Ensuring Premium Performance with I/A Series® Pulsed dc Magnetic Flowmeters

FLOWMETER FEATURES AT A GLANCE

8000A/8300/9300A SERIES FLOWTUBES

- 1.6 to 900 mm (1/16 TO 36 in) line sizes
- Flanged and wafer bodies
- ISO/DIS 13359 face-to-face dimensions
- PTFE, PFA, ceramic, neoprene, and polyurethane linings
- Standard flat head and conical head electrodes
- PTFE lining protection option
- Fluid grounding rings or grounding electrodes
- Ultrasonic and low voltage electrode cleaning options
- Proven electrode seal design

8000A WITH JUNCTION BOX

9300A WITH INTEGRAL TRANSMITTER

IMT25 AND IMT25L INTELLIGENT TRANSMITTERS

- Modular design
- Bi-directional measurement
- Alarm functionality
- Digital/analog/pulse outputs
- FoxCom and HART communications protocol selections
- Noise reduction circuitry
- Help-assisted configuration and diagnostics
- Automatic or manual zero lock

MODEL IMTSIM FLOWTUBE SIMULATOR

- Aids start-up and troubleshooting; verifies transmitter calibration and operation
- Compact, rugged, hand-held design
- Provides ISO 9000 verification for IMPT25/IMT25L transmitters
- Environmentally protected lightweight housing

Life Is On

Foxboro®

by Schneider Electric

INTRODUCTION

Pulsed dc Magnetic Flowmeters are rugged, durable, high accuracy instruments. They have been designed and manufactured to provide many years of premium performance. To ensure achieving this performance, take special note of the recommendations and suggestions listed in this document. Also, carefully follow the installation, configuration, and calibration procedures in the Instruction Books shipped with your flowmeter. If you have any questions or problems before, during, or after installation, contact Global Customer Support.

PRIOR TO INSTALLATION

CHECK MATERIALS OF CONSTRUCTION

The flowtube has lining and electrode materials that are wetted by the process. These materials must be compatible with the corrosive and abrasive characteristics of the process liquid, as well as any liquids that may be periodically used to flush or clean the process piping. Refer to Technical Information Document TI 27-71f (*Magnetic Flowtube Materials Selection Guide*) regarding the compatibility of flowtube wetted parts with your particular process.

CHECK PROCESS CONDUCTIVITY

Pulsed dc magnetic flowmeters are compatible with the vast majority of conductive process liquids, but require the process liquid to have a minimum conductivity of five microSiemens/cm. Refer to TI 027-072 for the electrical conductivities of process liquids.

CHECK MAGNETIC FLOWTUBE SIZING

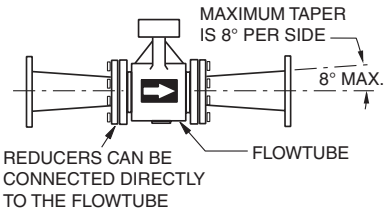
The flowtube operates over a flow velocity range of 0 to 33 ft/s (0 to 10 m/s). Proper flowtube sizing is essential to ensure premium performance and longevity. Refer to Table 1 as a guide to size magnetic flowtubes.

Table 1. Normal Recommended Flow Velocities

Process Liquid	Velocities Corresponding to Normal Flow Should be Between
General liquids	0.91 m/s and 4.6 m/s 3 ft/s and 15 ft/s
Erosive slurries	0.91 m/s and 1.8 m/s 3 ft/s and 6 ft/s
Liquids that can coat inside surface of flowtube	1.8 m/s and 4.6 m/s 6 ft/s and 15 ft/s

If the flow velocity in the pipeline is low, reducers can be used to install a smaller flowtube. Concentric reducers with a taper angle of eight degrees (8°) or less per side are preferred (eccentric reducers with a maximum taper angle of 8° can also be used), and can be connected directly to the flowtube. Refer to Figure 1 for a typical reducer installation. The unrecovered pressure loss caused by using reducers to increase the velocity in the tube to 5 to 10 ft/s (1.5 to 3 m/s) is small, typically less than 1 psi (<27.7 inH_2O, <51.7 mmHg). Equations to calculate the pressure loss can be found in “Fluid Flow through Valves, Fittings, and Pipes,” Technical Paper 410, by the Crane Co.

