Gilflo flowmeters
for steam, liquids and gases
The Gilflo spring loaded variable area flowmeter ... offers an unrivalled 100:1 turndown and can be used to meter most industrial fluids including steam and gases. A comprehensive range of associated sensors and electronic instrumentation to complement the Gilflo primary element is available.

Why install flowmeters?
The main justifications for installing flowmeters in any industrial plant are:

- **Product quality**: By providing management information, they enable a plant to be operated at peak efficiency thus ensuring product quality is maintained in the most cost effective way.

- **Direct cost control**: They can be used to cost raw materials or energy sources (such as compressed air) directly.

How the Gilflo flowmeter works
The Gilflo flowmeter operates on the well established spring loaded variable area principle. The area of an annular orifice is varied by the movement of a specially developed cone. The cone moves axially against the resistance of a heavy duty precision spring. This produces a differential pressure across the Gilflo pipeline unit which is measured by a differential pressure transmitter. By processing this differential pressure signal electronically, the Gilflo gives far superior performance over conventional differential pressure flowmeters such as orifice plates especially at low flowrates.

Compact installation
The correct installation of a flowmeter is of prime importance. The unique design of the Gilflo means that its installed length is much shorter than almost any other meter. A Gilflo can often be fitted into lines which were never designed to accept flowmeters.
The importance of turndown

DN150 Gilflo flowmeter 5 bar g saturated steam

To ensure that the flow information gathered is accurate whatever the process conditions or demand, it is essential that a flowmeter is capable of meeting its specification over the full operating range from low standing or weekend loads, right up to the maximum demand of the process. As actual demands are often unknown or may vary widely, a flowmeter should have the largest turndown possible based on practical flow conditions. Great care should be taken that claims for turndown are based on realistic flow velocities. For instance, steam systems should be sized on a maximum flow velocity of about 35 m/s... higher velocities will increase the risk of erosion and noise in the system.

Turndown ratios with flow velocities limited to 35 m/s

This graph shows a typical demand curve for a distributed steam system with a high start-up load and variable demand through the day. An orifice plate meter with a 4:1 turndown is sized on the peak load of 1 000 kg/h. Any flowrates below 250 kg/h are 'lost' or, at best recorded with a significant error. In this case 1 700 kg have been 'lost'.

The Gilflo flowmeter, with up to 100:1 turndown eliminates this type of error.

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 automatic density compensation options completely eliminate these errors and allow accurate metering whatever the steam pressure. This is shown in the adjacent diagram.

In the example above, a simple non-compensated flowmeter is set for 6 bar g. The actual pressure in the system varies through the day and unless this is allowed for, by the end of the day, very significant errors can arise. This is typical of many steam systems.
The Gilflo range of flowmeters is designed and manufactured by Spirax Sarco to meet the needs of users who want a flexible approach to metering.

Over thirty years experience and over 10 000 installations backed up by Spirax Sarco’s worldwide support makes Gilflo the logical choice.

Range availability
- Sizes DN50 (2") to DN400 (16")
- Flanged to ANSI 300 or PN40

Applications
- Cost metering for energy management
- Custody transfer
- Process and control applications
- Boiler load balancing

Commonly metered fluids
- Saturated steam
- Superheated steam
- Condensate
- Natural gas
- Nitrogen
- Carbon dioxide
- Compressed air
- Ethylene
- Fuel oil

Note: The DN200 to DN400 range incorporates an additional shaft support.
User benefits

- Suitable for most industrial fluids.
- Excellent turndown, up to 100:1.
- High accuracy pipeline unit, ±1% of reading.
- Ultra compact installation, normally requires only six pipe diameters upstream and three downstream.
- No expensive line size changes required to achieve low flow performance.
- Intrinsically safe for use in hazardous areas.
- Reliability proven over 30 years experience.
- Designed and manufactured by Spirax Sarco - a ISO 9001 : 2000 approved company.
- Fully complies with the requirements of the European Pressure Equipment Directive 97/23/EC.

Precision heavy duty nickel cobalt alloy spring operates up to 450°C without creep.

Orifice chamfer on upstream face eliminates wear and dirt build-up.

Drain hole in orifice to avoid condensate build-up.

