.2 bar	12.5 bar	11.5 bar	16 bar	16 bar	16 bar	15.3 bar
PN 25	22.36 bar	22.3 bar	19.5 bar	17.9 bar	25.0 bar	25.0 bar	25.0 bar	20.2 bar
PN 40	37.4 bar	37.4 bar	31.2 bar	28.6 bar	40 bar	40 bar	40 bar	38.3 bar
ANSI Flange Rating	**–40°F**	**100°F**	**200°F**	**356°F**	**–20°F**	**100°F**	**200°F**	**356°F**
Class 150	275 psig	275 psig	240 psig	205 psig	285 psig	285 psig	260 psig	213 psig
Class 300	720 psig	720 psig	620 psig	538 psig	740 psig	740 psig	675 psig	644 psig

— NOTE

For process temperatures >120°C (>250°F), the transmitter must be remotely mounted.

PED Compliance

The 9300A Series Magnetic Flowtubes are fully compliant with the European Pressure Equipment Directive as process piping devices for Fluid Group 2 liquids only. The resulting product category classifications are either SEP or Category I, depending on line size and pressure rating, and as such, the product data labels carry the CE mark only (with no notifying body number).

Electrical Safety Specifications

NOTE

These flowtubes have been designed to meet the electrical safety descriptions listed in Table 12. For detailed information, or status of testing laboratory approvals/certifications, contact Global Customer Support.

Table 12. Electrical Classification

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
CSA for use in Class I, Division 2, Groups A, B, C, and D; Class II, Division 2, Groups F and G; Class III, Division 2 hazardous locations.	Temperature Class T6.	L
FM nonincendive Class I, Division 2, Groups A, B, C, and D; suitable for Class II and III, Division 2, Groups F and G hazardous locations	Temperature Class T6. Ta =70°C.	N
No Certification		Z

Flowtube Identification

The flowtube can be identified by the data and plates located on the flowtube. Typical data plates are shown in Figures 1 and 2. Refer to MI 021-387 for information regarding transmitter data plates.

Figure 1. Sample Data Plates for Flowtube with Remote Mounted Transmitter

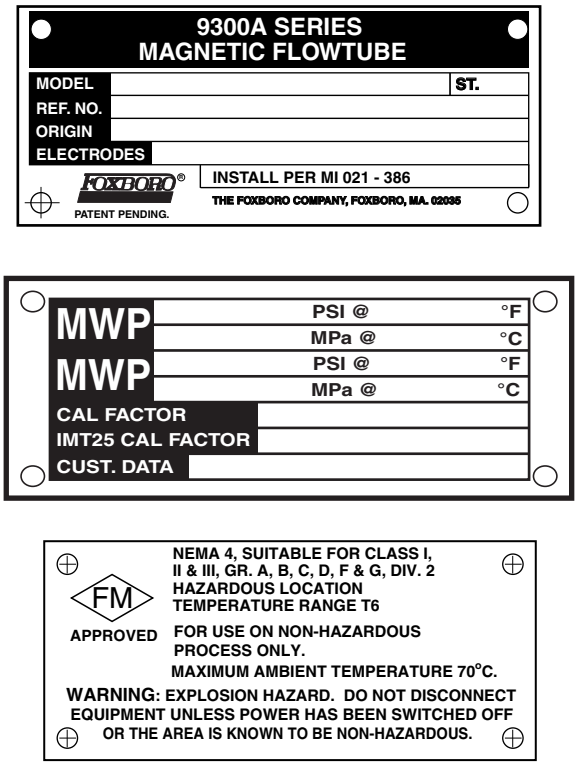
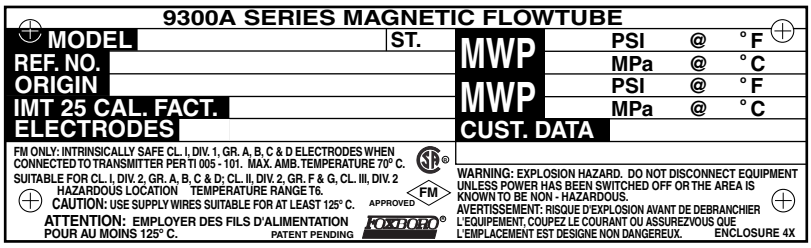


Figure 2. Sample Data Plate for Flowtube with Integrally Mounted Transmitter



2. Installation

Unpacking and Handling Procedure

After removing flowmeter from its shipping carton, inspect it for visible damage. If any damage is observed, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier.