Figure 1. Pipeline Installation Showing a Concentric Reducer and Expander



If normal flow is above the recommended maximum flow velocity, the flowtube liner wear rates become a concern. Generally, expanding a section of the pipeline to install a larger tube is not a good solution, as it creates potential air problems. If you have a high process velocity, consider the following recommendations:

- Use Polyurethane Liners
- Install the Flowtube where there is a Long, Straight, Upstream Piping Run
- Install a Liner Protection Ring at the Upstream End of the Flowtube.

Operating the flowmeter outside the recommended normal flow velocity limits may result in performance degradation, maintenance problems, and/or shortened life expectancy. The manufacturing company therefore provides its *FlowExpert* Sizing Software to facilitate and simplify the flowmeter sizing procedure for any application.

CHECK INSTALLATION AND ORIENTATION

- The magnetic flowtube must be installed so that it remains full of liquid during operation. An example of good orientation of the flowtube is in a vertical pipeline with flow in an upward direction, as shown in Figure 2.
- The flowtube should have straight, unobstructed piping for a distance of five pipe diameters (5 PDs) upstream and 3 PDs downstream (measured from the center of the flowtube) to ensure optimum performance (see Figure 2). Adjacent process piping should have the same diameter or be slightly larger than the flowtube.
- When installed in a horizontal pipe, the flowtube should be oriented so that the electrodes are not located near the top or bottom of the pipe (see Figure 3). Adjacent piping may be elevated so as to maintain a full flowtube.
- Tube orientation should not trap entrained air, nor cause a build-up of undissolved solids within the flowtube.
- Check valves may be installed to insure a full flowtube and prevent drainage under static flow conditions.
- Flowmeter performance can be affected if liquids are blended together upstream and are too near the flowtube. There must be enough piping upstream of the meter, between the blending point and the flowtube, to allow for a complete mixing of the liquid streams. This is one of the few cases where you may need to install more than 5 PDs of straight pipe upstream of the flowtube. An in-line static mixer can be installed upstream of the flowtube to insure proper mixing in very tight piping situations.

- Figure 2 also shows a flow direction arrow. However, the tube can be installed in the reverse direction if this orientation provides better wiring access to the connection box (tube performance is the same in both directions). If you do install the tube in the reverse direction, then configure the transmitter flow direction parameter for reverse flow, or reverse the polarity of the coil wires.

Figure 2. Flanged Body Flowmeter Mounted Vertically – Transmitter Mounted in Remote Location

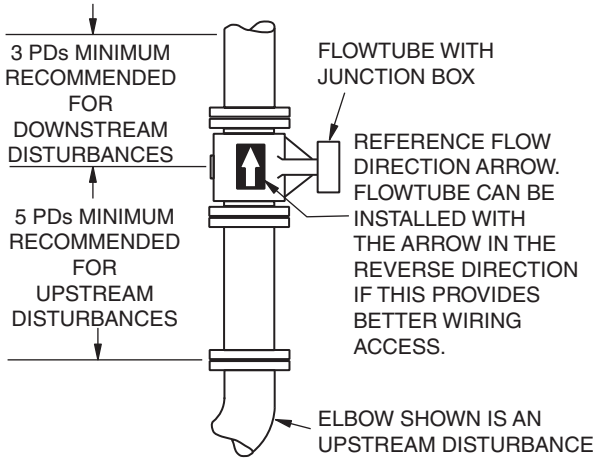
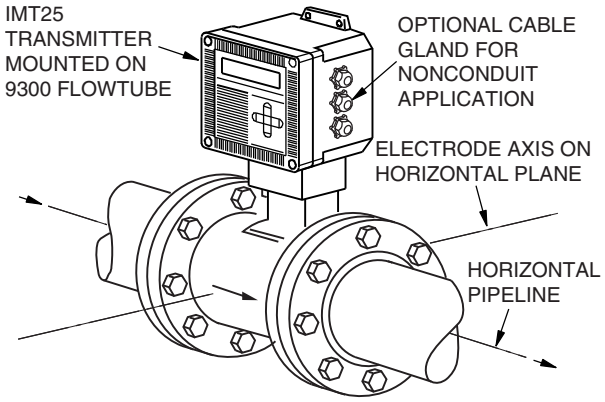


