OUTLINE

Our clamp-on type Ultrasonic Flowmeter UL330 is "Time-Flight" type flowmeter and capable of measuring a flow rate of metallic and plastic piping ranging from 25 to 400 mm in nominal diameter. A detector (an ultrasonic sensor) is mounted outside an existing piping by clamping method, so that it does not get into contact with the measuring fluid at all, and there are no concerns about the mixture of solid material and metallic ion into the fluid, the corrosion of sensor by chemical, and the pressure loss by installing the flowmeter.

FEATURES

- The sensor of ultrasonic flowmeter UL330 is clamped on just outside of an existing pipe without any piping modification and time consuming installation work.
- By adopting a DSP and an AD converters, the flow measurement has been speeded up, and the resistance to bubbles has been improved.
- Because of the noncontact measurement method, the formation of bubbles and the mixture of metallic ion have been completely prevented.
- Installing the flowmeter does not cause the pressure loss because of no obstacles in the measuring pipe.
- The ultrasonic flowmeter is not affected by the pressure or conductivity of fluids.
- Excellent in long-term stability because of no moving part.
- Providing the following functions: Forward/backward flow rate display, totalizing display, analog output, pulse output, status output.

MEASUREMENT PRINCIPLE

As shown in Fig. 1, when the ultrasonic wave is propagated in the fluid in \( \psi \) angle, there is the difference in propagation time between A to B and the reverse direction. The propagation time for each direction is calculated by the following formula.

\[
\begin{align*}
\tau_{AB} &= 2L / V_{AB} = 2L / (C_o + V_m \cdot \cos \psi) \\
\tau_{BA} &= 2L / V_{BA} = 2L / (C_o - V_m \cdot \cos \psi)
\end{align*}
\]

\( 2L \): Distance between A and B  
\( V_m \): Average fluid velocity  
\( C_o \): Ultrasonic propagation velocity in resting state of fluid  
\( \tau_{AB}, \tau_{BA} \): Ultrasonic propagation time between A to B and B to A  
\( V_{AB}, V_{BA} \): Ultrasonic propagation velocity A to B and B to A  
\( \psi \): Propagation angle of the ultrasonic wave

The average fluid velocity \( (V_m) \) can be calculated by measuring the difference in the propagation time as follows:

\[
2V_m \cdot \cos \psi = 2L / \tau_{AB} - 2L / \tau_{BA} = 2L (\tau_{BA} - \tau_{AB}) / (\tau_{BA} \times \tau_{AB})
\]

\[
V_m = L (\tau_{BA} - \tau_{AB}) / (\cos \psi \times \tau_{BA} \times \tau_{AB})
\]

Since the distance \( (2L) \) between A to B and the angle \( \psi \) are known, the average fluid velocity \( (V_m) \) can be calculated. The flow rate can be calculated from the above \( V_m \) and the cross-sectional area of pipe, displayed and outputted.
STANDARD SPECIFICATIONS

- Measuring method: Ultrasonic time-flight type (Ultrasonic path: Reflex mode / V path or Diagonal mode / Z path)
- Construction: Sensor, Converter, Exclusive coaxial cable with BNC connector, sensor fixing rail
- Sensor mounting: Piping clamp-on type
- Measuring fluid: Whole fluids, but excluding liquids containing high viscosity fluid, a lot of bubbles, and slurry
- Measurable fluid sonic velocity range: 1,000 to 2,500 m/s
- Measurable fluid kinematic viscosity range: 0.30 to 40.00 mm²/s
- Fluid temperature: Up to 90°C (Surface temperature of piping)
- Measurable pipe (Nominal diameter): 25mm (min) to 400mm (max)
- Measurable flow velocity range: 0 to 10m/s
- Settable full scale flow velocity range: Minimum 0.3m/s to maximum 10m/s
- Accuracy: ±2% of the reading at the condition that flow velocity is 1m/s or more and Reynolds number is 10000 or more.
- Display: 16-digit, 2-line alphanumeric LCD (with backlight) and status display LEDs (3 pieces)
- Display data: Flow rate, totalizing flow rate, various status
- Power supply: 100 to 240VAC 50/60Hz (85 to 264VAC 50/60Hz is acceptable)
- Power consumption: 12 VA or less
- Cable entry: For power/output (M20 x 1.5, 3 pieces); With waterproof cable gland (Applicable cable diameter: ø8.0 to ø13.0)
  For sensor; Waterproof BNC connector (2 pieces)