Gilflo calibration rig, Spirax Sarco, Cheltenham, England
Gilflo system configurations and
associated equipment

M240G (steam) and M250G (gas)
flow computers provide complete information
on flow, pressure and temperature.

Full density compensation.

Linearisation of Gilflo signal.

Wall or panel mounting.

Bright, easy to read display.

Alarm facilities for fluid flow pressure and
temperature.

4 independent timers.

Analogue, pulse and EIA232C outputs
available as standard.

M640 steam mass flow transmitter provides
density compensated 4 - 20 mA output.

Linearisation of Gilflo signal.

Ideal for applications where density
compensation is essential.

Suitable for use up to 74 bar g
saturated steam.

HART® 5.2 inbuilt.

Optional local display.

Intrinsically safe pipeline unit
and mass flow transmitter.

M750 display unit provides local display of
total flow and rate of flow.

Suitable for steam and most industrial
fluids and gases.

Ideal for applications where fluid density
is constant.

User configurable.

Linearisation of Gilflo signal.

Retransmission options of rate and / or total
flow available.

Bright, easy to read display.

Panel mounting.

Note:
The illustrations above are schematic only.
Refer to Installation and Maintenance Instructions for further details.
Sizing and selecting a Gilflo flowmeter

Two different versions of the Gilflo pipeline unit are available: 'B' type for high capacities and 'Spool' type for normal capacities.

Each unit is factory calibrated on a water flow rig to its maximum capacity. To choose the correct Gilflo, it is necessary to determine the equivalent water flowrate ($Q_E$) for the application (which should be based on the maximum anticipated actual flow) and then select the Gilflo best suited to the application using the tables below.

### Equivalent water flowrate $Q_E$

<table>
<thead>
<tr>
<th>Mass flow units</th>
<th>Volumetric units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Liquids</strong></td>
<td></td>
</tr>
<tr>
<td>$Q_E = \frac{q_m}{SG}$</td>
<td>$Q_E = Q_L / SG$</td>
</tr>
<tr>
<td><strong>Gases and steam actual flow conditions</strong></td>
<td></td>
</tr>
<tr>
<td>$Q_E = \frac{q_m}{\sqrt{\frac{1000}{D_F}}}$</td>
<td>$Q_E = Q_F \sqrt{\frac{D_F}{1000}}$</td>
</tr>
<tr>
<td><strong>Gases standard conditions</strong></td>
<td></td>
</tr>
<tr>
<td>$Q_E = \frac{q_m}{\sqrt{\frac{1000}{D_S} x \frac{P_S}{P_F} x \frac{T_S}{T_F}}}$</td>
<td>$Q_E = QS x \frac{P_S}{P_F} x \frac{T_S}{T_F}$</td>
</tr>
</tbody>
</table>

Where:
- $Q_E$ = Equivalent water flowrate (litres/min)
- $q_m$ = Mass flowrate (kg/min)
- $Q_L$ = Maximum liquid flowrate (litres/min)
- $Q_S$ = Maximum gas flowrate at standard conditions (litres/min)
- $Q_F$ = Maximum gas flowrate at actual flow conditions (litres/min)
- $SG$ = Specific gravity
- $D_S$ = Density of gas at standard conditions (kg/m$^3$)
- $D_F$ = Density of gas at actual flow conditions (kg/m$^3$)
- $P_S$ = Standard pressure = 1.013 bar $a$ = 1.033 kg/cm$^2$ $a$ = 14.7 psi $a$
- $P_F$ = Actual flow pressure in same absolute units as $P_S$
- $T_S$ = Standard temperature (K) = °C + 273
- $T_F$ = Actual flow temperature (K) = °C + 273

Using the value of $Q_E$ as determined above, select the correct Gilflo flowmeter from the table below:

### Example:
Determine which Gilflo pipeline unit is required to measure the flow of natural gas when:
1. Estimated maximum rate of flow = 2 000 kg/h
2. Fluid or gas density = 5.611 kg/m$^3$

Calculate $Q_E$ from $Q_E = \frac{q_m}{\sqrt{\frac{1000}{D_F}}}$, where $Q_E$ = equivalent water flowrate in litres/min

$q_m = \frac{2000}{60} = 33.33$ kg/min

$D_F = 5.611$ kg/m$^3$

$Q_E = 33.33 \sqrt{\frac{1000}{5.611}} = 445$ litres/min

From the table, it can be seen that either a DN80 Gilflo 'B' or a DN100 Gilflo 'Spool' would be suitable. The final decision will often be dictated by line size considerations and pipeline velocity.

