Electromagnetic flow sensor for partially filled pipes

- Measurement in partially filled pipes up to DN1600 / 64"
- Patented, non-contact level measurement
- Measurement possible down to 10% filling of pipe

The documentation is only complete when used in combination with the relevant documentation for the converter.
1 Product features

1.1 Solution for partially filled pipes

1.2 Options

1.3 Measuring principle

2 Technical data

2.1 Technical data

2.2 Dimensions and weights

2.3 Vacuum load

2.4 Measuring accuracy

3 Installation

3.1 Intended use

3.2 Installation conditions

3.2.1 Inlet and outlet

3.2.2 Mounting position

3.2.3 Flange deviation

3.2.4 Vibration

3.2.5 Magnetic field

3.2.6 Control valve

3.2.7 Slope

3.2.8 Mounting advice for difficult situations

3.2.9 Cleaning of flow sensor

3.2.10 Temperatures

3.3 Mounting

3.3.1 Mounting grounding rings

3.3.2 Torques and pressures

4 Electrical connections

4.1 Connection of cables

4.2 Cable lengths

4.3 Signal cable A [type DS 300], construction

4.4 Preparing signal cable A, connection to measuring sensor

4.5 Signal cable B [type BTS 300], construction

4.6 Preparing signal cable B, connection to measuring sensor

4.7 Preparing field current cable C, connection to measuring sensor

4.8 Interface cable

4.9 Grounding

5 Notes
1.1 Solution for partially filled pipes

The TIDALFLUX 4000 flow sensor with integrated and non-contact capacitive level measuring system provides accurate flow measurement in partially filled pipes. TIDALFLUX is designed to measure reliably between 10% and 100% of the pipe cross section. The integrated level sensors in the liner are in no contact with the liquid and are therefore insensitive against fat and oil floating on the surface.

① Various flange norms
② Patented, capacitive and non-contact flow level measuring system integrated in the liner
③ Separate converter
Highlights

- For partially filled pipes in the water and wastewater industry
- Broad diameter range up to DN1600 / 64"
- High abrasion resistance and chemical resistance
- Measurement possible between 10% and 100% filling
- Electrodes for flow measurement are below 10% filling level, therefore no blind folding by fat and oil floating on the water surface
- Complete factory calibration - no on-site calibration necessary

Industries

- Water
- Wastewater

Applications

- For partially filled pipes instead of expensive siphon tube constructions
- Water and wastewater
- Surface water
- Biological and chemical wastewater
1.2 Options

The solution for the water and wastewater industry

Robust construction
The TIDALFLUX 4000 has been designed for measuring all water and wastewater applications including groundwater, potable water, wastewater, sludges and sewage, industry water and salt water in partially filled pipes. The sensor is available for a wide diameter range of DN200 up to DN1600 for flow rates up to 90,000 m³/hr.
The TIDALFLUX 4000 causes no pressure loss and allows for bi-directional flow metering. Filters or straighteners are not required.
The flowmeter can be installed underground and allows for constant flooding (IP 68). A measurement chamber is not necessary, saving substantial costs.
The TIDALFLUX provides years of reliable measurements as it has no internal moving parts and nothing can wear. The flowmeter has a field proven and unsurpassed lifetime.
In addition, the TIDALFLUX 4000 in combination with the IFC 300 converter offers extensive diagnostic capabilities such as continuous monitoring of the converter, the sensor electrodes and electric functions.

Communication
The TIDALFLUX 4000 can be provided with state-of-the-art fieldbus communication systems. Data is transmitted by HART® or Modbus and then forwarded to a management system.
1.3 Measuring principle

The TIDALFLUX 4000 is an electromagnetic flow sensor with an integrated capacitive level measurement system, designed for electrically conductive process liquids. The flow rate $Q(t)$ through the tube is:

$$Q(t) = v(t) \times A(t),$$

in which

$v(t) = \text{Flow velocity of liquid product}$

$A(t) = \text{Wetted area of tube section.}$

The flow velocity is determined on basis of the known electromagnetic measurement principle. The two measuring electrodes are located in the lower part of the measuring tube, on a level of approx. 10% of the inner diameter of the pipe in order to get a reliable measurement to a level of 10%.

