TECHNICAL GUIDANCE

CLAMP-ON TYPE

UL330

ULTRASONIC FLOWMETER

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 ψ 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.

$$t_{AB} = 2L / V_{AB} = 2L / (C_o + V_m \cdot \cos\psi)$$
$$t_{BA} = 2L / V_{BA} = 2L / (C_o - V_m \cdot \cos\psi)$$

$2L$	: Distance between A and B
V_m	: Average fluid velocity
C_o	: Ultrasonic propagation velocity in resting state of fluid
t_{AB}, t_{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.
ψ	: 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:

$$2V_m \cdot \cos\psi = 2L / t_{AB} - 2L / t_{BA}$$
$$= 2L (t_{BA} - t_{AB}) / (t_{BA} \times t_{AB})$$
$$\therefore\ V_m = L (t_{BA} - t_{AB}) / (\cos\psi \times t_{BA} \times t_{AB})$$

Since the distance ($2L$) between A to B and the angle ψ 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.

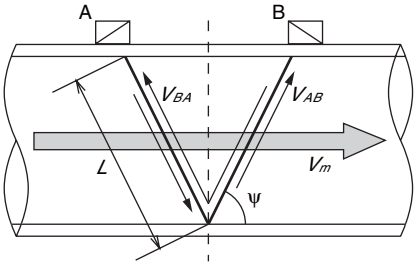


Fig. 1 Measurement Principle

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 mm^2/s
- Fluid temperature : Up to 90°C (Surface temperature of piping)
- Measurable pipe (Nominal diameter)
  : 25mm (min) to 400mm (max)
  Refer to Table 1 for Sensor Selection and Mounting Method.
  Note : The flowmeter is not applicable for lined piping.
- 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.
  : Flow velocity error is ±2cm/s at the condition that flow velocity is less than 1m/s.
- 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: 500Ω 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 temperaure
  : -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)

Table 1. Sensor selection table

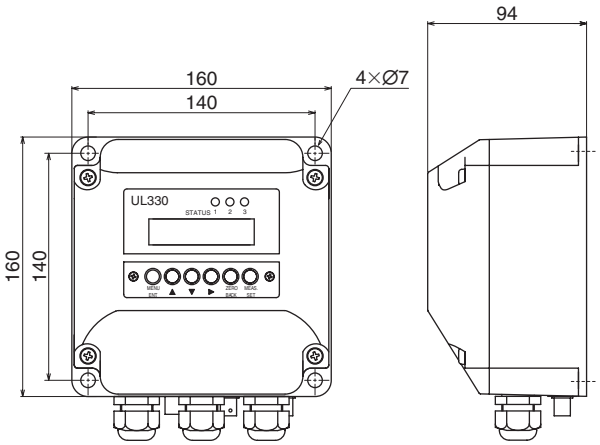
Pipe material	Nominal pipe size (D)	Sensor installation	Sensor rail length	Support rail	Code of sensor combination
PVC	25mm≦D≦40mm	V	320×1 pc	320×1 pc	1
	50mm≦D≦150mm	V	320×1 pc	Not provided	5
	200mm≦D≦400mm	V	620×1 pc	Not provided	4
PVDF / PP	25mm≦D≦40mm	V	320×1 pc	320×1 pc	1
	50mm≦D≦150mm	V	320×1 pc	Not provided	5
	200mm≦D≦400mm	Z	620×2 pc	Not provided	4
Metal	25mm≦D≦150mm	V	320×1 pc	Not provided	5
	200mm≦D≦400mm	Z	620×2 pc	Not provided	4

Note 1 : The flowmeter is applicable for the resin pipe made of PVDF in thickness 9mm or less or the one made of PP in 15mm or less.
Note 2 : The flowmeter is applicable for the SGP pipe and stainless steel pipe or likes made of metal. However, consult TOKYO KEISO for the applications of pipes with schedule 80 or more.
Note 3 : "V" and "Z" in the column "Sensor Installation" means V path of reflex mode and Z path of diagonal mode respectively.
Note 4 : The reinforcement rail is used for the resin piping whose nominal diameter is 40mm or less.
Note 5 : Depending on the piping specifications such as material and surface conditions, or fluid conditions, V path method can not be necessarily applied even for the nominal size 400mm or smaller. The Z path method is recommended in those cases. Specify 2 pieces of sensor rail in advance when such cases are anticipated.
Note 6 : Specify 2 pieces of longer sensor rail to cover the undecided pipe size with more than 100mm or unexpected changes of pipe size instead of short sensor rails which could not install the sensor.
Note 7 : Please see "Sensor combination" in "MODEL CODE"

