Process Solutions Guide

Separator Water Measurement Using Rosemount Vortex

Rosemount Key Benefits

- Reduced maintenance and operations cost
- Reduced risk of lost revenue due to gas blow by
- Reduced environmental risk of gas venting
- Improved reliability of separator water measurement for reservoir modeling
- Improve well availability

Overview

Many oil and gas producers are looking for opportunities to decrease maintenance costs and maximize production. Eliminating the utilization of older technology, such as mechanical meters, to measure flow provides an opportunity to reduce maintenance and operating costs and ensure the reliability of field data to maximize production. Modern maintenance free flowmeter technologies not only reduce cost, but also provide advanced diagnostic capabilities to reduce disruption should the meter or well require attention.

Producing wells flow into either a production or test separator to separate gas from liquids and further separate the oil from water. This document will focus on water measurement on the separator outlet. Typically on the water leg of the separator, flow rates are being measured by turbine meters. Due to debris in flow lines and gas blow by, turbine meters often require extensive maintenance to replace or clean the rotating internals. Many oil and gas producers report that replacement or cleaning of the internal parts is needed at least once per year. Also, when the meters fail, the water flow rate is not measured and must be inferred. This failure can be very costly, especially when the well experiences high water production and well intervention is needed. Also, not having accurate water production data decreases the reliability of the reservoir model. Some operators also monitor the trends in water production. A sudden increase in the flow rate or daily volume may indicate a stuck dump valve, and gas is being vented through the water leg of the separator resulting in lost revenue and environmental hazards.

The Rosemount 8800 vortex flowmeter can significantly reduce flowmeter related maintenance and failures. The Rosemount 8800 has no moving parts and a non clog design which does not require any routine replacement or cleaning to maintain performance. The Rosemount 8800 vortex flowmeter ensures an accurate and reliable measurement providing data to the reservoir model, and can be configured for multi-fluid measurement using the adaptive digital signal processing to detect a sudden increase in flow rate caused by gas discharge from the water leg. By setting flow limits in the RTU, this diagnostic tool can be used to shut in the well until corrective action can be taken reducing lost revenue and decreasing the environmental impact of venting gas to the environment.

Flowmeter Sizing Guide

Meter Size in Inches (mm)	Reducer Meter Size in inches (mm)	Min Instantaneous Flow Rate (barrels per day)	Max Instantaneous Flow Rate (barrels per day)
0.5 (15)	1.0 (25)	65.4	974.1
1.0 (25)	1.5 (40)	142	2770.7
1.5 (40)	2.0 (50)	240.6	6526.7
2.0 (50)	3.0 (80)	378.2	10757.8

Table 1

Sizing Considerations

The key to correctly sizing a vortex flowmeter on the water outlet of a separator is understanding what the instantaneous flow rate is. The instantaneous flow rate is often much higher than the average daily rate and it should be used to ensure that meter is correctly sized for the application. A snap acting dump valve should be used to provide the highest flow rate to ensure the flow remains above the low flow cutoff of the meter. The trim size of the dump valve can often be used to aid in determining the expected flow rate. If configuring the meter for multi-fluid measurement to detect gas blow-by, it is important not to oversize the meter and select a smaller meter that does not exceed the maximum flow rate. See the multi-fluid configuration section on the next page for more details. The sizing chart in Table 1 references water flow rates that can be measured by each meter type and size. For detailed analysis for your application consult an Emerson representative or the Instrument Toolkit® sizing software which can be downloaded from www.rosemount.com.

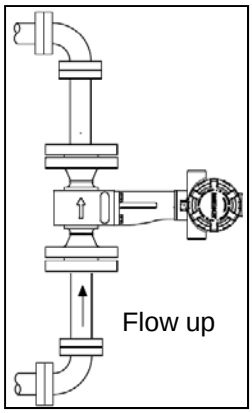
Many vortex meter installations require a line size reduction in order to take advantage of the optimal flow range of the meter. Rosemount also offers a Reducer vortex meter which has built in reducers integral to the flanges eliminating the need to modify piping. The reducer meter has the same lay length as the standard vortex meter allowing for a drop in replacement should the flow rates change during the life of the field.

Reducer Meter Standard Flanged

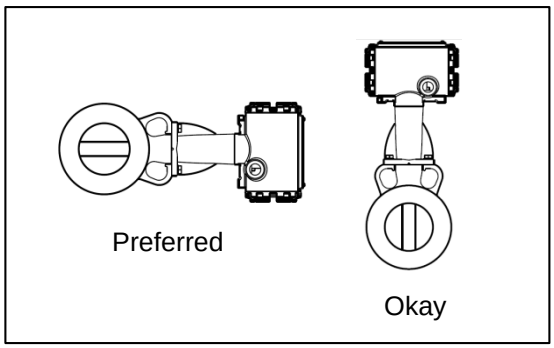
Installation Recommendations

The design of the process piping should ensure that the meter body will remain full, with no entrapped air. For best results the meter should be installed upstream of a snap acting dump valve. A minimum of ten straight pipe diameters upstream and 5 straight pipe diameters downstream is required for best measurement results. Vertical mounting with flow up for liquids is the best orientation, but horizontal mounting is also acceptable. When mounting horizontally with fluids with small solids content such as sand, it is recommended to have the flowmeter installed with the electronics to the side. This will minimize potential measurement errors by allowing solids to flow under the shedder bar without interrupting the vortex shedding. The Rosemount 8800 vortex meter design is less susceptible to error and abrasive wear due to sand content than turbine or differential pressure meters, but in applications with very high sand content it may be necessary to delay installation of the meter until the well stabilizes and sand production is reduced.

