Ensuring Premium Performance with Models 84 and 84C Vortex Flowmeters

FLOWMETER FEATURES AT A GLANCE

NOTE: Based on the specific model of your flowmeter, the electronics housing may be blue or green.

- Intelligent Electronics
- Remote Digital Communications
- Reduces “Jittery” or False Output due to Process Noise
- Improves Measurement Accuracy for Reynolds Number as Low as 5000; (Water @ 2.8 GPM in a 2 in Pipe)
- Optional Pulse Output (Raw, Rate, Total)
- Corrects Output for Pipe Schedule and Upstream Piping Effects
- Corrects for Thermal Expansion of Flowtube
- Automatic Filter Settings Based on Minimum and Maximum Flow Rates
- Automatic 4 to 20 mA Calibration (-T only)
- Totalized Flow Measurements

Measures Liquid, Gas, and Steam	Exclusive Isolation Valve
• Wafer Body Meters • Sanitary Meters • Flanged Body Meters with Integral Dual Sensors and Electronics • NPT Threaded Body Meters • Cleaned for Oxygen or Chlorine Service	• Valve in Manifold Negates Need for External Block Valves
	Wetted Vortex Sensor
	• No Moving Parts • Best Low Flow Sensitivity • Superior Vibration Immunity • Lifetime Warranty for meters without Temp. Compensation or 2 Year Warranty for meters with Temp. Compensation

INTRODUCTION

The vortex flowmeter is a rugged, durable, high accuracy instrument. As part of a calibrated precision system, it is designed and manufactured to provide you with premium performance for many years. To help ensure that you achieve this performance, carefully follow the installation, configuration, and calibration procedures in the Master Instructions (MIs) shipped with your flowmeter (see Table 1).

Table 1. Related Documents

Doc. #	Description
MI 019-222	Model 84, Flanged or Wafer Body with HART
MI 019-205	Model 84, Sanitary with HART
MI 019-211	Model 84 Low Power, Flanged or Wafer Body with HART (Low Power)
MI 019-214	Model 84 Sanitary with HART (Low Power)
MI 019-222	Model 84C with HART Communication or Low Power
MI 019-224	Model 84C with Modbus Communication

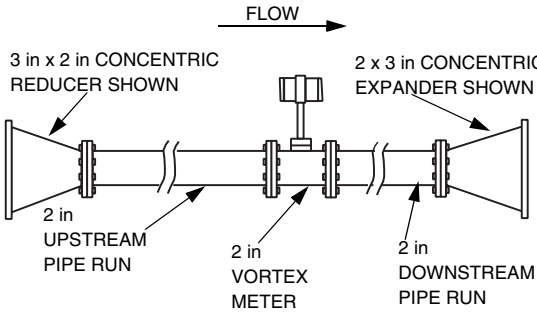
PRIOR TO INSTALLATION

CHECK AND VERIFY THE FLOWMETER SIZING

Vortex meters must be sized properly for the application, considering maximum, minimum, and start-up flow. Each meter has an Upper Range Limit (URL) which is the maximum flow that can be measured for that particular size meter. Also, each meter has a user-selectable range of low flow cut-in values. The low flow cut-in value sets the minimum flow that can be measured for that size meter, based on the specific fluid and process conditions for the application. The flow range you are measuring should fall within these limits. Sizing Software is provided which calculates the upper range limit and minimum low flow cut-in value and pressure drop for the meter, based on process information entered by the customer. This software is available at: **www.flowexpertpro.com**.

Be careful not to size the vortex meter simply to match existing piping, but rather size the meter to measure a specific flow range for a specific fluid. In many vortex applications, the meter is downsized to provide the necessary rangeability and low flow performance. To accomplish downsizing, either concentric or nonconcentric reducers and expanders may be used. Figure 1 shows a pipeline installation with a concentric pipe reducer and expander.

Figure 1. Pipeline Installation Showing a Concentric Reducer and Expander



In addition, vortex meters may be affected by “process noise” from pumps, chattering valves, steam traps, etc. This noise may cause false flow signals, or may cause the meter output to appear “jittery,” or unstable. To minimize this condition, the flowmeter’s intelligent electronics automatically set band pass filters in accordance with customer-entered maximum and minimum (low flow cut-in) flow rates. In addition, the patented noise rejection algorithm provides additional noise suppression. Since the amount of noise is impossible to predict in advance, the meter should be sized so the required minimum flow is at least two times the value for the low flow cut-in. For optimal performance the maximum flow rate (URV) should be between 25 and 100% of meter capacity (URL).

