Vortex Flowmeter FV4000 (TRIO-WIRL V)
Swirl Flowmeter FS4000 (TRIO-WIRL S)

For flow rate and volume measurement of liquids, gases and steam

- Cost savings due to high accuracy
- Low investment cost through short straight inlet and outlet sections
- No wear, no maintenance – no moving parts
- Reduced stock keeping cost through flexible Ex concept (incl. Dust Ex)
- Economic saturated steam measurement using the 2-wire technology
The Vortex Flowmeter FV4000 operation is based on the Karman Vortex Street, in which, the shedding frequency of eddies in a flow stream after an obstruction is measured. The shedding frequency of the eddies and the rotation are – over a wide Reynold’s number range – proportional to the flow rate.

Vortex and Swirl Flowmeters

When a flowing fluid meets an obstruction, pressure variations are created in the fluid, which cause eddies to shed at the obstruction. This phenomenon is utilized in the Vortex and Swirl flowmeters. The eddies are formed in the fluid at a geometrically defined obstruction (Vortex and Swirl bodies) whose frequency is measured by a sensor. The flowrate of liquids, gases and steam is determined precisely and reliably from this frequency measurement.

Technology that creates a whirl

Fixed spiral vanes in the Swirl Flowmeter’s entry body force the fluid into a rotation. The frequency of the resulting secondary rotation is then measured.

The shedding frequency of the eddies and the rotation are – over a wide Reynold’s number range – proportional to the flow rate.

A worthwhile comparison

<table>
<thead>
<tr>
<th></th>
<th>Vortex Flowmeter</th>
<th>Ring Chamber Standard Orifice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>1% of rate / 0.75% of measured value</td>
<td>approx. 2% of upper range value</td>
</tr>
<tr>
<td>Span</td>
<td>up to five times greater</td>
<td>small</td>
</tr>
<tr>
<td>Feed pipes</td>
<td>not required</td>
<td>requires 2 thin pipes to the Δp transmitter</td>
</tr>
<tr>
<td>Outputs</td>
<td>analog and pulse</td>
<td>analog, only</td>
</tr>
<tr>
<td>Installation</td>
<td>convenient, easy to</td>
<td>demanding</td>
</tr>
<tr>
<td></td>
<td>commission</td>
<td></td>
</tr>
<tr>
<td>Maintenance</td>
<td>maintenance-free</td>
<td>requires much maintenance</td>
</tr>
<tr>
<td>Cost</td>
<td>very economical</td>
<td>economical only for</td>
</tr>
<tr>
<td></td>
<td>up to DN 200</td>
<td>DN 200 or higher</td>
</tr>
</tbody>
</table>
Striking flexibility

ABB is the only manufacturer offering high-performance Vortex and Swirl flowmeters, which, as a result of their innovative DSP-Technology (Digital Signal Processing), are extremely reliable. The instruments are designed in 2-wire technology.

Most different measuring principles – special advantages

Vortex
- Easy orifice replacement through 65 mm installation length for wafer flange version
- Process safety through robust design (resistant to hammer blows)
- Unaffected by sediments, hence requiring only little maintenance

Swirl
- Amazingly low installation cost due to uniquely short straight sections (inlet and outlet)
- Cost savings through high accuracy
- Suitable for liquids with a viscosity greater than 7 mPas (up to 30 mPas, depending on pipe diameter)

Undisturbed inflow

In order to guarantee optimum functionality, the flow profile of the Vortex flowmeter should be as undisturbed as possible. This is achieved by using a straight inlet section with a length of 15D (pipe diameters) and an outlet section 5D long. The inlet length requirement may increase depending on the location.

Very short straight inlet and outlet sections

Swirl-Flowmeter requires virtually no straight pipe sections on the inlet or outlet. Generally lengths of 3D at the inlet and 1D at the outlet are sufficient.
FV4000-VR4 resp. FS4000-SR4 with remote converter

The separate primary of this variant can be installed at even hardly accessible measuring points.

This measuring system is also designed for measuring points in a harsh environment. As the primary does not contain any electronic components, it can be exposed to ambient temperatures up to 70 °C (158 °F).

The primary can be operated easily and conveniently from a distance of up to 10 m.

Impressive arguments

All calibration data and parameter values are stored in a removable FRAM, allowing the converter to be exchanged quickly and easily.

The sensors are vibration compensated, (pipeline vibrations up to 1g are suppressed in the converter).

Identical sensors and converters are utilized for both measuring methods (vortex and swirl). This reduces stocking costs.