An electrically conductive fluid flows inside an electrically insulating pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils. Inside of the fluid, a voltage $U$ is generated:

$$U = v \times k \times B \times D$$

in which:

$v = \text{mean flow velocity}$

$k = \text{factor correcting for geometry}$

$B = \text{magnetic field strength}$

$D = \text{inner diameter of flow meter}$

The signal voltage $U$ is picked off by electrodes and is proportional to the mean flow velocity $v$ and thus the flow rate $q$. The signal voltage is quite small (typically 1 mV at $v = 3 \text{ m/s} / 10 \text{ ft/s}$ and field coil power of 1 W). Finally, a signal converter is used to amplify the signal voltage, filter it (separate from noise) and convert it into signals for totalising, recording and output processing.

Figure 1-1: Measuring principle TIDALFLUX

1. Electrodes
2. Induced voltage (proportional to flow velocity)
3. Capacitive plates in liner for height measurement
4. Magnetic field
5. Field coils
The wetted area $A$ is computed from the known inside diameter of the pipe by the patented capacitive level measurement system that is built into the measuring tube liner. The required electronics unit is accommodated in a compact housing that is mounted on top of the measuring sensor. This electronics is connected to the remote IFC 300 F converter by means of a digital communication line.
2.1 Technical data

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local representative.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).

#### Measuring system

<table>
<thead>
<tr>
<th>Measuring principle</th>
<th>Faraday’s law</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application range</td>
<td>Electrically conductive fluids</td>
</tr>
</tbody>
</table>

#### Measured value

<table>
<thead>
<tr>
<th>Primary measured value</th>
<th>Flow velocity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Level</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Secondary measured value</th>
<th>Volume flow</th>
</tr>
</thead>
</table>

#### Design

<table>
<thead>
<tr>
<th>Features</th>
<th>Flange version with full bore flow tube</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard as well as higher pressure ratings</td>
</tr>
<tr>
<td></td>
<td>Broad range of nominal sizes</td>
</tr>
</tbody>
</table>

| Modular construction                          | The measurement system consists of a flow sensor and a signal converter. It is available as remote version. More information about the signal converter can be found in the documentation of the signal converter. |
|                                               |                                        |

| Remote version                                 | In field [F] version with IFC 300 converter: TIDALFLUX 4300 F. |
| Nominal diameter                               | DN200...1600 / 8...64” |
| Measurement range                              | -12...+12 m/s / -40...+40 ft/s |
Measuring accuracy

<table>
<thead>
<tr>
<th>Reference conditions</th>
<th>Slope: 0%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Medium: water</td>
</tr>
<tr>
<td></td>
<td>Electrical conductivity: 50...5000 μS/cm</td>
</tr>
<tr>
<td></td>
<td>Temperature: 10...30°C / 50...86°F</td>
</tr>
<tr>
<td></td>
<td>Inlet section: ≥ 10 DN</td>
</tr>
<tr>
<td></td>
<td>Outlet section: ≥ 5 DN</td>
</tr>
<tr>
<td></td>
<td>Flow velocity at full scale: &gt; 1 m/s / 3 ft/s</td>
</tr>
<tr>
<td></td>
<td>Operating pressure: 1 bar / 14.5 psig</td>
</tr>
<tr>
<td></td>
<td>Wet calibrated on EN 17025 accredited calibration rig by direct volume comparison</td>
</tr>
</tbody>
</table>

Maximum measuring error

For detailed information on the measuring accuracy, see chapter “Measuring accuracy”.