Check Intelligent Vortex Flowmeter Configuration

In order to function, the flowmeter requires specific process information, commonly called the “configuration database.” Each flowmeter is shipped from the factory with a configuration database containing information supplied by the customer with the sales order. If no information is supplied, the unit is shipped with a “liquid default” configuration database. Be sure to check the database of the meter prior to start-up.

Refer to Chapter 3, Operation Via Local Display in the Instruction Manuals listed in Table 1 for the database default values for liquid, gas, and steam. The MIs provide database parameter descriptions and instructions on how to change the database to match your process and application conditions. The parameters to be configured include:

- Fluid Type
- Type of Flow
- Measurement Units
- Flowing Temperature
- Flowing Density
- Base Density
- Absolute Viscosity
- Upper Range Value
- Pressure
- Heat Content

If the process parameters are not known, a default configuration based on fluid type (i.e., liquid, gas, or steam) can be used.

The following lists additional parameters pertaining to features or functions which can be implemented at your discretion, based upon application needs.

- Tag Name
- Pulse Compensation
- Pipe Bore
- Piping Configuration
- Upstream Distance
- Low Flow Cut-in
- Flow Damping
- Failsafe Condition
- Reynolds Number Correction
- Pulse Rate Output Upper Frequency

CHECK INSTALLATION CONDITIONS

ADJACENT UPSTREAM/DOWNSTREAM PIPING

The flowmeter should be mounted between sufficient lengths of straight, unobstructed pipe of the same nominal pipe diameter as the vortex meter to help ensure that it performs to its calibrated accuracy. The upstream piping should be sufficient to provide a symmetrical and undistorted velocity profile, free of swirl. 30 pipe diameters (PDs) of straight pipe upstream, and five PDs of straight pipe downstream of the meter are recommended. There are no upstream effects or K-factor corrections required when the aforementioned piping conditions exist.

The intelligent transmitter maintains accuracy with specific upstream pipe disturbances as close as five PDs by automatically correcting the K-factor in the configuration menu. Please refer to the applicable installation instructions for your model (see Table 1).

The flowmeters are calibrated using Schedule 40 pipe. For mating pipe other than Schedule 40, entering the mating pipe Schedule Number into the configuration menu automatically corrects the K-factor.

High-pressure meters (Class 900 and PN160 for 6 inch and 8 inch line sizes and Class 1500 for 2 inch through 8 inch line sizes) are calibrated using Schedule 160 because the meter bore is also Schedule 160.

The bores of the adjacent piping, the meter, and the mating gaskets must be carefully aligned to help prevent protrusions in the flowstream which may cause measurement errors.

METER LOCATION

It is recommended that for liquid flows, the vortex meter be located a minimum of five PDs upstream of any valve (valve >5 PDs downstream of meter).

It is recommended that for gas and steam flows, the vortex meter be located a minimum of 30 PDs downstream of any valve (valve >30 PDs upstream of meter).

NOTE: The only exception to the above would be when butterfly valves are used. Then the recommended meter location distances are increased from 5 to 10 PDs upstream of valve for liquids, and from 30 to 40-to-60 PDs downstream of valve for gases and steam.

METER ORIENTATION

Refer to Table 2 regarding sensor and electronics location, relative to the process piping, when the process fluid is a liquid, gas, saturated steam, or superheated steam.

Table 2. Flowmeter Orientation Table

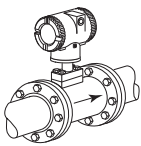
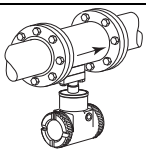
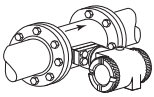
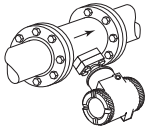
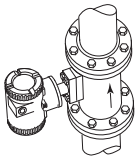
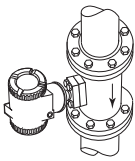
Flowmeter Orientation (a) for Single (Shown) or Dual Measurement Flowmeter		For Use With (b)			
		Liq.	Gas	Sat. St.	Sup. St.
	Housing above, pipe	Yes (c)	Yes	No	Yes (d)
	Housing below pipe	Yes (e) (f)	Yes (f)	Yes (d)	Yes (d)
	Housing to side of pipe	Yes	Yes	No	Yes (d)

