DIVA flowmeter
for saturated steam flow measurement
The Spirax Sarco Direct In-line Variable Area flowmeter (DIVA) is designed as an ideal system for any steam energy management scheme or steam flowmetering application, from monitoring and targeting initiatives to control applications. The contemporary technology and unique operating principle mean it is ideally suited to demanding industrial processes with a low cost of ownership.

The DIVA is an innovative development of the well established family of Spirax Sarco Gilflo flowmeters and the compact ILVA, which have been used in industrial flowmetering applications for more than 25 years.

### Flowmetering systems will:

- Check on the energy cost of any part of the plant.
- Cost energy as a raw material.
- Identify priority areas for energy savings.
- Enable efficiencies to be calculated for processes or power generation.

### Traditional system vs DIVA system

#### Traditional system
- Temperature sensor
- Isolation valves
- Differential pressure transmitter
- Flow computer

#### DIVA system
- 4-20 mA output

### The DIVA system will also:

- Provide process control for certain applications.
- Monitor plant trends and identify any deterioration and steam losses.

### User benefits

- Low cost integrated unit - No need for additional equipment or differential pressure transmitters.
- No impulse lines - Reducing maintenance, installation costs and potential problems.
- High turndown with high system accuracy and high repeatability - Provides accurate readings over a wide range of flows.
- In-built density compensation and error elimination - Accurate mass flow.
- Compact wafer design - Low cost installation.
- Industry standard - 4-20 mA loop powered.
- Simple digital commissioning via integral display.
**How the DIVA flowmeter operates**

The DIVA flowmeter operates on the well established spring loaded variable area (SLVA) principle, where the area of an annular orifice is continuously varied by a precision shaped moving cone. This cone is free to move axially against the resistance of a spring.

However, unlike other SLVA flowmeters, the DIVA does not rely on the measurement of differential pressure drop across the flowmeter to calculate flow, measuring instead the force caused by the deflection of the cone via a series of high quality strain gauges. The higher the flow of steam, the greater the force. This removes the need for expensive differential pressure transmitters, reducing installation costs and potential problems.

The DIVA has an internal temperature sensor which provides full density compensation for saturated steam applications, removing the need for, and expense of additional sensors.

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**As standard the DIVA is supplied with an easy to use digital commissioning display.**

All programming is via 5 push buttons using a menu driven commissioning sequence.

The display will also report errors detected by the on-board diagnostics program.

Flow rate and flow total, temperature, pressure and power are displayed in metric or imperial units.

**...mass flow without the need for additional equipment!**
Energy efficiency

The DIVA can be used to monitor the results of energy saving schemes, such as monitoring and targeting, and to compare the efficiency of one piece of plant with another.

Plant efficiency

The DIVA can be used to calculate overall plant efficiency, determine when machinery is switched off, when plant is loaded to capacity or when working practices are satisfactory. It will also show the deterioration of plant over time, predicting optimum time for plant cleaning or replacement. It will also establish peak steam usage times or identify sections or items of plant to be major steam users. This may lead to a change in production methods for a more economical use of steam and to ease peak load problems on the boiler plant.
Process control

The DIVA can be used as part of a system to control the supply of the correct quantity of steam to a process. Also, by controlling the rate of increase of flow at start-up, it can be used as an effective slow warm-up device.

Costing and custody

The DIVA’s high system accuracy and turndown means it is ideally suited to measure the flow of steam, and thus the cost of steam, either centrally or at major steam-using centres. Steam can be costed as a raw material at various stages of the production process thus allowing the true cost of individual product lines to be calculated.
Sizing the DIVA flowmeter - capacities kg/h