Related to volume flow (MV = Measured Value, FS = Full Scale)

These values are related to the pulse / frequency output

The additional typical measuring deviation for the current output is ±10 μA

Partly filled:

\[ v \text{ @ Full Scale} \geq 1 \text{ m/s / 3.3 ft/s:} \leq 1\% \text{ of FS} \]

Fully filled:

\[ v \geq 1 \text{ m/s / 3.3 ft/s:} \leq 1\% \text{ of MV} \]

\[ v < 1 \text{ m/s / 3.3 ft/s:} \leq 0.5\% \text{ of MV} \times 5 \text{ mm/s / 0.2 inch/s} \]

Minimum level: 10% of inner diameter

Operating conditions

<table>
<thead>
<tr>
<th>Temperature</th>
<th>-5...+60°C / 23...+140°F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>-40...+65°C / -40...+149°F (Protect electronics against self-heating with ambient temperatures above 55°C)</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-50...+70°C / -58...+158°F</td>
</tr>
</tbody>
</table>

Chemical properties

<table>
<thead>
<tr>
<th>Physical condition</th>
<th>Conductive liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical conductivity</td>
<td>≥ 50 μS/cm</td>
</tr>
<tr>
<td>Permissible gas content (volume)</td>
<td>≤ 5%</td>
</tr>
<tr>
<td>Permissible solid content (volume)</td>
<td>≤ 70%</td>
</tr>
</tbody>
</table>
### Installation conditions

<table>
<thead>
<tr>
<th>Installation</th>
<th>For detailed information see chapter &quot;Installation&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow direction</td>
<td>Forward and reverse. Arrow on flow sensor indicates positive flow direction.</td>
</tr>
</tbody>
</table>
| Inlet run | ≥ 5 DN (without disturbing flow, after a single 90° bend)  
| | ≥ 10 DN (after a double bend 2x 90°)  
| | ≥ 10 DN (behind a control valve) |
| Outlet run | ≥ 3 DN |
| Dimensions and weights | For detailed information see chapter "Dimensions and weights". |

### Materials

| Sensor housing | Standard: sheet steel  
| | Other materials on request |
| Measuring tube | Austenitic stainless steel |
| Flange | Standard: Carbon steel, polyurethane coated  
| | Other materials on request |
| Liner | Polyurethane |
| Connection box | IP 67: polyurethane coated die-cast aluminium  
| | IP 68: Stainless steel |
| Measuring electrodes | Hastelloy® C |
| Grounding rings | Stainless steel  
| | Tailor made to innerdiameter of connecting pipeline.  
| | Necessary if insides of connecting pipeline isn’t electrically conductive. |

### Process connections

| Flange | DN200...1600 in PN 6...40 (others on request)  
| EN 1092-1 |
| ASME | 8...64" in 150...300 lb RF (others on request) |
| JIS | DN200...1600 in JIS 10...20 K (others on request) |
| Design of gasket surface | RF (others on request) |
## Electrical connections

<table>
<thead>
<tr>
<th>General</th>
<th>Electrical connection is carried out in conformity with the VDE 0100 directive &quot;Regulations for electrical power installations with line voltages up to 1000 V&quot; or equivalent national specifications.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply</td>
<td>Standard: 110 / 220 VAC [-15% / +10%], 50/60 Hz settable by switch&lt;br&gt;Option: 24 VAC, 50/60 Hz</td>
</tr>
<tr>
<td>Power consumption</td>
<td>14 VA</td>
</tr>
<tr>
<td>Field current cable</td>
<td>Shielded cable must be used, no part of delivery.</td>
</tr>
<tr>
<td>Signal cable</td>
<td><strong>DS 300 (type A)</strong>&lt;br&gt;Max. length: 600 m / 1950 ft (dependent on electrical conductivity).&lt;br&gt;<strong>BTS 300 (type B)</strong>&lt;br&gt;Max. length: 600 m / 1950 ft</td>
</tr>
<tr>
<td>Data interface cable</td>
<td>For transmission of measured level to IFC 300 F. &lt;br&gt;Shielded Liycy cable, 3 x 0.75 mm²</td>
</tr>
<tr>
<td>Cable entries</td>
<td>Standard: 2x M20 x 1.5 + 2x M16 x 1.5 EMC type&lt;br&gt;Option: ½” NPT</td>
</tr>
</tbody>
</table>

## Approvals and certificates

### CE

- This device fulfills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.

