Steam Flow Measurement

RELIABLE STEAM FLOW MEASUREMENT FOR THE MOST CHALLENGING APPLICATIONS

Flexible ultrasonic flow measurement solutions

SICK
Sensor Intelligence.
Steam flow measurement often requires compromise, but it doesn’t have to...

With an ever increasing focus on steam producers and users to increase revenues, reduce costs and minimize waste, traditional flowmeter technologies sometimes struggle to meet the challenge.

Measurement point design, procurement, installation and commissioning costs are only the start of the story. Whilst vortex, differential pressure based flow measurement and turbine meters are adequate in many situations, more demanding applications often see rapid payback and ongoing savings using SICK Ultrasonic steam measurement technology.
Steam is generated and used in all industries for a wide variety of purposes, including heating, drying, optimizing combustion and motive power to pumps and compressors.

While DP flow and vortex meters are a good fit in many cases, there are applications where a more capable meter is needed; these are the applications where a FLOWSIC may be the optimum solution and can provide a fast payback:

- Where widely varying steam demand (flow rate) results in loss of measurement at low flowrates
- Where the lowest pressure loss is critical
- Where large steam lines limit the selection of suitable technologies
- Where poor accuracy results in lost revenue

FLOWSIC600 and FLOWSIC100 meters operate around the world on challenging, high-value steam flow installations. These include challenging applications and steam injection into flares, where the challenges of low uncertainty over a wide flow turndown cannot be met by traditional steam flow measurement technologies such as vortex and differential pressure (DP) based meters.

With a maximum process temperature of 280°C (536 °F) FLOWSIC solutions are suitable for a wide range of saturated and superheated steam applications.

Steam flow applications requiring great performance over a wide flow range and the lowest pressure loss?

FLOWSIC!
FLOWSIC600 Steam Flow Measurement
The FLOWSIC600 ultrasonic flow meter is ideal for high accuracy and greenfield installations where an in-line meter must meet the challenges of low uncertainty:

- Greater than 100:1 flow turndown
- Virtually no pressure loss
- In-situ validation
- No wear
- No routine maintenance

Maximum Reliability
The FLOWSIC600 ultrasonic flow meter has no moving parts and does not rely on intrusions into the vapor stream, making it highly resistant to contamination and wear. Self-diagnostics combine to ensure years of reliable measurement.

High Measurement Accuracy
The FLOWSIC600 measures saturated and superheated steam flow using ultrasonic technology. SICK ultrasonic sensors offer excellent measurement performance even at low flow rates and varying line pressures and provide outstanding long term performance.

<table>
<thead>
<tr>
<th></th>
<th>Installed cost</th>
<th>Cost of maintenance</th>
<th>Cost of steam „loss“ due to technology turndown</th>
<th>Cost of steam „loss“ due to technology % uncertainty</th>
<th>Cost of Permanent Pressure Loss (energy)</th>
<th>Second Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP + orifice plate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vortex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SICK FLOWSIC600</td>
<td></td>
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</tr>
</tbody>
</table>
Technical Data

### Meter characteristics

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DN 50/2&quot;</td>
<td>4</td>
<td>140</td>
<td>55</td>
<td>180</td>
<td>250</td>
<td>9.8</td>
<td>40</td>
<td>FL6ST-02CL600-*</td>
</tr>
<tr>
<td>DN 80/3&quot;</td>
<td>8</td>
<td>280</td>
<td>61</td>
<td>200</td>
<td>320</td>
<td>12.5</td>
<td>60</td>
<td>FL6ST-03CL600-*</td>
</tr>
<tr>
<td>DN 100/4&quot;</td>
<td>13</td>
<td>460</td>
<td>46</td>
<td>151</td>
<td>450</td>
<td>17.6</td>
<td>80</td>
<td>FL6ST-04CL600-*</td>
</tr>
<tr>
<td>DN 200/8&quot;</td>
<td>32</td>
<td>1,130</td>
<td>39</td>
<td>128</td>
<td>600</td>
<td>23.5</td>
<td>200</td>
<td>FL6ST-08CL600-*</td>
</tr>
<tr>
<td>DN 250/10&quot;</td>
<td>50</td>
<td>1,770</td>
<td>38</td>
<td>125</td>
<td>750</td>
<td>29.4</td>
<td>320</td>
<td>FL6ST-10CL600-*</td>
</tr>
<tr>
<td>DN 300/12&quot;</td>
<td>65</td>
<td>2,300</td>
<td>30</td>
<td>98</td>
<td>900</td>
<td>35.3</td>
<td>490</td>
<td>FL6ST-12CL600-*</td>
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<tr>
<td>DN 350/14&quot;</td>
<td>80</td>
<td>2,830</td>
<td>30</td>
<td>98</td>
<td>1,050</td>
<td>41.2</td>
<td>570</td>
<td>FL6ST-14CL600-*</td>
</tr>
<tr>
<td>DN 400/16&quot;</td>
<td>120</td>
<td>4,240</td>
<td>30</td>
<td>98</td>
<td>762</td>
<td>29.9</td>
<td>630</td>
<td>FL6ST-16CL600-*</td>
</tr>
</tbody>
</table>