### Gilflo 'B' maximum saturated steam flowrate in kg/h

<table>
<thead>
<tr>
<th>Size</th>
<th>1 bar g</th>
<th>3 bar g</th>
<th>5 bar g</th>
<th>8 bar g</th>
<th>12 bar g</th>
<th>18 bar g</th>
<th>20 bar g</th>
<th>30 bar g</th>
<th>40 bar g</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN50</td>
<td>730</td>
<td>1 015</td>
<td>1 230</td>
<td>1 490</td>
<td>1 785</td>
<td>2 155</td>
<td>2 765</td>
<td>3 185</td>
<td>3 185</td>
</tr>
<tr>
<td>DN80</td>
<td>2 400</td>
<td>3 330</td>
<td>4 035</td>
<td>4 905</td>
<td>5 870</td>
<td>7 085</td>
<td>9 080</td>
<td>10 470</td>
<td>10 470</td>
</tr>
<tr>
<td>DN100</td>
<td>3 860</td>
<td>5 355</td>
<td>6 495</td>
<td>7 890</td>
<td>9 444</td>
<td>11 400</td>
<td>14 605</td>
<td>16 845</td>
<td>16 845</td>
</tr>
<tr>
<td>DN150</td>
<td>9 380</td>
<td>13 030</td>
<td>15 795</td>
<td>19 195</td>
<td>22 910</td>
<td>27 275</td>
<td>35 525</td>
<td>40 975</td>
<td>40 975</td>
</tr>
<tr>
<td>DN200</td>
<td>16 650</td>
<td>23 120</td>
<td>28 050</td>
<td>34 090</td>
<td>40 765</td>
<td>49 155</td>
<td>62 910</td>
<td>72 775</td>
<td>72 775</td>
</tr>
<tr>
<td>DN250</td>
<td>22 900</td>
<td>31 790</td>
<td>38 565</td>
<td>47 407</td>
<td>56 050</td>
<td>67 590</td>
<td>86 500</td>
<td>100 065</td>
<td>100 065</td>
</tr>
<tr>
<td>DN300</td>
<td>39 760</td>
<td>55 100</td>
<td>66 965</td>
<td>81 930</td>
<td>97 320</td>
<td>117 355</td>
<td>150 200</td>
<td>173 750</td>
<td>173 750</td>
</tr>
<tr>
<td>DN400</td>
<td>64 580</td>
<td>89 650</td>
<td>108 770</td>
<td>132 200</td>
<td>158 080</td>
<td>190 620</td>
<td>243 970</td>
<td>282 220</td>
<td>282 220</td>
</tr>
</tbody>
</table>

### Gilflo 'Spool' maximum saturated steam flowrate in kg/h

<table>
<thead>
<tr>
<th>Size</th>
<th>1 bar g</th>
<th>3 bar g</th>
<th>5 bar g</th>
<th>8 bar g</th>
<th>12 bar g</th>
<th>18 bar g</th>
<th>20 bar g</th>
<th>30 bar g</th>
<th>40 bar g</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN80</td>
<td>750</td>
<td>1 040</td>
<td>1 265</td>
<td>1 535</td>
<td>1 840</td>
<td>2 220</td>
<td>2 840</td>
<td>3 280</td>
<td>3 280</td>
</tr>
<tr>
<td>DN100</td>
<td>1 940</td>
<td>2 695</td>
<td>3 265</td>
<td>3 970</td>
<td>4 750</td>
<td>5 730</td>
<td>7 340</td>
<td>8 470</td>
<td>8 470</td>
</tr>
<tr>
<td>DN150</td>
<td>3 420</td>
<td>4 750</td>
<td>5 760</td>
<td>7 000</td>
<td>8 370</td>
<td>10 105</td>
<td>12 945</td>
<td>14 930</td>
<td>14 930</td>
</tr>
<tr>
<td>DN200</td>
<td>8 130</td>
<td>11 295</td>
<td>13 695</td>
<td>16 635</td>
<td>19 910</td>
<td>24 030</td>
<td>30 790</td>
<td>35 510</td>
<td>35 510</td>
</tr>
<tr>
<td>DN300</td>
<td>15 195</td>
<td>21 095</td>
<td>25 595</td>
<td>31 105</td>
<td>37 200</td>
<td>44 855</td>
<td>57 405</td>
<td>66 410</td>
<td>66 410</td>
</tr>
</tbody>
</table>