### Electromagnetic compatibility

- Harmonized standard: EN 61326-1 : 2006

### Low voltage directive

- Directive: 2006/95/EC
- Harmonized standard: EN 61010 : 2001

### Pressure equipment directive

- Directive: 97/23/EC
- Category I, II or SEP
- Fluid group 1
- Production module H

### Hazardous areas

- ATEX<br>Option: Ex zone 2<br>Ex zone 1 in preparation

### Other approvals and standards

- **Vibration resistance**<br>IEC 68-2-6
- **Random vibration test**<br>IEC 68-2-34
- **Shock test**<br>IEC 68-2-27
2.2 Dimensions and weights

The inner pipe diameter should match the inner diameter of the flowmeter. Since the inner diameter is not a standard DN size, choose the inner pipe diameter to be just a little bit bigger than the flow meter diameter. If a lot of sediment or fat is expected the optimal solution is to produce a diameter compensation ring on both sides to have smooth transits.

<table>
<thead>
<tr>
<th>Nominal size</th>
<th>Dimensions [mm]</th>
<th>Approx. weight [kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>DN</td>
<td>PN</td>
<td>a</td>
</tr>
<tr>
<td>200</td>
<td>10</td>
<td>350</td>
</tr>
<tr>
<td>250</td>
<td>10</td>
<td>400</td>
</tr>
<tr>
<td>300</td>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>350</td>
<td>10</td>
<td>500</td>
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<tr>
<td>400</td>
<td>10</td>
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<td>900</td>
</tr>
<tr>
<td>1000</td>
<td>10</td>
<td>1000</td>
</tr>
<tr>
<td>1200</td>
<td>6</td>
<td>1200</td>
</tr>
<tr>
<td>1400</td>
<td>6</td>
<td>1400</td>
</tr>
<tr>
<td>1600</td>
<td>6</td>
<td>1600</td>
</tr>
</tbody>
</table>
150 lb flanges

<table>
<thead>
<tr>
<th>Nominal size</th>
<th>Dimensions [inches]</th>
<th>Approx. weight [lb]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASME 1</td>
<td>PN [psi]</td>
<td>a</td>
</tr>
<tr>
<td>IP 67</td>
<td>IP 68</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>284</td>
<td>13.78</td>
</tr>
<tr>
<td>10</td>
<td>284</td>
<td>15.75</td>
</tr>
<tr>
<td>12</td>
<td>284</td>
<td>19.69</td>
</tr>
<tr>
<td>14</td>
<td>284</td>
<td>27.56</td>
</tr>
<tr>
<td>16</td>
<td>284</td>
<td>31.5</td>
</tr>
<tr>
<td>20</td>
<td>284</td>
<td>31.5</td>
</tr>
<tr>
<td>24</td>
<td>284</td>
<td>31.5</td>
</tr>
<tr>
<td>28</td>
<td>Class D</td>
<td>35.43</td>
</tr>
<tr>
<td>32</td>
<td>Class D</td>
<td>39.37</td>
</tr>
<tr>
<td>36</td>
<td>Class D</td>
<td>43.31</td>
</tr>
<tr>
<td>40</td>
<td>Class D</td>
<td>47.24</td>
</tr>
<tr>
<td>48</td>
<td>Class D</td>
<td>55.12</td>
</tr>
</tbody>
</table>

1 Nominal size ≤ 24”: ASME; > 24”: AWWA

2.3 Vacuum load

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Vacuum load in mbar abs. at a process temperature of</th>
</tr>
</thead>
<tbody>
<tr>
<td>[mm]</td>
<td>40°C</td>
</tr>
<tr>
<td>DN200...1600</td>
<td>500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Vacuum load in psia at a process temperature of</th>
</tr>
</thead>
<tbody>
<tr>
<td>[inches]</td>
<td>104°F</td>
</tr>
<tr>
<td>8...64”</td>
<td>7.3</td>
</tr>
</tbody>
</table>
2.4 Measuring accuracy

The measuring accuracy for partly filled pipes and completely filled pipes are different. In these graphs it is assumed that the velocity at full scale value is at least 1 m/s (is also the standard value for calibration, since it will result in the most accurate measurements).