NOTICE

Avoid touching the electrodes with fingers or any material that can contaminate the electrodes. A deposit on the electrodes will result in a high-impedance boundary between the electrodes and conductive fluid. If the electrodes have been touched, clean them with isopropyl alcohol.

Installation Guidelines

When properly installed, these magflow tubes are capable of providing high accuracy and durability while operating under real life conditions. To get maximum performance from the tube, select an appropriate location in the pipeline and avoid the factors that create bending loads at the flowtube. These factors are highlighted below in general terms and covered specifically in the detailed installation instructions.

It is very important that:

- A location be selected that will ensure a full flowtube under all operating conditions.
- The pipe line and flanges are aligned per the detailed instructions.
- Gaskets are centered on the ends of the tube.
- Flange bolts are tightened carefully to produce a uniform, well-centered load on the tube.
- Torque limits are not exceeded. (By following the installation instruction details, reliable joints can be made without exceeding these limits.)
- You allow approximately 5 pipe diameters of straight pipe upstream of the flowtube and 3 pipe diameters downstream.
- If mating pipe is lined, metal or plastic grounding rings be installed on each end of the flowtube.

Selecting a Location for the Flowtube

The flowtube can be installed in plastic or metal (magnetic or non-magnetic) piping. Usually the flowtube tube can be placed at any convenient location in the pipeline, but to insure good performance, the location should be reviewed relative to the factors listed below:

- It is essential for accuracy that the tube be completely full during operation. Horizontal, vertical, or sloping positions are acceptable, but some positions require special attention to be sure that the tube remains full. In addition to obvious problem locations such as down flowing vertical runs, consider areas where air pockets may form and where siphoning action or low pressure areas could create voids.
- The effects of upstream disturbances, such as valves and elbows, are difficult to predict, but in nearly all cases, standard accuracy will be realized if there are at least 5 pipe diameters of straight pipe upstream of the flowtube. Downstream disturbances that are 3 or more pipe diameters from the center of the tube do not affect the measurement accuracy. The inside diameter of the piping should be the same as, or larger than, the nominal size of the flowtube. Flowtubes can be placed in larger nominal size pipelines by using tapered conical reducers. The small ends of the reducers can be directly coupled to the flowtube and have a maximum included angle of 16°.
- If the flowtube is to be used to measure a slurry flow, it is important for accuracy to select a location where the velocities of the slurry components will be nearly equal and high enough to ensure good mixing.

To ensure good service life:

- Avoid areas that may have large stresses, such as water hammer or severe shaking of the pipeline.
- Provide protection from freezing.
- With slurries, do not position the electrodes in such a way that a bend or other pipeline feature would cause large solid particles to strike the electrodes.
- The tube enclosure is rated for NEMA 4X, NEMA 4, or IEC IP66 protection and has wide ambient temperature limits, but the tube should be protected from chemical spills and direct exposure to high temperature radiant heat sources.

Select a site with good accessibility for installation.

Mounting Positions

After a location is selected in the pipeline for the flowtube, the mounting position of the tube at that location still has to be determined. The choices are: (1) position of the conduit connections, (2) electrode position, and (3) convenience. Performance of the flowtube is not affected by the direction of the flow through the tube. This permits the tube to be installed in the direction that provides the best location for the wiring connections. **If the actual flow direction does not agree with the "direction-of-flow" arrow on the tube, just reverse the polarity of the coil drive wire connections. The IMT25 Transmitter can also be configured for reverse flow.**

The flowtube can be mounted at any position without degrading performance. The only requirement is that the flowtube be completely full with the process liquid during measurement, and that the electrodes be in the horizontal plane.

If the flowtube is not mounted in a vertical position, it is recommended that it be turned so that the electrodes are not near the top and bottom of the pipe. This is to avoid the possibility of losing electrode-to-fluid contact, either because of bubbles (at top), or sediment (at bottom) of the flowtube.