Table 2. Flowmeter Orientation Table (Continued)

Flowmeter Orientation (a) for Single (Shown) or Dual Measurement Flowmeter		For Use With (b)			
		Liq.	Gas	Sat. St.	Sup. St.
	Housing to side and below pipe	Yes	Yes	No	Yes (d)
	Vertical pipe, upward flow	Yes	Yes	No	Yes (d)
	Vertical pipe, downward flow	Yes (g)	Yes	No	Yes (d)

a. These diagrams show flanged connections; however, these mounting arrangements apply to other connections as well.
b. Liq.= Liquid, Gas = Gas, Sat. St. = Saturated Steam, and Sup. St. = Superheated Steam.
c. Possibility of temporary start-up error due to trapped air.
d. Requires adequate insulation.
e. Best choice when errors due to trapped air on start-up cannot be tolerated.
f. Recommended only for clean fluids.
g. Not preferred; must maintain full pipe with no voids in fluid.

INTERMITTENT FLOWS

Vortex flowmeters can be used to measure intermittent (on/off) flows. However, the meter does not measure below the low flow cut-in value. The user should design the piping and valving so that intermittent flows help ensure a full pipe in liquid applications.

OTHER INSTALLATION CONSIDERATIONS

- Maintain full pipe conditions at the vortex meter. When the flow is moving with gravity, elevate the downstream pipe length above the meter installation level to maintain a full pipeline.

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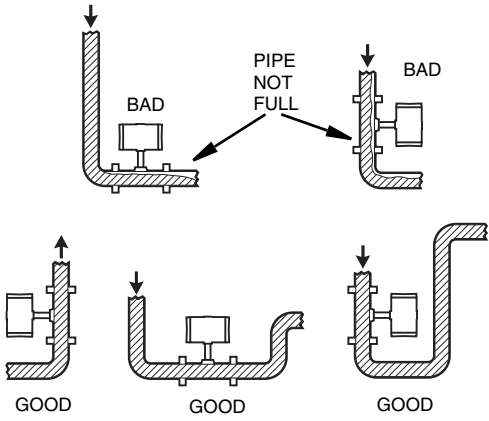
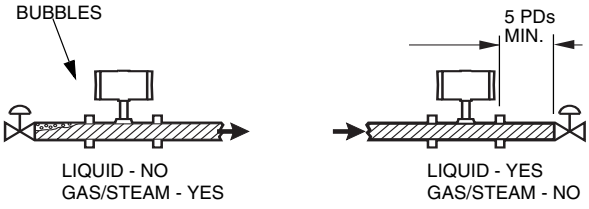


- In liquid control valve applications, the valve should be placed downstream of the meter because the pressure drop through an upstream valve can create bubble formation, flashing and/or cavitation. This affects vortex meter accuracy.



- In gas/steam control valve applications, the valve should be placed upstream of the meter because the valve pressure drop causes expansion of the gas/steam, increasing velocity and flow signal amplitude.
- Pressure and temperature taps are used in gas/steam applications. Pressure taps for mass or standard volumetric measurement should be located 3.5 to 4.5 PDs downstream of the meter. See figure below and Table 3.

  Temperature taps should be located five to six PDs downstream, and the smallest possible probe is recommended to reduce the chances of flow disturbance.

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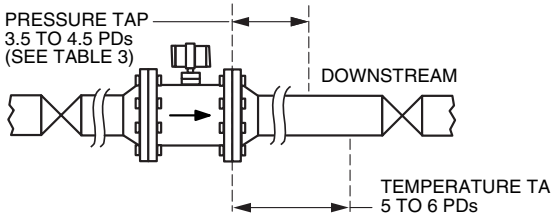
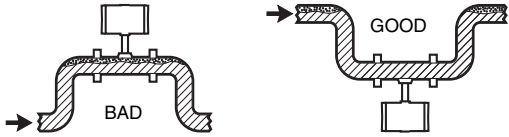


Table 3. Pressure Tap Location Table for Horizontal Pipelines

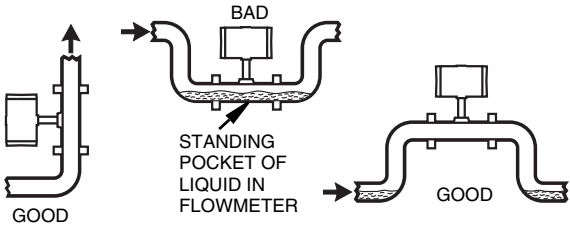
Fluid	Pressure Tap Location (a)
Liquid	On side of pipe (If required)
Gas	On top of pipe
Steam	On top of pipe when pressure measuring device is above the pipeline. On side of pipe when pressure measuring device is below the pipeline.

a. Locations indicated are for horizontal pipelines. For vertical pipelines, the pressure tap may be located anywhere around the circumference of the pipe.