**Fully filled:**
- \( v \geq 1 \text{ m/s} / 3.3 \text{ ft/s} \): \( \leq 1\% \) of MV
- \( v < 1 \text{ m/s} / 3.3 \text{ ft/s} \): \( \leq 0.5\% \) of MV + 5 mm/s / 0.2 inch/s
- Minimum level: 10% of inner diameter

![Graph showing maximum measuring error of measured value.](image.png)

Figure 2-1: Maximum measuring error of measured value.
Partly filled:
- \( v \geq \text{Full Scale} \geq 1 \text{ m/s} / 3.3 \text{ ft/s} \): \( \leq 1\% \) of FS

Partly filled pipes

Figure 2-2: Maximum measuring error of measured value.

\( \text{① Advised working area} \)
3.1 Intended use

The TIDALFLUX 4300 F has been designed for measuring the flow of conductive fluids, even in partially filled pipes. It can be combined with the IFC 300 electromagnetic flow converter.

3.2 Installation conditions

3.2.1 Inlet and outlet

![Figure 3-1: Recommended inlet and outlet sections, top view](image)

1. \( \geq 5 \text{ DN} \)
2. \( \geq 3 \text{ DN} \)

3.2.2 Mounting position

*Only install the flow sensor in the shown position to keep the electrodes under water. Limit the rotation to ±2° to maintain the accuracy.*

![Figure 3-2: Mounting position](image)
3.2.3 Flange deviation

*Max. permissible deviation of pipe flange faces:*

\[ L_{\text{max}} - L_{\text{min}} \leq 0.5 \text{ mm} / 0.02" \]

![Figure 3-3: Flange deviation](image1)

1. \( L_{\text{max}} \)
2. \( L_{\text{min}} \)

3.2.4 Vibration

![Figure 3-4: Avoid vibrations](image2)

3.2.5 Magnetic field

![Figure 3-5: Avoid magnetic fields](image3)
3.2.6 Control valve

![Diagram of control valve installation](image)

Figure 3-6: Installation before control valve

3.2.7 Slope

The accuracy is influenced by the slope. Stay within ±1% to get the most accurate measurements!

![Diagram of recommended slope](image)

Figure 3-7: Recommended slope

3.2.8 Mounting advice for difficult situations

If you cannot meet the installation conditions install the flowmeter between two containers. The inlet to the flowmeter must be higher than the outlet of the fluid. In this way you will have a calm flow into the flowmeter, resulting in a highly accurate measurement. The sizes of the containers must be proportional to the size of the flowmeter.

![Diagram of difficult situations](image)

Figure 3-8: Installing in difficult situations

1. Use a container if the Inlet pipe has a slope > 1%. Make sure that the outlet level of this pipe is below the inlet to the flowmeter.
2. Inlet container
3. Inlet section of 10 DN
4. Outlet section of 5 DN
5. Outlet container advisable if outlet pipe has a slope > 1%.
3.2.9 Cleaning of flow sensor

The TIDALFLUX flow sensor is highly resistant against dirt and the measurement will rarely be influenced by anything. However, it is advisable to create a possibility for cleaning just before or after the sensor.