Figure 3. Flowtube Mounted Vertically

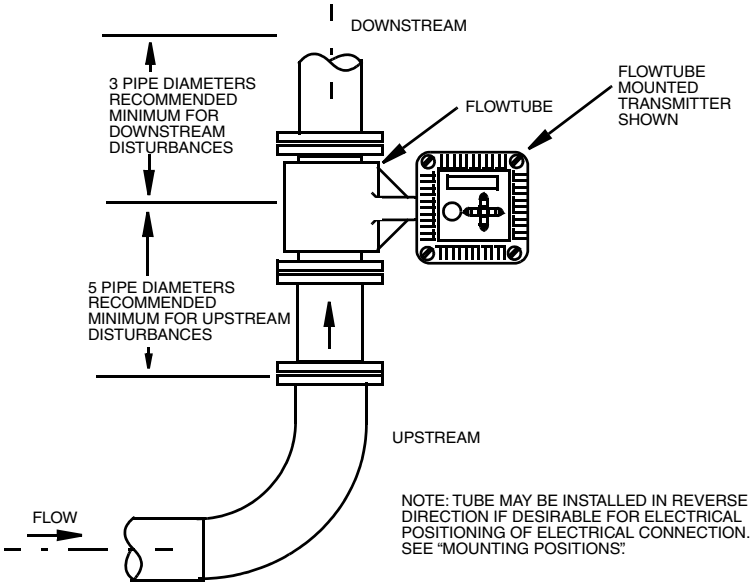
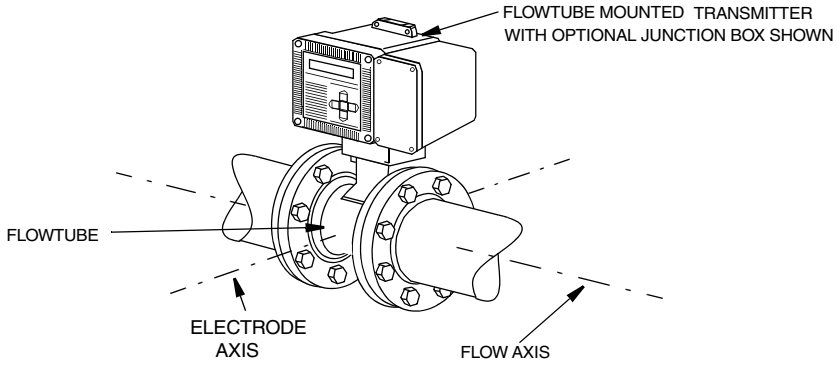


Figure 4. Flowtube Mounted Horizontally



If the flowtube has an integrally mounted transmitter, it may be desirable to adjust the orientation of the transmitter relative to the flowtube. To turn the transmitter, remove the four transmitter screws and washers. Turn the transmitter ±90° to the desired orientation and mount it back on the flowtube. If this does not give a satisfactory mounting position for the transmitter, reinstall the flowtube rotated 180° (flowtube direction reversed). This permits mounting the transmitter in the desired position. If installed in this manner, with flow direction reversed, you must either have to change the coil connections to the transmitter or modify the transmitter configuration to accommodate the change in flow direction.

NOTICE

When turning the transmitter, do not separate it from the flowtube. Separating the transmitter from the flowtube may cause interconnecting wires to be damaged.

Transmitter covers can also be turned in 90° increments so that the display and data plate can be easily read. Unscrew the four captive screws and turn cover to desired position. Refer to MI 020-387 for detailed IMT25 Transmitter instructions.

NOTICE

Do not separate cover from transmitter any more than required to turn it. Excessive separation can cause any of the interconnecting electrical wires to be damaged.

Pipeline Preparation

Flowtube Dimensions

Refer to DP 021-364.

Flange Types and Materials

The pipe and flange material can be magnetic, non-magnetic metal, or plastic without affecting the accuracy of the flowtube. To help control the stresses on the liner flanged ends, it is best to use a flange type that has a raised face I.D. equal to the pipeline I.D., such as a welding neck or socket welding flange. This assures full gasket contact for more even loading of the liner ends of the flowtube and permits higher bolting torques without over-compressing the gasket. Flange types that do not provide full surface contact with the gasket can be used, but with reduced bolt torques and careful attention to alignment.

Pipeline Support and Alignment

Adequately support the pipeline to carry its weight when full and to control pipeline motions such as can be caused by water hammer or other disturbances within the piping system.

In cases where temperature differences occur, make provisions to accommodate thermal expansions in a way that preserve the initial alignment of the piping at the flowtube.

It is important to align the pipeline flanges so that they make flat contact with the flowtube flanges. Bolt torque in excess of the maximum recommended values or misaligned flanges that cause an uneven flange clamping force can crush the liner. To prevent liner damage due to an uneven flange clamping force, align the flange well enough to allow full face contact to be made without exceeding 25% of the recommended maximum torque in any of the flange bolts. See Table 14.