Figure 3. Flanged Body Flowmeter Mounted Horizontally, Electrode Axis in Horizontal Plane (Preferred)



Probably the most common reason for mag flow errors and erratic performance is air in the flow stream. A magnetic flowmeter is a volume flow instrument, and, as such, will show the total volume flow rate of liquid and gas passing through the tube. Therefore, if the fluid is 1% by volume of air, the flow signal will be 1% greater than the amount of liquid flowing. If the entrained air is well mixed, the flow signal will be stable, but high. If the air builds up in the piping until it becomes a sizable bubble and then passes through the pipeline, there will then be disturbances of the flow rate through the tube and the output of the tube will appear to be unstable.

TO AVOID PROBLEMS WITH AIR IN THE FLOW STREAM

- Avoid installing the tube in a location that may not be full in all operating conditions.
- Avoid (or correct) upstream conditions that may draw air into the flow stream.
- Avoid (or correct) upstream conditions where any air that is entrained in the flow could collect into a large bubble, and then flow downstream. High spots and places where the flow velocity slows are likely places to create this problem.

Figures 4 to 6 show causes of aeration problems, and preferred installations that can correct these problems.

Figure 4. A Bad Installation Showing Causes of Aeration Problem (see Figure 5 for Corrected Installation)

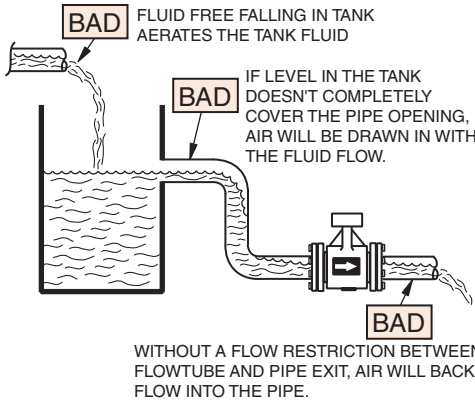


Figure 5. A Preferred Installation to Correct the Aeration Problems Shown in Figure 4

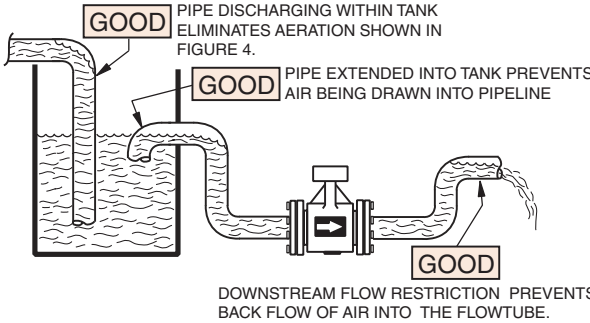
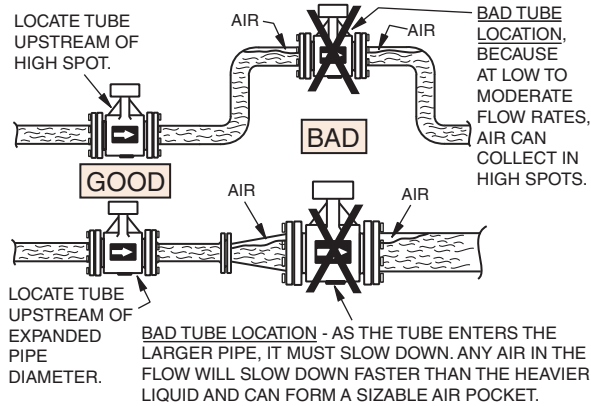


Figure 6. Proper Flowtube Location to Avoid Air Entrainment Due to Upstream Conditions



CHECK TRANSMITTER CONFIGURATION

These transmitters require specific information, called the configurational database, in order to function. The parameters in Table 2 are the only ones that must be correctly configured by the user for basic functionality. The “Actual Info” column is for the customer’s use.

Table 2. Parameters that must be Set by User

Parameter	Factory Default	Actual Info.
Flowtube Factor	**012.000**	
Flow Rate Units	**GPM**	
URV (a)	100	
Line Frequency (Hz)	60(b)	

(a) Upper Range Value setting required for Analog Output only.
(b) If IMT25 Transmitter is powered from a 24 V dc source, then select the line frequency (Hz) of the user’s country.

