Electromagnetic flowmeters
Series FLOMAT

Insertion electromagnetic flowmeter for conductive liquids

- For use in large diameter pipes as an economical solution for flow measurement
- Flow rate measurement is independent of density, temperature, viscosity and pressure
- Pulsed coil excitation to obtain a minimum zero drift
- No moving parts involve low maintenance, low pressure drop and allow the pass of solids
- Low power consumption
- Good chemical resistance
- Flow rate: 2300 l/h ... 110000 m³/h
- Accuracy: ±3.5% reading value
- Minimum electric conductivity: 20 μS/cm
- Connections: inserted in pipes of DN40 ... DN2000, by means of:
  - TF Tecfluid standard flange
  - 2 ¼” BSP-F
  - DN40 PN16 EN 1092-1 flange
- Materials:
  - Sensor: EN 1.4404 (AISI 316L), PVDF
  - Sensor head: PVDF
  - Insert pipe adaptor: EN 1.4404 (AISI 316L), PE, PVC
  - Others on request
  - Electrodes: EN 1.4404 (AISI 316L), Hastelloy C, Tantalum, Titanium, Zirconium
- Local indication, volume totalizer, 4-20 mA and pulse outputs
- Alarms, empty pipe detection, etc. depending on converter model
- Full diagnosis for MX4 converter
- HART and Modbus Communication protocols available on request
- Modular design in two versions:
  - Compact converter, mounted on top of the sensor
  - Remote converter for wall or pipe mounting
Working principle

The measurement principle is based on Faraday’s induction law. A voltage $V$ is induced between a pair of electrodes when a conductive liquid flows in a pipe of diameter $D$ at an average velocity $v$, through a magnetic field $B$ (which is perpendicular to the flow direction).

This voltage, proportional to the average velocity of the liquid, is acquired by the electronic converter in order to be processed and converted to a flow rate measurement.

$$V = B \cdot v \cdot D$$

- $V$ = Voltage across the electrodes
- $v$ = Liquid velocity
- $B$ = Magnetic field strength
- $D$ = Pipe diameter

Applications

- Water supply & water treatment plants
- Food and beverage industries
- Leak detection in pipelines & chemicals flow monitoring
- HVAC

Technical data

- **Accuracy:** ±3.5% reading value for flow speed ≥ 0.4 m/s
- **Minimum electric conductivity:** 20 μS/cm
- **Liquid temperature:** -20°C ... +120°C
- **Ambient temperature:** -20°C ... +60°C
- **Working pressure:** PN16. Others on request
- **Connections:** inserted in pipes of DN40 ... DN2000, by means of:
  - TF Tecfluid standard flange
  - 2 ¼” BSP-F
  - DN40 PN16 EN 1092-1 flange
- **Materials:**
  - Sensor: EN 1.4404 (AISI 316L), PVDF
  - Sensor head: PVDF
  - Insert pipe adaptor: EN 1.4404 (AISI 316L), PVC, PE
  - Electrodes: EN 1.4404 (AISI 316L), Hastelloy C, Tantalum, Titanium, Zirconium

Installation

- Sensor must not be installed in the upper or lower parts of the pipe, in order to avoid air bubbles or solids sedimentation.
- Pipe must always be full of liquid.
- Required straight pipe run depends on the flow profile, which can be affected by the disturbing elements found in the installation before and after the sensor, as shown in the following chart:

<table>
<thead>
<tr>
<th>Disturbing element before the sensor</th>
<th>Minimum distance between the element and the sensor</th>
</tr>
</thead>
<tbody>
<tr>
<td>90° elbow or T-bend</td>
<td>50 x DN</td>
</tr>
<tr>
<td>Several 90° coplanar bends</td>
<td>50 x DN</td>
</tr>
<tr>
<td>Several 90° non-coplanar bends</td>
<td>80 x DN</td>
</tr>
<tr>
<td>Total angle convergent 18° to 36°</td>
<td>30 x DN</td>
</tr>
<tr>
<td>Total angle divergent 14° to 28°</td>
<td>55 x DN</td>
</tr>
<tr>
<td>Fully opened butterfly valve</td>
<td>45 x DN</td>
</tr>
<tr>
<td>Fully opened plug valve</td>
<td>30 x DN</td>
</tr>
</tbody>
</table>