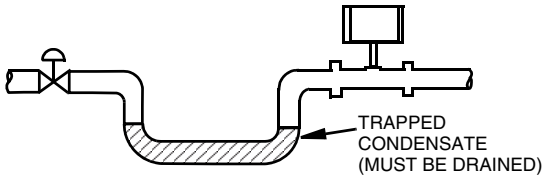
- For liquid applications with occasional gas pockets or bubble formation, install piping as depicted below so as not to trap the gas pockets or bubbles inside the meter.



- On gas flows, avoid installation conditions that create standing pockets of liquids inside the meter. The best installation is in vertical lines.



- For condensate gas or steam applications, take precautions to avoid any trapped condensate that causes a “water hammer” during startup.



VORTEX METER ACCURACY

Meter accuracy is based upon the known value for the K-factor, determined from a water calibration at the factory. This water calibration data yields a K-factor value which is valid for any other fluid. However, accuracy varies with fluid type as follows: ±0.5% of rate for liquids, and ±1.0% of rate for gases and steam. Flow rates at low Reynolds Numbers (down to 5000) can be measured at a reduced accuracy. See the applicable Product Specifications Sheets for more comprehensive performance specifications.

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Table 4. Related Product Specifications Sheets (PSSes)

Doc. #	Description
PSS 1-8A3A	Model 84, Wafer Body with HART (Standard and Low Power)
PSS 1-8A5A	Model 84, Sanitary with HART (Standard and Low Power)
PSS 1-8A7A	Model 84, Flanged and Male NPT Body with HART (Standard and Low Power)
PSS 1-8A8A	Model 84C with Flanged, Wafer, or Threaded (NPT) Body Styles

UNRECOVERED HEAD LOSS

Vortex flowmeters are designed to produce a maximum of 8 psi unrecovered head loss for liquids flowing at the meter upper range limit. Exact pressure losses can be calculated using *FlowExpertPro* software.

MASS OR STANDARD VOLUME MEASUREMENT

Vortex flowmeters measure volumetric flow rates at actual process conditions. You may want the measurement to be in mass units or standard volumetric units (volumetric flow rates referenced to standard temperature and pressure conditions).

If the pressure and temperature are being controlled, the meter can be configured to output in mass units or standard volumetric units directly. Enter the flowing density (for mass or standard volume EGUs) and the base density (for standard volume EGUs) into the configuration database. Also select and enter the desired EGUs.

If the pressure and/or temperature are not being controlled, external flow computers may be used with the vortex meter to measure mass or volumetric flow.

For liquids, compensation for density changes with temperature must be provided.

For gases and steam, both temperature and pressure values must be provided, along with the vortex meter signal. Flow computers calculate density, based upon the temperature and pressure units, using internal algorithms. Mass or standard volumetric flow rate is calculated, displayed, and output based upon the density calculation and the actual volumetric flow rate from the vortex meter.

MULTIPHASE FLUID MEASUREMENT

Multiphase fluids have liquids, gases, and solids mixed together in some proportion. For example, liquids with gas bubbles and/or undissolved solids, and gases with liquids and/or solids, are typical examples of multiphase fluids.

Vortex meter accuracy is specified for single phase fluids only. Accurate measurement of multiphase fluid is not possible. However, measurements can be made with some degree of accuracy, depending on various fluid conditions, including the degree of homogeneous mixing, stratification of flow, and process conditions that may alter fluid state.

TROUBLESHOOTING

Following the instructions in this document helps to prevent measurement problems. Various conditions can cause measurement errors with vortex meters:

- Improper sizing
- Improper configuration
- Insufficient upstream or downstream piping
- Improper meter orientation
- Mixed/Stratified phase flow
- Flow at low Reynolds Numbers
- Improper pressure and/or temperature tap locations
- Excessive pressure loss
- Severely pulsating flow

Any combination of the above still yields an output from the vortex meter. If your meter is generating an output that does not agree with other measurements, check for the above conditions first. Then refer to the troubleshooting guidelines in the applicable instruction manuals (see Table 1).

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