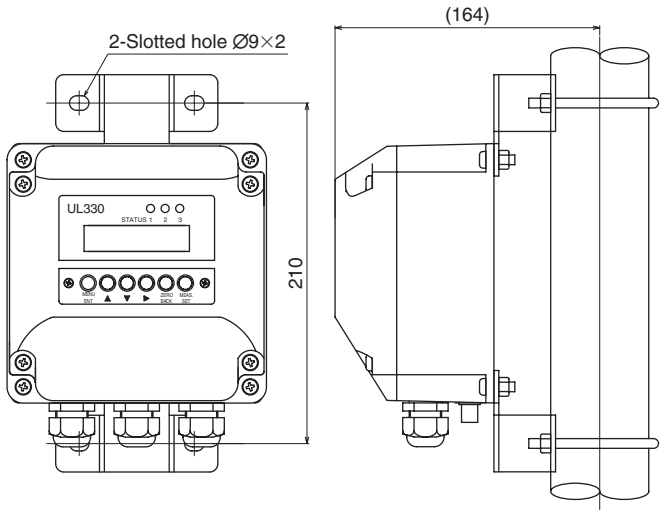
DIMENSIONS

CONVERTER

- Wall mount type

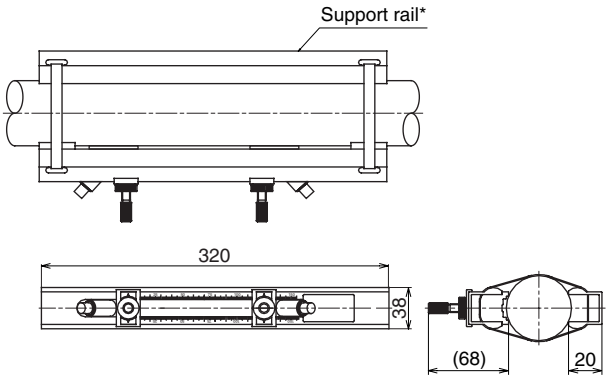


- 2" pipe mount

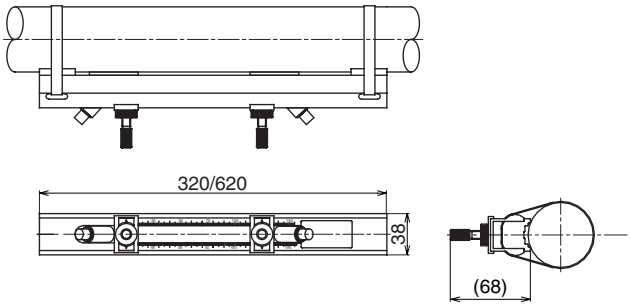


SENSOR

- Reflex mode (V path)

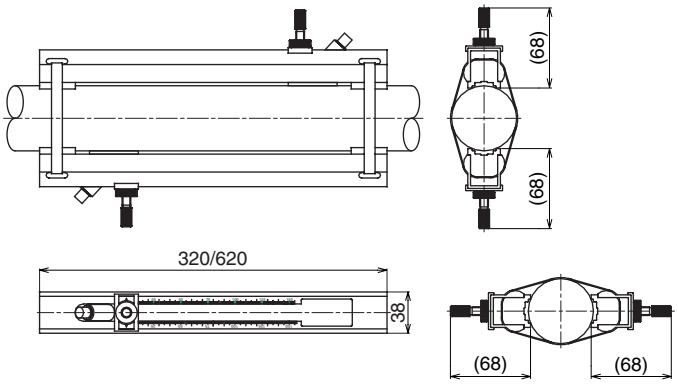


With support rail



Without support rail

- 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

Nominal diameter (mm)	Possible scale range (m³/h)	
	Minimum	Maximum
25	0.684	22.80
32	1.167	38.91
40	1.568	52.27
50	2.556	85.21
65	4.192	139.7
80	5.857	195.2
100	9.948	331.6
125	15.00	500.1
150	21.28	709.4
200	36.80	1226
250	57.07	1902
300	81.25	2708
350	101.3	3377
400	133.2	4442

[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.)

WIRING DIAGRAM

CN1			CN2									
Power supply (AC)			Analog output 4 to 20mADC		Totalized pulse output		External totalization reset		Status output			
									ST1	ST2	com	ST3
(3P)			(2P)		(2P)		(2P)		(4P)			
L1	L2	FG	+	–	+	–	+	–	+	+	com	+

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.