![Figure 3-9: Option for cleaning of flow sensor](image)

Opening for cleaning

3.2.10 Temperatures

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>max.</td>
<td>min.</td>
<td>max.</td>
</tr>
<tr>
<td>All versions</td>
<td>-5</td>
<td>60</td>
<td>-25</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>-13</td>
<td>140</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.3 Mounting

3.3.1 Mounting grounding rings

In order to get a reliable height measurement it is absolutely necessary that the inner side of the connecting pipeline is electrically conductive and connected to ground. If not, tailor-made grounding rings with a cylindrical part can be delivered. Please contact your local agency in case of doubt.

![Grounding with grounding rings](image1)

Sizes of the grounding rings are diameter dependent and available on request.

3.3.2 Torques and pressures

![Tightening of bolts](image2)

Tightening of bolts

1. Step 1: Apply approx. 50% of max. torque given in table.
2. Step 2: Apply approx. 80% of max. torque given in table.
3. Step 3: Apply 100% of max. torque given in table.
**Tighten the bolts uniformly in diagonally opposite sequence.**

<table>
<thead>
<tr>
<th>Nominal size DN [mm]</th>
<th>Pressure rating</th>
<th>Bolts</th>
<th>Max. torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td>PN 10</td>
<td>8 × M 20</td>
<td>68</td>
</tr>
<tr>
<td>250</td>
<td>PN 10</td>
<td>12 × M 20</td>
<td>65</td>
</tr>
<tr>
<td>300</td>
<td>PN 10</td>
<td>12 × M 20</td>
<td>76</td>
</tr>
<tr>
<td>350</td>
<td>PN 10</td>
<td>16 × M 20</td>
<td>75</td>
</tr>
<tr>
<td>400</td>
<td>PN 10</td>
<td>16 × M 24</td>
<td>104</td>
</tr>
<tr>
<td>500</td>
<td>PN 10</td>
<td>20 × M 24</td>
<td>107</td>
</tr>
<tr>
<td>600</td>
<td>PN 10</td>
<td>20 × M 27</td>
<td>138</td>
</tr>
<tr>
<td>700</td>
<td>PN 10</td>
<td>20 × M 27</td>
<td>163</td>
</tr>
<tr>
<td>800</td>
<td>PN 10</td>
<td>24 × M 30</td>
<td>219</td>
</tr>
<tr>
<td>900</td>
<td>PN 10</td>
<td>28 × M 30</td>
<td>205</td>
</tr>
<tr>
<td>1000</td>
<td>PN 10</td>
<td>28 × M 35</td>
<td>261</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nominal size [inch]</th>
<th>Flange class [lb]</th>
<th>Bolts</th>
<th>Max. torque [Nm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>150</td>
<td>8 × 3/4”</td>
<td>69</td>
</tr>
<tr>
<td>10</td>
<td>150</td>
<td>12 × 7/8”</td>
<td>79</td>
</tr>
<tr>
<td>12</td>
<td>150</td>
<td>12 × 7/8”</td>
<td>104</td>
</tr>
<tr>
<td>14</td>
<td>150</td>
<td>12 × 1”</td>
<td>93</td>
</tr>
<tr>
<td>16</td>
<td>150</td>
<td>16 × 1”</td>
<td>91</td>
</tr>
<tr>
<td>18</td>
<td>150</td>
<td>16 × 1 1/8”</td>
<td>143</td>
</tr>
<tr>
<td>20</td>
<td>150</td>
<td>20 × 1 1/8”</td>
<td>127</td>
</tr>
<tr>
<td>24</td>
<td>150</td>
<td>20 × 1 1/4”</td>
<td>180</td>
</tr>
<tr>
<td>28</td>
<td>150</td>
<td>28 × 1 1/4”</td>
<td>161</td>
</tr>
<tr>
<td>32</td>
<td>150</td>
<td>28 × 1 1/2”</td>
<td>259</td>
</tr>
<tr>
<td>36</td>
<td>150</td>
<td>32 × 1 1/2”</td>
<td>269</td>
</tr>
<tr>
<td>40</td>
<td>150</td>
<td>36 × 1 1/2”</td>
<td>269</td>
</tr>
</tbody>
</table>

*Information for bigger sizes is available on request.*
4.1 Connection of cables

Figure 4-1: Electrical connection
1. Unscrew the cover to reach the connectors
2. Unscrew the cover to reach the connectors
3. Field current cable
4. Interface cable
5. Signal cable (DS or BTS)

Connection diagram

Figure 4-2: Connection diagram
1. Protective Earth connection (PE)
2. Mains power neutral (N)
3. Mains power live (L)
4. Field current cable
5. Interface cable
7. Connect housing to PE
Flow sensors with protection class IP 68 can not be opened anymore. The cables are factory connected and labeled as follows.