### Materials

- Meter body: Low temperature carbon steel
- Transducers: Titanium
- Electronics: Aluminum

### Flange type

ASME B16.5, Raised face

### Meter body finish

Meter body: nickel plated, covers: RAL7012

### Measuring parameters

- **Fluid**: Steam up to 280°C (536 °F)
- **Process value**: Volumetric flow, volume totals at actual conditions velocity of gas, speed of sound
- **Measurement principle**: Ultrasonic transit time difference measurement
- **Typical accuracy**
  - DN50 / 2": 10% Q_max ...
  - DN80 / 3" or larger: ±1.5% of rate ±1% of rate
- **Repeatability**: < 0.1%
- **Process temperature**: -15 °C … + 280 °C (+5 °F ... +536 °F)
- **Pressure rating**: CL600

### Approvals

- **Conformities**: ISO 17089-2
- **Ex approvals**: CSA, ATEX, IECEx, zone 1 and zone 2
- **Electrical Safety**: CE
- **IP classification**: IP 67
- **Ambient conditions**: Temperature -40 °C ... + 60 °C (-40 °F ... +140 °F) Humidity ≤ 95%

### Power supply, Outputs and Interfaces

- **Voltage**: 15 … 28.8 V DC, ≤ 1 W
- **Analog output**: 4 ... 20 mA (Ω 200), Active/passive mode, isolated
- **Digital outputs**: 1x pulse, 2x status, isolated, OC or NAMUR, frequency @ Q_max = 2 kHz
- **Digital interfaces**: RS485, Modbus ASCII/RTU, HART rev. 5
- **Display**: 2-line LCD

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1) Order of ATEX version – replace * with A, Order of CSA version - replace * with C, IIECEx version on request
2) Other pressure ratings or flange types available on request
3) With good piping conditions (developed flow profile). Typical uncertainty below Q_t is ±3.0% for DN50 (2") and ±2.0% for DN80 (3") or larger
4) With a steam quality of ≥ 80%
5) Accuracy ±0.5% available on request
The FLOWSIC100 ultrasonic gas and steam flow meter family delivers an optimum combination of performance and installation flexibility, especially in brown-field and large pipe installations.

- 400:1 flow turndown
- Virtually no pressure loss
- In-situ validation
- No wear
- No routine maintenance

**Maximum Reliability**
The FLOWSIC100 ultrasonic flow meter has no moving parts and offers outstanding performance and durability.

Contaminated steam carrying corrosive components has no impact on the measurement. Highly corrosion resistant materials (such as titanium) are selected for critical transducer wetted parts. Material suitability is assessed for each application.

**High Installation Flexibility**
The FLOWSIC100 offers high flexibility enabling optimized solutions for even the most challenging saturated and superheated applications.

- Cross-duct type for easy installation on an existing pipeline using welding nozzles.
- Single-probe type for simple and cost-saving installation on one side of the steam line.
- Retraction mechanism for quick and simple replacing of sensor during plant operation.

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Illustration based on 6” line

- Installed cost
- Cost of maintenance
- Cost of steam „loss“ due to technology % uncertainty
- Cost of steam „loss“ due to technology turndown
- Cost of Permanent Pressure Loss (energy)
- Second Year

Illustration based on 6” line
## Technical Data

<table>
<thead>
<tr>
<th>Meter characteristics</th>
<th>FLOWSIC100 EX-S</th>
<th>FLOWSIC100 EX-PR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement configuration</td>
<td>Cross-duct 1-path or 2-path</td>
<td>Probe version 1-path or 2-path</td>
</tr>
</tbody>
</table>