Vertical Mounting



Horizontal Mounting



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Configuration for Multi-Fluid Measurement

In order to detect if the dump valve on the separator has become stuck in the open position, the vortex meter must be configured for multi-fluid measurement. Multi-fluid measurement is defined as the ability of a single meter to measure more than one separate homogeneous fluid (liquids and/or gases) without changing the meter configuration, while multi-phase measurement is defined as a liquid and gas mixture. Multi-phase fluids will result in inaccurate measurements using vortex technology and is beyond the scope of this document. As in all vortex applications, the selected flowmeter size must be able to measure both fluids over the desired flow ranges and a sizing analysis should be performed. Since each size meter has flow limitations, some compromises may be necessary for the liquid or gas measurement. In order to best optimize the adaptive digital signal processing, it is best to select a smaller meter size provided the liquid flow rates do not exceed the maximum value in Table 1.

Up to three outputs are available on the Vortex 8800 transmitter to represent flow, 4-20mA analog, pulse output, and HART (digital) communications. When measuring liquid and gas with a single configuration the appropriate output must be selected. The flow velocity for liquids can be as much as 1/10th the flow velocity of gas. As can be seen in the Figure 1 below, the span of the liquid output is limited when trying to measure both liquid and gas using the 4-20mA scale. This can result in a significant measurement error for the liquid measurement. In order to ensure the best possible measurement, the pulse output or HART output should be used with a multi-fluid configuration. The pulse output resolution remains constant over the entire span and the digital HART output is unaffected by the span of the vortex meter providing a more accurate measurement. Alternatively, the vortex meter can also be configured so that the 4-20mA output is used for liquid measurement and the pulse output is used for gas measurement.

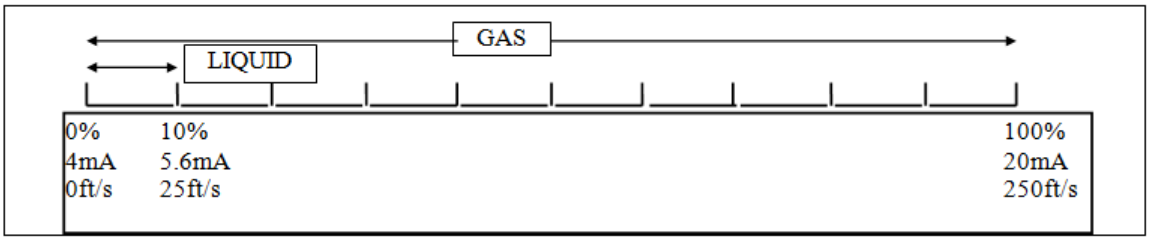

Figure 1

In order to measure both liquids and gases, the adaptive digital signal processing must be configured correctly using a HART field communicator or AMS® Suite: Intelligent Device Manager.

1. Select gas/steam as the process fluid in the meter configuration.
2. Set the adaptive digital signal processing filter settings using the density of the gas to be measured. This is the “optimize flow range” selection in AMS or HART field communicator.
3. Decrease the low flow cutoff to half the maximum expected water flow rate. The low flow cutoff should not be set to a value lower than minimum flow rate value for the meter size listed in Table 1. It may be necessary to adjust the low flow cutoff value if vibration or noise is present and the meter registers flow when no flow is present.
4. Set the trigger level to 4.

Using the above configuration, the vortex meter will measure both gas flow and liquid flow rates. Since the gas will flow at a much higher velocity than the liquid flow rate, flow limits and alarms setup in the RTU can be used as an indication that gas blow by is occurring on the separator water outlet. Table 1 can be used as a guideline for the maximum measurable liquid flow rate limits to be set in the RTU.

Additional Specifications

Performance Specifications

Liquids – Reynolds number over 20000
Digital and pulse output: ±0.65% of rate

Gas and Steam – Reynolds number over 15000
Digital and pulse output ±1.0% of rate

Output Signals

4-20 mA Digital HART signal
Superimposed on 4-20mA signal

Scalable pulse output
0-10000 Hz; transistor switch closure with adjustable scaling via HART communications; capable of switching up to 30Vdc, 120mA max

FOUNDATION Fieldbus

Min Upstream / Downstream Piping Length

The Rosemount 8800D Flowmeter may be installed with a minimum of ten straight pipe diameters (D) upstream and five straight pipe diameters (D) downstream by following the K-factor corrections as described in the 8800 Installation Effects Technical Data Sheet (00816-0100-3250). No K-factor correction is required if 35 straight pipe diameters upstream (35D) and 10 straight pipe diameters downstream (10D) are available.

Power Supply

HART Analog
External power supply required. Flowmeter operates on 10.8 to 42 Vdc terminal voltage with 250-ohm minimum load required for HART communications, 16.8 Vdc power supply is required.

Power Consumption
One watt maximum

Consult the 8800 Product Datasheet for additional product specifications

Rosemount 8800 Vortex Offering

Flanged | Wafer | Reducer | Weld End | Multi-Variable | Critical Process | NPT Threaded

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