<table>
<thead>
<tr>
<th>Steam pressure bar g</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>10</th>
<th>12</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>32</th>
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</thead>
<tbody>
<tr>
<td>DN50 Maximum horizontal flow</td>
<td>759</td>
<td>960</td>
<td>1 126</td>
<td>1 335</td>
<td>1 458</td>
<td>1 626</td>
<td>1 871</td>
<td>2 094</td>
<td>2 296</td>
<td>2 374</td>
</tr>
<tr>
<td>DN50 Minimum horizontal flow</td>
<td>20</td>
<td>25</td>
<td>28</td>
<td>33</td>
<td>36</td>
<td>40</td>
<td>46</td>
<td>51</td>
<td>56</td>
<td>58</td>
</tr>
<tr>
<td>DN80 Maximum horizontal flow</td>
<td>1 973</td>
<td>2 482</td>
<td>2 901</td>
<td>3 434</td>
<td>3 746</td>
<td>4 173</td>
<td>4 799</td>
<td>5 369</td>
<td>5 884</td>
<td>6 082</td>
</tr>
<tr>
<td>DN80 Minimum horizontal flow</td>
<td>44</td>
<td>54</td>
<td>62</td>
<td>73</td>
<td>79</td>
<td>87</td>
<td>100</td>
<td>111</td>
<td>121</td>
<td>125</td>
</tr>
<tr>
<td>DN100 Maximum horizontal flow</td>
<td>3 275</td>
<td>4 030</td>
<td>4 661</td>
<td>5 469</td>
<td>5 945</td>
<td>6 600</td>
<td>7 563</td>
<td>8 442</td>
<td>9 238</td>
<td>9 544</td>
</tr>
<tr>
<td>DN100 Minimum horizontal flow</td>
<td>68</td>
<td>83</td>
<td>95</td>
<td>111</td>
<td>121</td>
<td>134</td>
<td>153</td>
<td>171</td>
<td>186</td>
<td>193</td>
</tr>
</tbody>
</table>

Note: Minimum measurable flowrate is 2% of maximum horizontal flow. For vertical flow capacities please contact Spirax Sarco.

Density compensation

It is rare for the pressure in a steam system to remain absolutely constant. Unless this variation is taken into account, flow measurement errors will occur. The integral automatic density compensation provided by the DIVA flowmeter eliminates these errors and ensures accurate flowmetering whatever the steam pressure.

The example shown is for a metering system without density compensation and set at 7 bar g. By the end of the day significant errors can arise.

System uncertainty

The DIVA steam flowmeter has a system uncertainty in accordance with ISO 17025, of:

- ± 2% of actual flow to a confidence of 95% (2 standard deviations) over a range of 10% to 100% of maximum rated flow.
- ± 0.2% FSD to a confidence of 95% (2 standard deviations) from 2% to 10% of the maximum rated flow.

As the DIVA is a self-contained unit the uncertainty quoted is for the complete system. Many flowmeters claim a pipeline unit uncertainty and for a true system uncertainty, the individual uncertainty values of any associated equipment, such as DP cells, need to be taken into account.

The importance of turndown

The turndown of a flowmeter is the ratio of the maximum to minimum flowrate over which it will meet its specified performance, or its operational range. The DIVA flowmeter has a high turndown ratio of up to 50:1, i.e. an operational range of up to 98% of its maximum flow.

In steam systems, load variations can lead to wide variations in flow, from standing or weekend loads up to the maximum demands of the process. It is essential for the flowmeter to be able to cope with this. The chart compares the minimum flowrates that can be measured for typical flowmeters with a maximum flow of 2 500 kg/h. Flows below the minimum reading will be lost or at best inaccurate.

The DIVA flowmeter can achieve turndown ratios of up to 50:1, ensuring that the flow information gathered is accurate whatever the process conditions.

Minimum measurable flowrates, based on a practical steam velocity of 35 ms⁻¹
Flow orientations
The DIVA can be installed in any of the following orientations:

- Flow orientation: vertically up or down
  - Turndown up to 30:1
  - Pressure limitation 7 bar g

- Flow orientation: horizontal
  - Turndown up to 50:1
  - Pressure limitation 32 bar g

Associated equipment
If desired, the DIVA can output a 4-20 mA signal to a Spirax Sarco M750 display unit for remote indication of flowrate and totals. The M750 provides the loop power for the DIVA and is available with 4-20 mA retransmission or pulsed output. See separate literature for details.