MODEL CODE

- Sensor

Sensor Model code						Description
UFS330	A					
Sensor combination		1				Short sensor rail × 1 pc, Support rail × 1 pc
		4				Long sensor rail × 2 pcs
		5				Short sensor rail × 2 pcs
Cable length			1			10m (Standard)
			2			20m
			3			30m
			4			40m
			5			50m
			6			60m
Additional functions				(Blank)		NA
				/Z		Provided

- Converter

Converter Model code						Description
UFC330	A					
Power supply		A				100 to 240 V AC 50/60Hz
		-				
Mounting			1			Wall mount type
			2			2“ pipe mount type
Serial output				1		Standard
				-		
Additional functions					(Blank)	NA
					/Z	Provided

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.

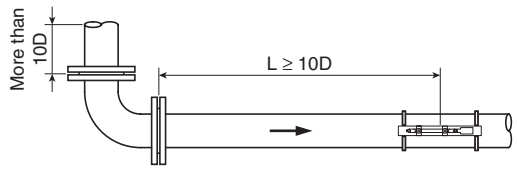
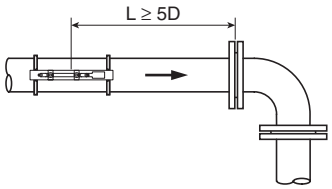
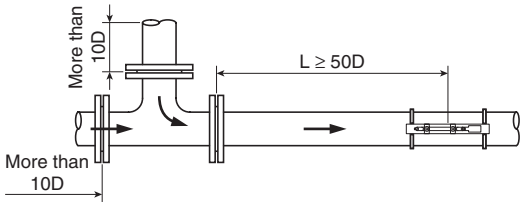
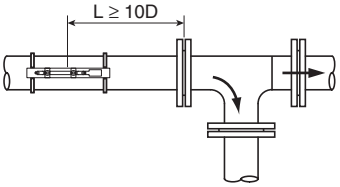
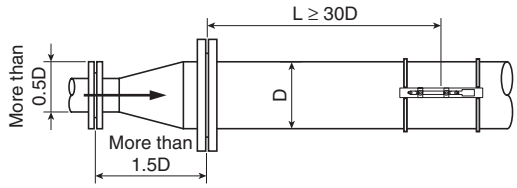
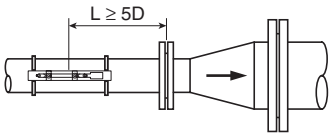
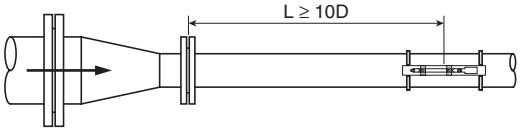
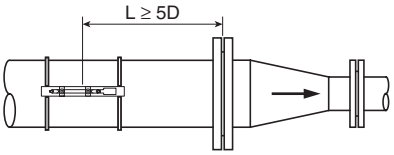
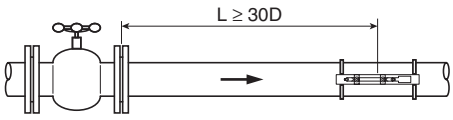
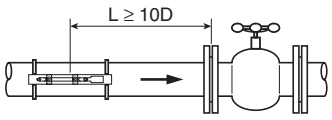
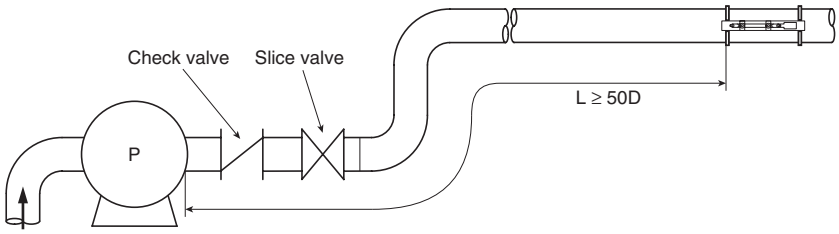
PRECAUTION FOR USE

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

Classification	Required upstream straight length	Required downstream straight length
90° bend		
Tee		
Expansion pipe		
Reducer		
Valve	 Valve throttling at upstream pipe	 Valve throttling at downstream pipe
Pump		

* Specification is subject to change without notice.

TOKYO KEISO CO., LTD.

Head Office : Shiba Toho Building, 1-7-24 Shibakoen, Minato-ku, Tokyo 105-8558
Tel : +81-3-3431-1625 (KEY) ; Fax : +81-3-3433-4922
e-mail : overseas.sales@tokyokeiso.co.jp ; URL : http://www.tokyokeiso.co.jp