The Following Functions May be Configured at the Discretion of the User

- Flow Rate Outputs
  - 4 to 20 mA Signal
  - Frequency Signal
  - Digital (FoxCom or HART)
  - Display
- Totalizer
  - Built-in Totalizer
  - Forward, Reverse, Net, and Grand Totals
  - Scaled Pulse Output to Drive Remote Totalizer
  - Digital Output of Totals
- Alarms Available for:
  - Flow Rate (HI and LO)
  - Totalizer
  - Auto Zero Lock
- Contact Outputs (Two Available) can be activated by:
  - Alarms
  - Diagnostic Conditions
  - Flow Direction
  - Test Mode
- Contact Inputs (Two Available) can be used to:
  - Acknowledge Alarms
  - Reset Totalizer
  - Select Flow Range
  - Lock Outputs at Zero

See applicable MI for the complete database and factory default configurations, and procedure relating to changing the parameters in the database.

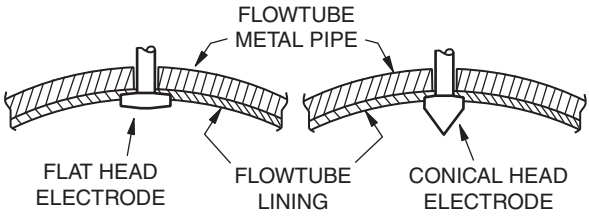
COATINGS OR DEPOSITS ON ELECTRODES AND INSIDE SURFACE OF PROCESS PIPING

Process fluids that can leave coatings or deposits on the inside surfaces of process piping can create problems for magnetic flowmeters. Some coatings can cause accuracy to degrade with time (as the coating builds up), or can cause a complete loss of the measurement signal.

An excellent method used to prevent errors and maintenance problems is to size the flowtube (see Table 1) so that the fluid velocity will be high enough to keep the inside surfaces clean.

Secondary measures can also be employed to avoid coating problems. Conical head electrodes can be used in place of standard, flat-head electrodes. The increased fluid velocity around the conical electrode head provides a self-scouring action that keeps the electrode surface clean. See Figure 7 for an example of a flat head and conical head electrode

Figure 7. Inside Surface of Flowtube Showing Flat Head and Conical Head Electrodes



Electrode cleaning systems can also be incorporated into the flowtube to remove build-ups from the electrode surfaces. The Ultrasonic Cleaning option offered by the company is ideal for hard, crystalline types of coatings, and, alternatively, the Low Voltage Electrode cleaning option is best for greasy, sludgy types of coatings. Conical head electrodes and cleaning systems do not prevent build-ups from forming in the rest of the flowtube, and hence do not prevent all potential sources of measurement errors. They can, however, lengthen the in-service time of the flowmeter between flowtube clean-ups.

SLURRIES

Magnetic flowmeter accuracy on slurries is based on the assumption that all phases are well mixed and moving at the same velocity. Accuracy is adversely affected if this is not a valid assumption. It is therefore important for any magnetic flowtube used on slurry flow to be installed in a location where the velocity of the slurry components will be nearly equal, and sufficiently high to ensure good mixing. The special case of magnetic slurries will cause a shift of the factory calibration. An in-line calibration of the flowtube on the actual process fluid, to determine the actual value of the flowtube factor, is the ideal way to achieve higher accuracy for magnetic slurries.

AUTOMATIC OR MANUAL SIGNAL LOCK

Magnetic flowmeter output signals may drift and indicate a false flow rate when the tube is energized and the electrodes are exposed to air. This is why the flowtube should be installed so that it always remains full of liquid. However, this is not always possible.

If the magnetic flowmeter output is being used for control purposes, the false flow signals due to an empty tube, or partially full tube, may not be tolerable. The IMT25 Magnetic Flow Transmitter provides two methods of locking the output signals at their zero value when the electrodes become exposed to air.