Flowtube Grounding

For proper system performance, it is necessary to establish a fluid reference signal. Additional grounding details are given in MI 021-387.

When the flowtube is mounted between unlined metal pipes, the flange bolts provide the electrical connection from the flowtube to the pipeline and, therefore, the fluid.

When the flowtube is mounted between nonmetal or lined metal pipe, installation of grounding rings on each pipe flange is required as shown in Figures 5 and 6. Continuity is provided by connecting grounding wires from the flowtube to the grounding rings.

A third electrode for grounding is optionally available for 8- to 16-inch sizes.

Figure 5. Use of Grounding Rings when Transmitter is in Remote Location

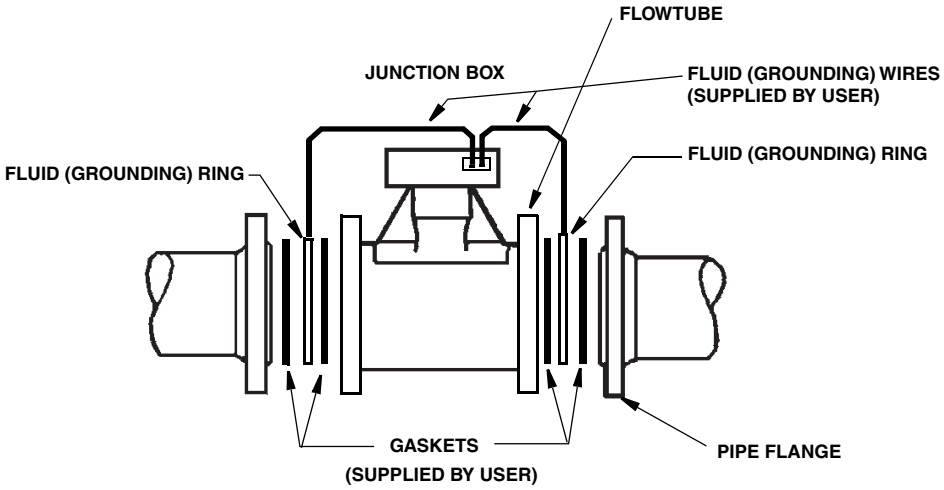


Figure 6. Use of Grounding Rings when Transmitter is Mounted to Flowtube

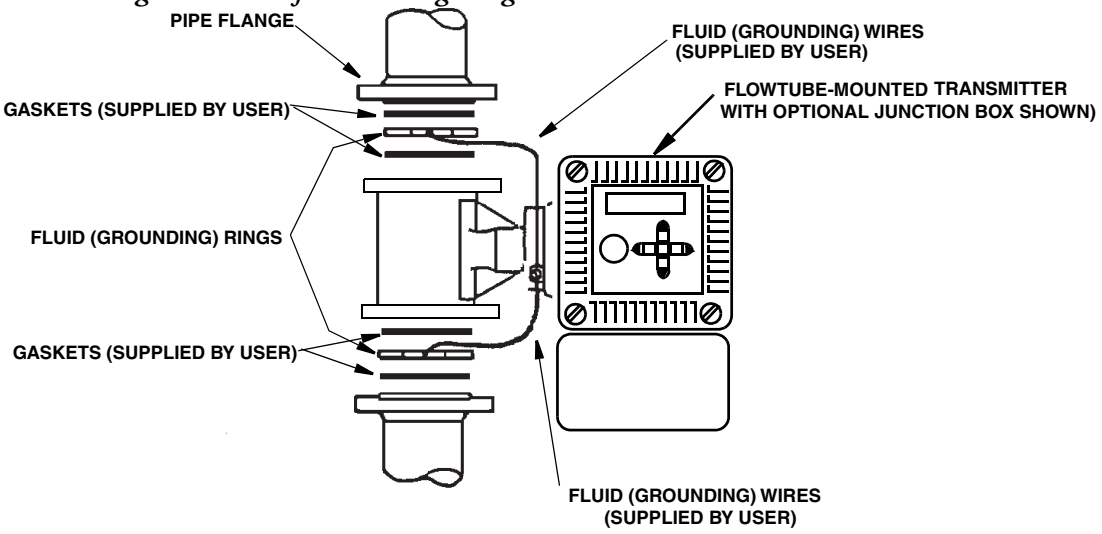


Table 13. Inside Diameters of Grounding Rings

Nominal Flowtube Size		Flowtube Model Codes (a)	Grounding Ring Inside Diameter	
mm	in		mm	in
15	1/2	930HA	11.1	0.437
25	1	9301A	21.4	0.843
40	1-1/2	931HA	36.5	1.437
50	2	9302A	48.4	1.906
80	3	9303A	75.4	2.97
100	4	9304A	100.8	3.97
150	6	9306A	152	5.98
200	8	9308A-..BA/BB-P 9308A-..ZD/ZE-P 9308A-..ZL/ZM-P	206	8.11
		9308A-..BD/BC-P 9308A-..ZF/ZG-P 9308A-..ZN/ZP-P	197	7.76
		9308A-....-T	202	7.95
		9308A-....-A	196	7.70
250	10	9310A-..BA/BB-P 9310A-..ZD/ZE-P 9310A-..ZL/ZM-P	259	10.21
		9310A-..BD/BC-P 9310A-..ZF/ZG-P 9310A-..ZN/ZP-P	249	9.81
		9310A-....-T	255	10.05
		9310A-....-A	249	9.80
300	12	9312A-..BA/BB-P 9312A-..ZD/ZE-P 9312A-..ZL/ZM-P	309	12.18
		9312A-..BD/BC-P 9312A-..ZF/ZG-P 9312A-..ZN/ZP-P	299	11.79
		9312A-....-T	305	12.02
		9312A-....-A	299	11.77
350	14	9314A-....-T 9314A-....-A	341 330	13.42 13.01
400	16	9316A-....-T 9316A-....-A	392 381	15.42 15.01

a. Lining code: P = PFA, T = PTFE, A = Polyurethane.

Installation Procedure Details

1. Review the guidelines on page 20 for selecting a location for the flowtube.
2. Prepare the pipeline for the flowtube, per “Pipeline Preparation” on page 22.
3. Review Flowtube Grounding requirements on page 23.
4. Locate and remove all foreign objects from the piping. If possible, make up and install a section of pipe (spool piece) in the space provided for the flowtube and flush the pipeline.
5. Center the gaskets on the tube ends.