After the sensor a minimum straight pipe run of 5 x DN is required.
Models

In case of metallic or plastic pipe where Tecfluid insert pipe adaptor can be supplied (see p. 2), installation can be made by welding or gluing the adaptor as follows:

In those cases where Tecfluid insert pipe adaptor cannot be used (FRP or similar pipes), installation should be made by means of a CLAMP-ON saddle (not supplied):

Materials

<table>
<thead>
<tr>
<th>Nº</th>
<th>Description</th>
<th>Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>MX4 housing</td>
<td>Aluminium</td>
</tr>
<tr>
<td>1B</td>
<td>XT5 housing</td>
<td>Polycarbonate</td>
</tr>
<tr>
<td>1C</td>
<td>Packing gland</td>
<td>Polyamide</td>
</tr>
<tr>
<td>2</td>
<td>Connector</td>
<td>Polycarbonate *</td>
</tr>
<tr>
<td>3</td>
<td>Flange / BSP nut</td>
<td>EN 1.4404 (AISI 316L)</td>
</tr>
<tr>
<td>4</td>
<td>Insert pipe adaptor</td>
<td>EN 1.4404 (AISI 316L), PVC, PE **</td>
</tr>
<tr>
<td>5</td>
<td>Electrodes</td>
<td>EN 1.4404 (AISI 316L), Hastelloy C, Titanium, Tantalum, Zirconium</td>
</tr>
<tr>
<td>6</td>
<td>Head</td>
<td>PVDF</td>
</tr>
<tr>
<td>7</td>
<td>Sensor body</td>
<td>EN 1.4404 (AISI 316L), PVDF</td>
</tr>
<tr>
<td>8</td>
<td>Gasket</td>
<td>NBR, VITON®</td>
</tr>
</tbody>
</table>

* Also available in EN 1.4404 (AISI 316L) on request
** Others on request
Dimensions

Sensor

<table>
<thead>
<tr>
<th>DN (mm)</th>
<th>A</th>
<th>FX</th>
<th>FM</th>
<th>FR</th>
</tr>
</thead>
<tbody>
<tr>
<td>40...400</td>
<td>113,5</td>
<td>340</td>
<td>327</td>
<td>240</td>
</tr>
<tr>
<td>500...1000</td>
<td>218,5</td>
<td>445</td>
<td>432</td>
<td>345</td>
</tr>
<tr>
<td>1200...2000</td>
<td>368,5</td>
<td>595</td>
<td>582</td>
<td>495</td>
</tr>
</tbody>
</table>

* minimum dimension to remove the flowmeter from the pipe

Insert pipe adaptor

There are two different types of insert pipe adaptors. For pipe size DN40 ... DN65, insert pipe adaptor is supplied already welded to short length of pipe that must be just coupled to the pipe by welding or gluing (in the case of PVC).

For pipe size of DN80 or bigger, insert pipe adaptor is directly welded (or glued) on the pipe.

<table>
<thead>
<tr>
<th>DN (mm)</th>
<th>C (mm)</th>
<th>Insert pipe adaptor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>L (mm)</td>
</tr>
<tr>
<td>80</td>
<td>10,0</td>
<td>88,0</td>
</tr>
<tr>
<td>100</td>
<td>12,5</td>
<td>85,5</td>
</tr>
<tr>
<td>125</td>
<td>15,5</td>
<td>82,5</td>
</tr>
<tr>
<td>150</td>
<td>19,0</td>
<td>79,0</td>
</tr>
<tr>
<td>200</td>
<td>25,0</td>
<td>73,0</td>
</tr>
<tr>
<td>250</td>
<td>31,0</td>
<td>67,0</td>
</tr>
<tr>
<td>300</td>
<td>37,5</td>
<td>60,5</td>
</tr>
<tr>
<td>350</td>
<td>44,0</td>
<td>54,0</td>
</tr>
<tr>
<td>400</td>
<td>50,0</td>
<td>48,0</td>
</tr>
<tr>
<td>500</td>
<td>62,5</td>
<td>140,5</td>
</tr>
<tr>
<td>600</td>
<td>75,0</td>
<td>128,0</td>
</tr>
<tr>
<td>700</td>
<td>87,5</td>
<td>115,5</td>
</tr>
<tr>
<td>800</td>
<td>100,0</td>
<td>103,0</td>
</tr>
<tr>
<td>900</td>
<td>112,5</td>
<td>90,5</td>
</tr>
<tr>
<td>1000</td>
<td>125,0</td>
<td>78,0</td>
</tr>
<tr>
<td>1200</td>
<td>150,0</td>
<td>203,0</td>
</tr>
<tr>
<td>1400</td>
<td>175,0</td>
<td>178,0</td>
</tr>
<tr>
<td>1600</td>
<td>200,0</td>
<td>153,0</td>
</tr>
<tr>
<td>1800</td>
<td>225,0</td>
<td>128,0</td>
</tr>
<tr>
<td>2000</td>
<td>250,0</td>
<td>103,0</td>
</tr>
</tbody>
</table>