Calibration information
It is important that any flowmeter is calibrated accurately. DIVA flowmeters are calibrated on a high accuracy flow facility at Spirax Sarco’s flowmeter manufacturing facility in Cheltenham, UK. Designed and built by Spirax Sarco engineers in conjunction with the UK National Engineering Laboratories, it ensures that every flowmeter meets the highest possible standards of accuracy.

The facility is capable of calibrating flowmeters of between DN50 and DN300 and has a total flow capacity of 19 000 litres of water per minute.

Gravimetric and transfer standard electromagnetic flowmeters are used.

All flow data is electronically archived for future reference/recalibration.

Sophisticated clamping arrangements ensure the flowmeters are concentric to the all 316L stainless steel pipework ensuring highly accurate calibration. The upstream and downstream pipework straight runs are well in excess of standard recommended lengths.

Note: Full calibration documentation is supplied as standard with every flowmeter.
Technical data

Operating principle
Spring loaded variable area with strain measurement

Limiting conditions

<table>
<thead>
<tr>
<th>Flow Type</th>
<th>Maximum Operating Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal</td>
<td>32 bar g @ 239°C</td>
</tr>
<tr>
<td>Vertical</td>
<td>7 bar g @ 170°C (see Flow Orientations diagram on page 7)</td>
</tr>
</tbody>
</table>

Measurable fluids
Saturated steam

Sizes available
DN50, DN80 and DN100

Flange specifications
Sandwich design, suitable for installation between the following flanges:
- EN 1092 PN16, PN25 or PN40
- BS 10 Table H
- ANSI B 16.5 class 150 or 300
- JIS 20
- KS 20

Electrical connections
Standard M20 x 1.5 Available to order 1/4" NPT

Materials of construction
- Body and internals: Inconel® X750 (or equivalent)
- Housing: Aluminium HE30

Window end cap
Available as an optional extra

Installation
- Below 7 bar g - Any flow orientation
- Above 7 bar g - Horizontal flow lines only
  Caution: the unit must not be lagged

Power supply
Loop powered nominal 24 Vdc

Turndown
Up to 50:1

Outputs
- 4-20 mA (directly proportional to mass flowrate)
- Pulsed output (per mass or energy unit)

System uncertainty in accordance with ISO 17025
- ± 2% of actual flow between 10% and 100% of maximum rated flow
- ± 0.2% of FSD for flows from 2% to 10% of maximum rated flow

Unrecovered pressure drop
Less than 750 mbar at maximum flowrate for the DN50 and less than 500 mbar for the DN80 and DN100

Dimensions and weights approximate in mm and kg

<table>
<thead>
<tr>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>DN50</td>
<td>35</td>
<td>103</td>
<td>265</td>
<td>160</td>
<td>145</td>
<td>3.35</td>
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<tr>
<td>DN80</td>
<td>45</td>
<td>138</td>
<td>285</td>
<td>160</td>
<td>145</td>
<td>5.25</td>
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<tr>
<td>DN100</td>
<td>60</td>
<td>162</td>
<td>315</td>
<td>215</td>
<td>145</td>
<td>8.20</td>
</tr>
</tbody>
</table>

How to order

Example: 1 off Spirax Sarco DN100 DIVA flowmeter for installation between EN 1092 PN40 flanges.
For use on saturated steam at 10 bar g, maximum flow 5 469 kg/h. Complete with M750 display unit with 4 - 20 mA output.

In addition to the DIVA flowmeter range, Spirax Sarco can provide flowmeters such as the ILVA for fluids other than steam or higher pressure applications. Please contact us for further details.

Some of the products may not be available in certain markets.

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