- Outputs
  1) Analog output: 4 to 20 mA DC, Load resistance: 50Ω or less
  2) Pulse output: Open collector output
     Load rating: 30 V DC, 50mA, Low level 2V or less
     Pulse width: 0.5 ms (max.1000pps), 50ms (max.10pps), 100ms (max.5pps), 500ms (max.1pps), 1s (0.5pps or less): It is selected by the number of the maximum setting pulses.
  3) Status output: Open collector output
     Load rating: 30VDC, 50mA, Low level 2V or less
     Status 1: Hold output
     Status 2: Empty pipe detection
     Status 3: Forward or backward flow detection
- Damping setting: 0 to 100 s (Settable in increments of 1s step)
  * Valid for display, analog output and pulse output.
  There is a response delay of 0.5 s, even if damping is set to 0 s.
- Low cutoff setting: 0 to 30% of the maximum flow rate
  (Settable in increments of 1%)
  * Valid for display, analog output and pulse output.
- Parameter setting: Set with the key switches on the front panel of converter.
- Other additional functions
  1) Analog and pulse simulation output function (For loop check)
  2) Forward/backward direction measuring function
- Converter mounting method: Mounted onto the wall or 2 inch pipe
- Enclosure: Converter / IP65 Jet-proof, Sensor / IP65 Jet-proof (guaranteed with BNC connectors coupled)
- Material: Sensor housing / Heat-resisting ABS
  Sensor mounting rail / Aluminum
  Converter housing / Heat-resisting ABS
- Painting of converter: Housing cover = Blue
  Housing body = Light gray
- Sensor ambient temperature: -10 to 70°C
- Converter ambient temperature and humidity: -20 to 50°C, 10 to 90% RH (No dew condensation)
- Sensor signal cable: Standard 10 m (Up to 60 m)

Note 1: The UL330 flowmeter is applicable to pipes made of stainless steel or similar metals. For pipes with a schedule number of 80 or more, consult TOKYO KEISO.
Note 2: "V" in the sensor installation column means reflex mode (V path), and "Z" means diagonal mode (Z path).
Note 3: Reinforcement rails are used for resin pipes with a nominal size of up to 40 mm.
Note 4: The V-path method may not be applicable to pipes with a nominal size of up to 400 mm depending on the specifications (material and surface of piping, or fluid condition). In this case, use the Z-path method. To avoid this, it is recommended to specify a model with two sensor rails.
Note 5: Flowmeters with a single short sensor rail may not be mounted on pipes with a nominal size of more than 100 mm, or those which are scheduled to be replaced in the near future. In this case, specify a model with two long sensor rails.
Note 6: See the sensor combination in MODEL CODE.

<table>
<thead>
<tr>
<th>Pipe material</th>
<th>Nominal pipe size (D)</th>
<th>Sensor installation</th>
<th>Sensor rail length</th>
<th>Sensor rail fpr support</th>
<th>Code of sensor combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC/Polyethylene</td>
<td>25A≤D≤40A</td>
<td>V</td>
<td>320×1 pc</td>
<td>320×1 pc</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>50A≤D≤150A</td>
<td>V</td>
<td>320×1 pc</td>
<td>Not provided</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>200A≤D≤300A</td>
<td>V</td>
<td>620×1 pc</td>
<td>Not provided</td>
<td>4</td>
</tr>
<tr>
<td>Stainless (thickness≤40mm)</td>
<td>25A≤D≤150A</td>
<td>V</td>
<td>320×1 pc</td>
<td>Not provided</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>200A≤D≤400A</td>
<td>V</td>
<td>620×1 pc</td>
<td>Not provided</td>
<td>4</td>
</tr>
</tbody>
</table>

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DIMENSIONS

CONVERTER
- Wall mount type
- 2" pipe mount

SENSOR
- Reflex mode (V path)
- Diagonal mode (Z path)

*Support rail is to be used for the resin pipe from 25 to 40mm.
*Refer to Table 1 Sensor selection table.
FLOW RATE RANGE/ SIZE

<table>
<thead>
<tr>
<th>Nominal diameter (mm)</th>
<th>Possible scale range (m3/h)</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td></td>
<td>0.684</td>
<td>22.80</td>
</tr>
<tr>
<td>32</td>
<td></td>
<td>1.167</td>
<td>38.91</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td>1.568</td>
<td>52.27</td>
</tr>
<tr>
<td>50</td>
<td></td>
<td>2.556</td>
<td>85.21</td>
</tr>
<tr>
<td>65</td>
<td></td>
<td>4.192</td>
<td>139.7</td>
</tr>
<tr>
<td>80</td>
<td></td>
<td>5.857</td>
<td>195.2</td>
</tr>
<tr>
<td>100</td>
<td></td>
<td>9.948</td>
<td>331.6</td>
</tr>
<tr>
<td>125</td>
<td></td>
<td>15.00</td>
<td>500.1</td>
</tr>
<tr>
<td>150</td>
<td></td>
<td>21.28</td>
<td>709.4</td>
</tr>
<tr>
<td>200</td>
<td></td>
<td>36.80</td>
<td>1326</td>
</tr>
<tr>
<td>250</td>
<td></td>
<td>57.07</td>
<td>1902</td>
</tr>
<tr>
<td>300</td>
<td></td>
<td>81.25</td>
<td>2708</td>
</tr>
<tr>
<td>350</td>
<td></td>
<td>101.3</td>
<td>3377</td>
</tr>
<tr>
<td>400</td>
<td></td>
<td>133.2</td>
<td>4442</td>
</tr>
</tbody>
</table>

[Note] The above-mentioned flow rates have been calculated for the SUS Sch. 10s pipes, at the minimum range flow velocity of 0.3 m/s and maximum range flow velocity of 10 m/s. (The flow rate range may differ slightly, depending on the piping standard.)