s: pipe thickness (depends on pipe material and pressure rating)
C: penetration depth

Sensor with compact converter

Sensor with remote converter (IP68 10 m H₂O)
Flow ranges

Sensor selection
The diagram shows the correspondence between the liquid velocity and the flow rate for different sensor sizes.

The sensor size should be chosen selecting a liquid velocity of about 3-4 m/s. The minimum liquid velocity should not be below 0.5 m/s.

When the liquid has solids in suspension, it is better to work between 3 and 5 m/s in order to avoid sedimentation in the pipe and sensor.

Accuracy curve (error vs velocity)

\[ e = \begin{cases} 
3.5\% & \text{for } v \geq 0.4 \text{ m/s} \\
\pm \frac{1.4}{v} \% & \text{for } v < 0.4 \text{ m/s} 
\end{cases} \]
Electronic converters

Different models of electronic control units are available to comply with the options of flow indication, maximum / minimum flow rate control, analog and pulse outputs. All of them are compatible with the different FLOMAT-FX sensor models. These converters can be supplied for compact mounting directly on top of the sensor or for remote mounting. Cable is supplied. HART protocol is available for both MX4 and XT5 converters. Modbus RTU protocol is available for MX4 converter.

XT5 converter

Technical data

- IP67 polycarbonate enclosure
- Programming via front tactile push buttons
- Linearity: ±0.2% f.s.
- Repeatability: ±0.1% f.s.
- Ambient temperature range: 0°C ... +60°C
- Power supply: 24, 115, 230, 240 VAC 50 / 60 Hz 24 VDC
- Power consumption: ≤ 5 VA
- Flow rate indication:
  - No. of digits: 4 (0 to 2 decimal configuration)
  - Digit size: 5 mm
- Volume totalizer:
  - No. of digits: 7 (2 decimal)
  - Digit size: 8 mm
  - Reset button
- Analog output: 4-20 mA, active or passive, programmable measuring units
- Pulse output: optoisolated:
  - \( V_{\text{max}} \): 30 VDC ; \( I_{\text{max}} \): 30 mA
  - Maximum frequency in “P/U” mode: 6.25 Hz
  - Frequency in “Hz” mode: 0.04 ... 5000 Hz
- Empty pipe detection
- Flow rate cut off, programmable
- Adaptative flow rate filter: programmable integration time between 0.1 ... 20 seconds
- Zero offset adjustment

HART Communication protocol

XT5H conversion has a modem for HART communication. All the features regarding HART communication can be found in the corresponding document “Field Device Specification”. Compatible with HART Server Communication software. Also available for remote mounted version XT5HM.
Electromagnetic flowmeters