6. Place the flowtube in the pipeline. Note that the tube can be installed with the “direction-of-flow” arrow reversed to the actual flow direction. This does not affect performance and should be done if it places the electrical connections in a better position. (Refer to “Mounting Positions” on page 20.)
7. If grounding rings are being used, position them between flowtube ends and pipe flanges. Use additional suitable gasket material between the grounding rings and the flanges.
8. Begin tightening the flanges to the flowtube. Initially, this should be done by lightly tightening the nuts in an order that will bring the flanges flat against the flowtube gaskets.
9. Tightening the flange nuts requires special care — first, to create a uniform clamping load on the tube, and second, to avoid over-compressing the flared ends. Begin by bringing the flanges into full-face contact with the gaskets, using minimum possible torque. This should be done by tightening the nuts adjacent to the largest flange-to-gasket gaps until full circle contact is made. Then, with all nuts at least finger-tight, proceed to tighten the nuts, basically following a diametrically opposite pattern. Turn the first nut 1/6 of a turn, then move to the next nut and tighten it 1/6 of a turn. Continue this sequence until one nut on each bolt has made one complete turn, or until the maximum torque specification has been reached.

Table 14. Maximum Mounting-Nut Torques for Flanged-Body Flowtubes

Flowtube Size		No. of Bolts in Flange	Max. Mounting Nut Torque	
mm	in		N•m	lb•ft
15	1/2	4	7	5
25	1	4	14	10
40	1-1/2	4	27	20
50	2	4	75	55
		8	40	30
80	3	4	80	60
		8	54	40
100	4	8	54	40
150	6	8	95	70
		12	75	55
200	8	8	115	85
		12	95	70
250	10	12	122	90
		16	108	80
300	12	12	163	120
		16	176	130
350	14	12	219	160
		16	163	120
400	16	16	204	150

⚠ CAUTION

The torque values in the table are for metal flanges. If plastic flanges are used, torque nuts to lower value of table limits or flange limits.

Transmitter Installation and System Wiring

For instructions on the installation of a remote transmitter and system wiring details into and out of the transmitter, refer to MI 021-387.

System Maintenance

System maintenance information is located in MI 021-391. For flowtube parts, refer to PL 008-742.

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