MODEL CODE

- **Sensor**

<table>
<thead>
<tr>
<th>Sensor Model code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UFS330</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Short sensor rail × 2 pcs, Sensor rail for support × 1 pc (*)</td>
</tr>
<tr>
<td>4</td>
<td>Long sensor rail × 2 pcs (*)</td>
</tr>
<tr>
<td>5</td>
<td>Short sensor rail × 2 pcs (*)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sensor combination</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UFS330</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>10m (Standard)</td>
</tr>
<tr>
<td>2</td>
<td>20m</td>
</tr>
<tr>
<td>3</td>
<td>30m</td>
</tr>
<tr>
<td>4</td>
<td>40m</td>
</tr>
<tr>
<td>5</td>
<td>50m</td>
</tr>
<tr>
<td>6</td>
<td>60m</td>
</tr>
</tbody>
</table>

- **Converter**

<table>
<thead>
<tr>
<th>Converter Model code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UFC330</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>100 to 240 V AC 50/60Hz</td>
</tr>
</tbody>
</table>

- **WIRING DIAGRAM**

<table>
<thead>
<tr>
<th>CN1</th>
<th>CN2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply (AC)</td>
<td>Analog output 4 to 20mA DC</td>
</tr>
<tr>
<td>Totalized pulse output</td>
<td>External totalization reset</td>
</tr>
<tr>
<td>ST1</td>
<td>ST2</td>
</tr>
<tr>
<td>(3P)</td>
<td>(2P)</td>
</tr>
<tr>
<td>L1</td>
<td>L2</td>
</tr>
</tbody>
</table>

Note 1:
ST1 (Status 1): Hold output
ST2 (Status 2): Empty pipe detection
ST3 (Status 3): Forward or backward flow detection

Note 2:
The detachable connectors are used.

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ST1 (Status 1): Hold output
ST2 (Status 2): Empty pipe detection
ST3 (Status 3): Forward or backward flow detection

Note 2:
The detachable connectors are used.

* Refer to table 1, Sensor selection table.
POINTS TO BE CHECKED BEFORE USING

It may be unable to make measurement when falling into the following conditions.
Contact us in advance. When it cannot be judged whether it is suitable, we are prepared to make preliminary test by the actual equipment.

1) Liquid
- The liquid containing a lot of bubbles (over 2% only as a guide).
- The liquid containing slurry and solid material (over 5wt% only as a guide).
- The liquid of low Reynolds number (less than Re.10000 only as a guide).
- Liquids other than water such as lean chemical solutions, oils, waste waters and hot spring water.

2) Piping
- The inside wall of carbon steel pipe is rusty.
- Adhesion and sediment are in a pipe.
- The outside surface of cast iron pipe is coarse.
- Pipe made of PVDF with thickness more than 9mm.
- Pipe made of PP with thickness more than 15mm.
- SGPW pipe [The galvanized steel pipe for water service (white gas pipe)]
- Lined pipe

3) Straight runs
The accurate flow measurement requires straight runs both upstream and downstream of the flow sensor as shown at the next page.

PRECAUTION FOR USE

1) Pipe shall be always filled with fluid.
2) In the case of horizontal piping, please do not mount a sensor on the upper and the lower part of piping.
3) When you wrap a sensor in an insulating material, be careful not to exceed the ambient temperature limits of a sensor.
4) In order to prevent the sensor grease from degrading when installed outside, we recommend you to mount the waterproof cover which covers a sensor assembly.
**REQUIRED STRAIGHT RUNS**

D : Nominal diameter  
Reference : JEMIMA standard  JEMIS-32

<table>
<thead>
<tr>
<th>Classification</th>
<th>Required upstream straight length</th>
<th>Required downstream straight length</th>
</tr>
</thead>
<tbody>
<tr>
<td>90° bend</td>
<td>More than 10D L ≥ 10D</td>
<td>L ≥ 5D</td>
</tr>
<tr>
<td>Tee</td>
<td>More than 100D L ≥ 50D</td>
<td>L ≥ 10D</td>
</tr>
<tr>
<td>Expansion pipe</td>
<td>More than 100D L ≥ 30D</td>
<td>L ≥ 5D</td>
</tr>
<tr>
<td>Reducer</td>
<td>L ≥ 10D</td>
<td>L ≥ 5D</td>
</tr>
<tr>
<td>Valve</td>
<td>L ≥ 30D</td>
<td>L ≥ 10D</td>
</tr>
<tr>
<td></td>
<td>Valve throttling at upstream pipe</td>
<td>Valve throttling at downstream pipe</td>
</tr>
<tr>
<td>Pump</td>
<td>Check valve Slice valve</td>
<td>L ≥ 50D</td>
</tr>
</tbody>
</table>

*Specification is subject to change without notice.*

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