**Figure 4-3: Labeled cables for IP 68 versions**

1. Mains power (10 = blank, 11 = blue, 12 = black)
2. Field current (7 = white, 8 = green)
3. Data interface [black wires, C = marked “1”, D = marked “2”, E = marked “3”]
4. Electrodes (1 = blank, 2 = white, 3 = red)
4.2 Cable lengths

The maximum allowed distance between the flow sensor and the converter is determined by the shortest cable length.

**Interface cable:** maximum length is 600 m / 1968 ft.

**Type B (BTS) signal cable:** maximum length is 600 m / 1968 ft.

**Type A (DS) signal cable:** maximum length depends on the conductivity of the fluid:

<table>
<thead>
<tr>
<th>Electrical conductivity [µS/cm]</th>
<th>Maximum length [m]</th>
<th>Maximum length [ft]</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>120</td>
<td>394</td>
</tr>
<tr>
<td>100</td>
<td>200</td>
<td>656</td>
</tr>
<tr>
<td>200</td>
<td>400</td>
<td>1312</td>
</tr>
<tr>
<td>≥400</td>
<td>600</td>
<td>1968</td>
</tr>
</tbody>
</table>
Field current cable: The cross section of the cable determines the maximum length:

<table>
<thead>
<tr>
<th>Cross section [mm²]</th>
<th>Maximum length [m]</th>
<th>Maximum length [ft]</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 x 0.75 [AWG 2 x 18]</td>
<td>150</td>
<td>492</td>
</tr>
<tr>
<td>2 x 1.5 [AWG 2 x 14]</td>
<td>300</td>
<td>984</td>
</tr>
<tr>
<td>2 x 2.5 [AWG 2 x 12]</td>
<td>600</td>
<td>1968</td>
</tr>
</tbody>
</table>
4.3 Signal cable A (type DS 300), construction

- Signal cable A is a double-shielded cable for signal transmission between the measuring sensor and signal converter.
- Bending radius: \( \geq 50 \text{ mm} / 2'' \)

![Figure 4-4: Construction of signal cable A](image)

1. Stranded drain wire (1) for the inner shield (10), 1.0 mm\(^2\) Cu / AWG 17 (not insulated, bare)
2. Insulated wire (2), 0.5 mm\(^2\) Cu / AWG 20
3. Insulated wire (3), 0.5 mm\(^2\) Cu / AWG 20
4. Outer sheath
5. Insulation layers
6. Stranded drain wire (6) for the outer shield (60)
4.4 Preparing signal cable A, connection to measuring sensor

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

- The outer shield [60] is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius: ≥ 50 mm / 2"

Required materials
- PVC insulating tube, Ø2.0...2.5 mm / 0.08...0.1"
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire [1]
- 2 wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors [2, 3]

1. Strip the conductor to dimension a.
2. Trim the outer shield [60] to dimension b and pull it over the outer sheath.
4. Slide an insulating tube over the stranded drain wire [1].
5. Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire [1].
6. Pull the heat-shrinkable tubing over the prepared signal cable.