**Note:** These capacities are based on a differential pressure across the flowmeter of 140 inches H$_2$O (349 mbar). Minimum flow is 1% of maximum (100:1 turndown).
Gilflo spring design

The design and manufacture of the spring in a Gilflo flowmeter is fundamental to its accuracy and long term performance. A conventional spring would gradually change its characteristics over years of operation, especially at high temperatures, and so the spring in the Gilflo is special:

- Made from ‘aerospace’ alloy Inconel X.750 which is widely used in jet engine turbine components due to its exceptional high temperature performance.
- During manufacture all springs are age hardened at 650°C for 4 hours.
- All springs are ‘hot set’ at 460°C after manufacture to eliminate any possibility of relaxation in high temperature applications.
- Design stress levels range between 11% and 30% UTS... most springs are designed to stress levels of around 60%.
- In service, all Gilflo meters incorporate over-range stops to prevent overstressing of the spring in overload conditions.
- Many thousands of installations have proved the integrity of the design and manufacture of the spring.

**Specification**

| Operating principle | Spring loaded variable area with differential pressure output. |
| Limiting conditions | Minimum operating pressure 0.6 bar g |
|                     | Minimum operating temperature 0°C |
|                     | To flange limits |
| Maximum viscosity   | 30 Centipoise. |
| Sizes available     | 'B' DN50, 80, 100, 150, 200, 250, 300, 400 |
|                     | 'Spool' DN80, 100, 150, 200, 300 |
| Flange specifications | EN 1092 PN40 or ANSI B 16.5 class 300 |
| Materials of construction | Body: Carbon steel to ASTM A105 / A106 / A234 |
| | Internals: Mostly stainless steel (S304 / S316) |
| | Spring: Inconel X.750 |
| Installation | Normally horizontal but vertical (flow downwards) acceptable (specify at time of ordering). |
| | Six clear pipe diameters upstream and three downstream are normally required. |
| Accuracy | When used in conjunction with an M200 series flow computer, M640 steam mass flow transmitter or M750 display unit, pipeline unit accuracy is better than ± 1% of reading for flowrates between 5% and 100% of maximum flow. Flow flows between 1% and 5% of maximum flow, the pipeline unit accuracy is better than ± 0.1% of maximum flow. |
| Repeatability | 0.25% |
| Pressure drop | Maximum 140 inches H₂O (349 mbar). |

**Dimensions / Weights** (approximate in mm and kg)

<table>
<thead>
<tr>
<th>Gilflo</th>
<th>Size</th>
<th>A</th>
<th>B</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>'B'</td>
<td>DN50</td>
<td>480</td>
<td>89</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>DN80</td>
<td>543</td>
<td>114</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>DN100</td>
<td>716</td>
<td>168</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>DN150</td>
<td>797</td>
<td>219</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>DN200</td>
<td>990</td>
<td>324</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>DN250</td>
<td>1458</td>
<td>406</td>
<td>257</td>
</tr>
<tr>
<td></td>
<td>DN300</td>
<td>1599</td>
<td>457</td>
<td>340</td>
</tr>
<tr>
<td></td>
<td>DN400</td>
<td>1995</td>
<td>610</td>
<td>900</td>
</tr>
<tr>
<td>'Spool'</td>
<td>DN80</td>
<td>327</td>
<td>89</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>DN100</td>
<td>543</td>
<td>114</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>DN150</td>
<td>716</td>
<td>168</td>
<td>76</td>
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<tr>
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<td>DN200</td>
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</tr>
<tr>
<td></td>
<td>DN300</td>
<td>990</td>
<td>324</td>
<td>109</td>
</tr>
</tbody>
</table>

**Notes:**

- High and low pressure tappings are threaded ¼" NPT (female).
- On the DN50 unit, PN40 flanges are thicker to ANSI 300 (22.2 mm) to accommodate pressure tappings.
- On DN400 unit the pressure tappings are on the body tube, not the flanges.

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