Vortex Flowmeter FV4000 (TRIO-WIRL V)

Swirl Flowmeter FS4000 (TRIO-WIRL S)

**Principle**
- Karman Vortex Street
- Swirl flow

**Fluids**
- Liquids, gases, steam
- Liquids, gases, steam

**Temperature range**
- -55 °C…+400 °C (131 °F…722 °F)
- -55 °C…+280 °C (131 °F…536 °F)

**Process connection**
- Flanged, wafer design
- Flanged
- IP 67
- HART, PROFINET PA, FOUNDATION Fieldbus

**Accuracy**
- Liquids: ±0.75% of rate
- Gases/steam: ±1% of rate
- ±0.5% of rate

Flow ranges FV/FS4000

<table>
<thead>
<tr>
<th>Meter Size</th>
<th>Liquid Flow Range [m³/h]</th>
<th>Gas Flow Range [m³/h]</th>
<th>Meter Size</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>QV&lt;sub&gt;min&lt;/sub&gt; DN</td>
<td>QV&lt;sub&gt;max&lt;/sub&gt; DN</td>
<td>QV&lt;sub&gt;min&lt;/sub&gt; DN</td>
</tr>
<tr>
<td>1/2 15</td>
<td>0.5</td>
<td>6</td>
<td>2.5</td>
</tr>
<tr>
<td>3/4 20</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>1 25</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>1-1/4 32</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>1-1/2 40</td>
<td>2.4</td>
<td>48</td>
<td>30</td>
</tr>
<tr>
<td>2 50</td>
<td>3</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>3 80</td>
<td>4</td>
<td>100</td>
<td>170</td>
</tr>
<tr>
<td>4 100</td>
<td>5</td>
<td>170</td>
<td>270</td>
</tr>
<tr>
<td>6 150</td>
<td>10</td>
<td>300</td>
<td>630</td>
</tr>
<tr>
<td>8 200</td>
<td>20</td>
<td>1000</td>
<td>1100</td>
</tr>
<tr>
<td>10 250</td>
<td>70</td>
<td>1700</td>
<td>–</td>
</tr>
<tr>
<td>12 300</td>
<td>100</td>
<td>2400</td>
<td>–</td>
</tr>
<tr>
<td>16 400</td>
<td>180</td>
<td>1800</td>
<td>1410</td>
</tr>
</tbody>
</table>

* water at 20 °C (68 °F)  * air at 20 °C (68 °F), 1013 mbar
**Type Fieldbus:**
The Ex-version complies with the FISCO (Fieldbus Intrinsically Safe Concept) of the PTB (German Federal Establishment of Physics and Engineering).

II 2 G EEx ia IIC T4
II 2 D T85 °C...T-medium IP67

**Type 4…20 mA HART:**
- Intrinsically safe power supply:
  - II 2 G EEx ib IIC T4
  - II 3 G EEx n(L) IIC T4
  - II 2 D T85 °C...T-medium IP67

**Flame proof/intrinsically safe design:**
- Non-intrinsically safe power supply:
  - II 2 G EEx d [ib] IIC T6
  - II 2 D T85 °C...T-medium IP67
- Intrinsically safe power supply:
  - II 2 G EEx ib IIC T4
  - II 2 D T85 °C...T-medium IP67

Advantage: Reduced stock requirement because the same instrument can be installed in either “EEx d” or “EEx ib” areas. This model is certified for hazardous area zone 2 as well.

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**Integrated temperature measurement**

The measurement of the temperature and flowrate at the same location offers considerable advantages:
- Saturated steam measurement directly in mass flow units
- Higher accuracy through compensation of temperature effects
- High accuracy through advantageous positioning of the temperature sensor
- No additional wiring
- Fast response time

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**Pressure and temperature compensation**

If the process conditions are changing, e.g. due to pressure variations, or overheated steam is to be measured, the integrated temperature measurement equipment is not sufficient for exact measurement and display of the gas flow (in mass or standard units) or steam mass flow. Swirl and Vortex flowmeter together with FCU400-G (gases) or FCU400-S (steam) are the optimal tools for these applications. The instrument supply is realized via the FCU evaluation unit, thus reducing the wiring efforts considerably.

**Additionally used ABB components**
- Pressure transmitter
  - for absolute pressure, e.g. Multi Vision 2020 TA
- Resistance thermometer
  - e.g. TSWT-R, optionally with integrated TH 02 head-mounted transmitter
- Evaluation unit
  - FCU400-S, FCU400-G (SensyCal S/G)