Figure 4-5: Preparing signal cable A, connection to measuring sensor

a = 50 mm / 2"
b = 10 mm / 0.39"
4.5 Signal cable B (type BTS 300), construction

- Signal cable B is a triple-shielded cable for signal transmission between the measuring sensor and signal converter.
- Bending radius: ≥ 50 mm / 2"

![Figure 4-6: Construction of signal cable B](image)

4.6 Preparing signal cable B, connection to measuring sensor

*Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.*

- The outer shield [60] is connected in the terminal compartment of the measuring sensor directly via the shield and a clip.
- Bending radius: ≥ 50 mm / 2"

**Required materials**

- PVC insulation tubing, Ø2.0...2.5 mm / 0.08...0.1"
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46 228: E 1.5-8 for the stranded drain wire [1]
- 2x wire end ferrules to DIN 46 228: E 0.5-8 for the insulated conductors [2, 3]
1. Strip the conductor to dimension a.
2. Trim the outer shield (60) to dimension b and pull it over the outer sheath.
3. Remove the stranded drain wire (6) of the outer shield and the shields and stranded drain wires of the insulated conductors (2, 3). Remove the inner shield (10). Be sure not to damage the stranded drain wire (1).
4. Slide an insulating tube over the stranded drain wire (1).
5. Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire (1).
6. Pull the heat-shrinkable tubing over the prepared signal cable.
4.7 Preparing field current cable C, connection to measuring sensor

Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

- The field current cable is not part of the scope of delivery.
- The shield is connected in the terminal compartment of the converter directly via the shield and a clip.
- The shield is connected in the sensor via the special cable gland.
- Bending radius: \( \geq 50 \text{ mm} / 2'' \)

**Required materials**

- Shielded 2-wire insulated copper cable
- Insulating tube, size according to the cable being used
- Heat-shrinkable tubing
- DIN 46 228 wire end ferrules: size according to the cable being used

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Figure 4-8: Preparation of field current cable C

- Strip the conductor to dimension a.
- Trim the outer shield to dimension b and pull it over the outer sheath.
- Crimp wire end ferrules onto both conductors.

\[
\begin{align*}
\text{a} &= 125 \text{ mm} / 5'' \\
\text{b} &= 10 \text{ mm} / 0.4''
\end{align*}
\]
At flow converter side:
Connecting shielding under clamp in connection box of converter

Figure 4-9: Clamping of shields
1. Field current cable
2. Signal cable

At flow sensor side:
Connecting shielding via special cable gland

Figure 4-10: Connecting the shield within the cable gland
1. Wires
2. Isolation
3. Shielding
4. Isolation
5. Feed cable through dome nut and clamping insert and fold shielding over clamping insert. Make sure that the braided shield overlaps the O-ring by 2 mm / 3/32”.
6. Push clamping insert into body.
7. Tighten the dome nut.
4.8 Interface cable

The data interface cable is a shielded, 3 x 1.5 mm² LIYCY cable. The standard length 10 m / 32.8 ft is included in the delivery.

Preparing the interface cable

1. Strip the conductor to dimension a.
2. Trim the outer shield to dimension b and pull it over the outer sheath.
3. Crimp the wire end ferrules onto the conductors 1, 2 and 3.

Connect the shielding at both sides of the cable via the special cable gland.

Connecting shielding via special cable gland

1. Wires
2. Isolation
3. Shielding
4. Isolation
5. Feed cable through dome nut and clamping insert and fold shielding over clamping insert. Make sure that the braided shield overlaps the O-ring by 2 mm / 3/32”.
6. Push clamping insert into body.
7. Tighten the dome nut.
4.9 Grounding

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

In order to get a reliable height measurement it is absolutely necessary that the inner side of the connecting pipeline is electrically conductive and connected to ground. If not, tailor-made grounding rings with a cylindrical part can be delivered. Please contact your local agency in case of doubt.

Figure 4-13: Grounding ring number 3
KROHNE product overview

• Electromagnetic flowmeters
• Variable area flowmeters
• Ultrasonic flowmeters
• Mass flowmeters
• Vortex flowmeters
• Flow controllers
• Level meters
• Temperature meters
• Pressure meters
• Analysis products
• Measuring systems for the oil and gas industry
• Measuring systems for sea-going tankers

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