### Measuring parameters

<table>
<thead>
<tr>
<th>Measured values</th>
<th>Flow velocity, volumetric flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring range</td>
<td>0.03 ... 120 m/s (0.1 ... 393 ft/s) 0.03 ... 90 m/s (0.1 ... 295 ft/s)</td>
</tr>
<tr>
<td>Repeatability</td>
<td>0.2 % at ≥ 10 m/s (33 ft/s)</td>
</tr>
<tr>
<td>Uncertainty of measurement</td>
<td>± 5 % in the range 0.3 m/s (1 ft/s) up to the upper range value</td>
</tr>
<tr>
<td>Volumetric flow a. c. (1-path measurement):</td>
<td>± 5 %</td>
</tr>
<tr>
<td>Volumetric flow a. c. (2-path measurement):</td>
<td>± 3 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal pipe size</th>
<th>1-path measurement 12” ... 24” 18” ... 72”</th>
</tr>
</thead>
<tbody>
<tr>
<td>过程温度</td>
<td>Standard: -70 °C ... +180 °C (-94 °F ... +356 °F)</td>
</tr>
<tr>
<td></td>
<td>Zone 1: -70 °C ... +280 °C (-94 °F ... +536 °F)</td>
</tr>
<tr>
<td></td>
<td>Zone 2: -70 °C ... +260 °C (-94 °F ... +500 °F)</td>
</tr>
<tr>
<td>Operating pressure</td>
<td>-0.5 bar (g) ... 16 bar (g), optional up to 20 bar (g)</td>
</tr>
</tbody>
</table>

### Approvals

<table>
<thead>
<tr>
<th>Ex approvals</th>
<th>S/R units</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATEX zone 1 and 2, IECEx, CSA CI I, Div 1</td>
<td>Control unit ATEX zone 1 and 2, IECEx, CSA CI I, Div 1; CI I Div 2</td>
</tr>
</tbody>
</table>

### Outputs and interfaces

| Analog outputs | 1 active output: 0/2/4 ... 22 mA, max. load 500 W, according to NAMUR NE43 |
| Analog inputs | 2 inputs: 0 ... 5/10 V or 0 ... 20 mA |
| Digital outputs | Pulse/frequency output (opt. module); 5 outputs: 48 V d.c./1A, 30 V d.c./1A (MCUP zone 2); floating status signals: operation/malfunction, maintenance, check cycle, limit value, maint. request |
| Digital inputs | 2 inputs for connection of floating contacts |
| Interfaces | USB 1.1 (virtual COM, service interface) RS-232 (service interface) RS-485 (only Ex-versions) Digital transmitter interface (via optional interface module) Interface module (option) |
| Bus protocol (via optional interface module) | Pulse, Ethernet + pulse, Ethernet triplex + pulse, MODBUS TCP + pulse, MODBUS RS485 + pulse, HARTBUS AO + pulse, PROFIBUS RS485 + pulse, Foundation Fieldbus + pulse |

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1) No standard solution, available separately only. For full specification see product data sheet.
2) For fully developed flow profiles.
3) Optional extendable by using I/O modules.
Challenging flow conditions result in loss of measurement and high maintenance costs

A major European steel mill needed reliable measurement of steam flow over a wide flow turndown for internal cost metering. A turbine meter was chosen as this promised acceptable flow turndown and accuracy and would therefore avoid measurement losses at lower flow rates. A vortex meter was also considered however its inability to provide a measurement at lower flowing velocities made this technology unsuitable. The turbine meter was installed and provided measurement over the full steam flow range; however linearity at lower flows was poor.

In addition to the disappointing low flow performance, the turbine meter required costly, regular maintenance. Rapid changes in steam velocity resulted in bearing wear and damaged blades; causing inaccurate measurement and subsequent frequent failure of the meter. The meter was returned to the manufacturer two to three times each year as a result.

The combination of loss of measurement, de-commissioning, repair costs and re-commissioning was unacceptable and drove the plant to seek a better solution.

The solution?

Following detailed consultation with SICK, a FLOWSIC100 was installed on the 8" (DN200) saturated steam flow line in 2010. The ultrasonic flow meter has provided a reliable and maintenance free measurement ever since.
Ultrasonic flow meter benefits

1. Full bore ultrasonic meter producing virtually no pressure drop and no corresponding energy loss.
2. Very high flow turndown enables reliable measurement over a wider flow range.
3. High accuracy, even at low flow rates, resulting in less “lost” steam.
4. No moving or damageable parts, enabling further maintenance savings.
5. No risk of damage to equipment downstream from failed turbine blades.

Rapid return on investment

In spite of an initially higher capex cost, the FLOWSIC100 Process flow meter delivered a return on investment of less than one year; considering maintenance savings alone.

Cumulative Ownwership Cost Example
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SICK is a leading manufacturer of intelligent sensors and sensor solutions for industrial applications. With more than 9,700 employees and over 50 subsidiaries and equity investments as well as numerous agencies worldwide, SICK is always close to its customers. A unique range of products and services creates the perfect basis for controlling processes securely and efficiently, protecting individuals from accidents, and preventing damage to the environment.

SICK has extensive experience in various industries and understands their processes and requirements. With intelligent sensors, SICK delivers exactly what the customers need. In application centers in Europe, Asia, and North America, system solutions are tested and optimized in accordance with customer specifications. All this makes SICK a reliable supplier and development partner.

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That is “Sensor Intelligence.”

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Detailed addresses and additional representatives → www.sick.com