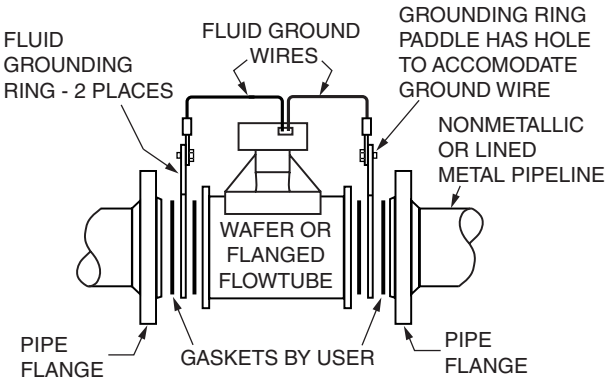
One method uses a switch to manually activate or deactivate the signal lock circuits. Alternatively, the IMT25 has internal circuitry that can detect when the electrodes are covered or uncovered by liquid. The Transmsitter can be programmed to automatically activate or deactivate the signal lock circuits based on these internal readings.

GROUNDING (EARTHING)

It is necessary to establish a fluid reference signal for proper magnetic flowmeter operation. The flange bolts can provide the necessary electrical connection from the flowtube to the pipeline, and therefore the fluid, when the flowtube is mounted between unlined metal pipes. Continuity is provided for wafer body flowtubes by connecting the ground (earth) wires from the flowtube to both the upstream and downstream piping.

Grounding (Earthing) Rings are used to provide continuity when the flowtube is mounted between nonmetal pipe, or lined metal pipe. Grounding rings (available from the company) are simply paddle-type orifice plates. The grounding wires from the flowtube junction box ground terminal are connected to the paddles of the grounding rings, and the grounding rings in turn make contact with the fluid. Two grounding rings, sandwiched between the upstream and downstream flowtube/process piping connections, are required to ensure proper grounding. See Figure 8.

Figure 8. Use of Grounding Rings with Nonmetallic or Lined Metal Pipeline

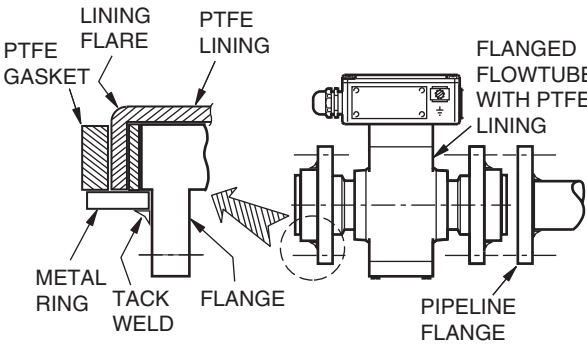


Grounding electrodes are an alternative to grounding rings for 9300 Series Flowtubes 8 in (200 mm) and larger. The grounding electrode is basically a third electrode added to the flowtube for continuity purposes only. Grounding electrodes can be very cost effective options, particularly on corrosive fluids.

LINING PROTECTION

It may be necessary to protect PTFE liners against excessive wear due to continuously high flow rates (> 15 ft/s or > 4.6 m/s) or non-ideal installation conditions, such as locating the flowtube on the discharge of an elbow. A single grounding ring, installed against the upstream face of the flowtube, can provide the required protection. The grounding ring has a slightly smaller bore than the flowtube and protects the liner from excessive wear and premature failure. Refer to the applicable Flowtube Installation MI. Also, an optional lining protector (shown in Figure 9) is offered to protect the PTFE lining flare. Contact Global Customer Support for details.

Figure 9. Optional PTFE Lining Protector



TROUBLESHOOTING

Following the instructions in this brochure will help to prevent measurement problems. Remember the various things that can cause measurement errors with magnetic flowmeters:

- Fluids with Entrained Air
- Poor Installation Conditions
- Poor Grounding (Earthing)
- Wiring Errors
- Incorrect Transmitter Configuration
- Partially Full Flowtube
- Nonhomogeneous Mixtures
- Fluids with Conductivities of <5 microSiemens/cm
- Slurries with Non-Uniform Velocities
- Fluids that leave Coatings on Inside Surface of Flowtube
- Blending of Liquids too Close Upstream of the Flowtube
- Pulsating Flow with a Frequency <15 Hz
- Magnetic Slurries
- Slurries with Low Flow Rates at Velocities <2 ft/s (<0.61 m/s)

If you receive a signal that does not agree with other measurements, check for the above error sources first. Then refer to the troubleshooting guidelines found in the applicable instruction manuals for more help.

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