MX4 converter

Technical data
- IP67 coated aluminium enclosure
- Programming via front push buttons
- 128 x 64 graphic display
- Linearity: ±0.2% f.s.
- Repeatability: ±0.1% f.s.
- Ambient temperature range: -20°C ... +60°C
- Power supply: 90 ... 265 VAC 50 / 60 Hz
  12 ... 48 VDC
- Power consumption: ≤ 5 VA
- Flow rate and liquid velocity indication:
  - No. of digits: 5 (0 to 2 decimal configuration)
  - Digit size: 11 mm
- Volume totalizer:
  - No. of digits: 8 (2 decimal)
  - Digit size: 8 mm
  - Reset button
- Analog output: 4-20 mA, active or passive, programmable measuring units
- Pulse output: optoisolated NPN bipolar transistor:
  - V_{max}: 30 VDC ; I_{max}: 30 mA
  - Output frequency: 0.01 ... 5000 Hz
  - Programmable duty cycle
- Relay outputs: 2 relays with potential free contacts.
  - Contact characteristics:
    - Maximum voltage: 250 VAC
    - Maximum current: 8 A
    - Maximum power: 500 VA
- Programmable as flow rate alarms, empty pipe detection or reversed flow indication
- Empty pipe detection
- Flow rate cut off, programmable
- Adaptative flow rate filter: programmable integration time between 0 ... 40 seconds
- Zero offset adjustment
- Full diagnosis of the coil current, the differential voltage on the sensor electrodes and the conductivity of the liquid, as well as detection of an electronic failure in the measuring circuit
- Easy programmable by means of Tecfluid’s Winsmeter MX4 software, available for download at www.tecfluid.com

HART and Modbus RTU RS485 Communication protocols
MX4B converter includes a Modbus RTU RS485 Communication protocol module.
MX4H converter has a modem for HART communication. All the features regarding HART communication can be found in the corresponding document “Field Device Specification”. Compatible with HART Server Communication software.
Also available for remote mounted versions MX4BM & MX4HM.

Remote mounted converter (model MX4M)

Remote mounted converter (model MX4M)

FLOMAT-FX1 with compact MX4 converter

Installation example
## Accessories

### FLOMAT-TAP

The FLOMAT-TAP accessory is a useful complement for the FLOMAT sensors in some type of installations.

The key features of the product are:

- FLOMAT sensors can be inserted or removed under pressure (pipe full of liquid),
- Designed for obtaining flow measurement in different points of a distribution network with only one FLOMAT sensor.

### FLOMAT-TAP dimensions

<table>
<thead>
<tr>
<th>DN (mm)</th>
<th>A (mm)</th>
<th>B (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>750</td>
<td>420</td>
</tr>
<tr>
<td>700</td>
<td>865</td>
<td>535</td>
</tr>
<tr>
<td>1300</td>
<td>990</td>
<td>660</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DN (mm)</th>
<th>C (mm)</th>
<th>LT (mm)</th>
<th>HT (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>12.5</td>
<td>357.0 - s</td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>15.5</td>
<td>354.0 - s</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>19.0</td>
<td>350.5 - s</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>25.0</td>
<td>344.5 - s</td>
<td></td>
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<tr>
<td>250</td>
<td>31.0</td>
<td>339.5 - s</td>
<td></td>
</tr>
<tr>
<td>300</td>
<td>37.5</td>
<td>332.0 - s</td>
<td></td>
</tr>
<tr>
<td>350</td>
<td>44.0</td>
<td>325.5 - s</td>
<td></td>
</tr>
<tr>
<td>400</td>
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<td>319.5 - s</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>62.5</td>
<td>307.0 - s</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>75.0</td>
<td>294.5 - s</td>
<td></td>
</tr>
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<td>700</td>
<td>87.5</td>
<td>377.0 - s</td>
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<td>100.0</td>
<td>364.5 - s</td>
<td></td>
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<td>112.5</td>
<td>352.0 - s</td>
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<td>125.0</td>
<td>339.5 - s</td>
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<td>1200</td>
<td>150.0</td>
<td>314.5 - s</td>
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<td>1400</td>
<td>175.0</td>
<td>414.5 - s</td>
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<td>389.5 - s</td>
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<td></td>
</tr>
<tr>
<td>2000</td>
<td>250.0</td>
<td>339.5 - s</td>
<td></td>
</tr>
</tbody>
</table>

- Maintenance of FLOMAT sensors without interruption of the flow.

The M-TAP accessory must be installed to the main pipe as an insert pipe adaptor and it is a part of the complete system FLOMAT-TAP.

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