MJ400252C1

KOFLOC Kyoto

Straight Type Ultrasonic Flow Meter

FML-500

Instruction Manual

KOFLOC Corp.

Please read this manual thoroughly prior to installing and using the product. This way it is possible to ensure the performance and safety of the product and prevent possible accidents and damage to the product due to incorrect use.

When the product has failed or is considered to require readjustment, please contact our sales office. Our experienced technical staff will give you appropriate advice. Please follow the instructions given.

Please note that if you repair/modify the product yourself, not only serious accidents may occur, but our warranty will become void.

The contents of the manual are subject to change without notice for improvement. Prior to shipment, every care has been taken in preparing this manual not to mention the product itself, but if you notice any imperfections, errors or omission, please contact KOFLOC.

<< Prior to use >> and << Precautions for use >>

Various alert symbols and signal words are used in this manual and attached to the product to ensure correct use of the product and to prevent possible personal injury or loss of life and property damage. The symbols and meanings of the signal words are as follows:

DANGER	Ignoring this symbol and handling the product incorrectly will immediately result in loss of life or serious injury.
WARNING	Ignoring this symbol and handling the product incorrectly may result in loss of life or serious injury.
CAUTION	Ignoring this symbol and handling the product incorrectly may result in personal injury or damage to property.

Table of Contents

1. Foreword

Thank you for your selection of the ultrasonic flow meter Model FML-500. Prior to using your new equipment, please read this manual thoroughly to ensure it is used in the correct way.

2. Precautions for Handling

2-1 Checking the ID plate

All the products have been assembled and adjusted one by one according to the specifications, and liquids to use, flow rates and other data are shown on the ID plate attached to the back of the case. Check the ID plate and make sure your new equipment meets these specifications.

Check items:

① Model
② Name of fluid
③ Flow rate
④ Presence of the serial No.

2-2 Precautions for transportation

Wherever possible, transport the product in the condition in which it has been received from KOFLOC to the installation site in order to prevent damage due to accidents during transportation.

2-3 Precautions for storage of the product

If the product is not put in use for a long time after it was received, unexpected troubles may occur. When it is expected that the product will be kept in storage for a long time, take the following precautions:

1) Store the product in the package in which it was received from KOFLOC, wherever possible.
2) Store the product in a place described below:
   ① A place free of rain and water.
   ② A place free of vibration and impact.
   ③ A place of normal temperature and normal humidity (around 25℃, 65%).
   ④ A place free of dust.
   ⑤ A place free of corrosive gases.
   ⑥ A place free of a strong electric/magnetic field.
3) To store the product that has been used, purge with pure water, etc. so that measuring liquid will not remain in the flow meter.
   Cover the inlet and outlet of the meter with caps to prevent intrusion of dust and dirt.

3. Overview

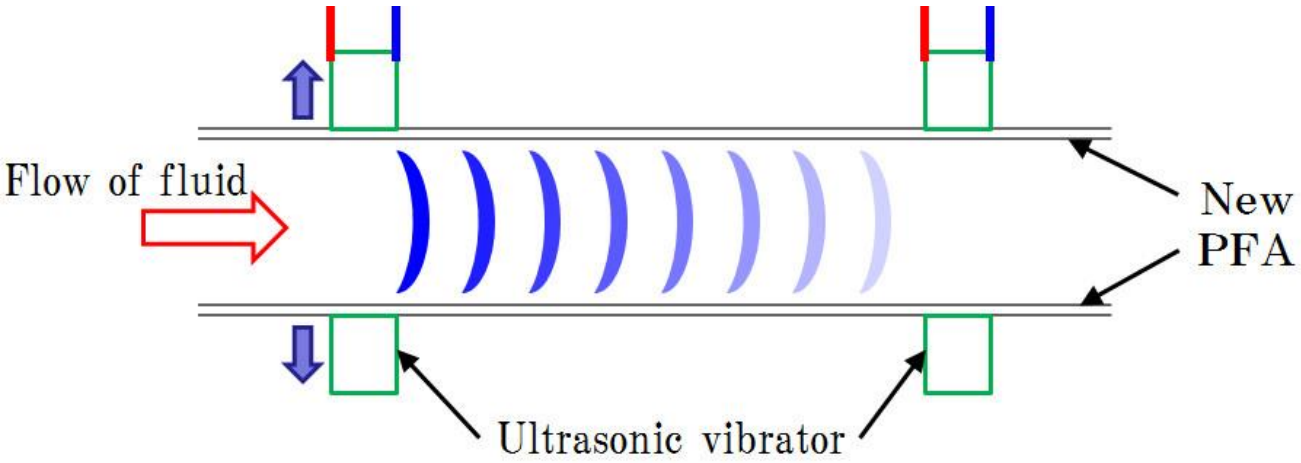
Model FML-500 is a straight type ultrasonic flow meter for liquid.

The areas in contact with liquid are made of New PFA, which is highly resistant to chemicals, and the passage is a simple straight construction having no obstacles inside to facilitate maintenance.

The indicator-integrated meter becomes ready for measurement once its cables are connected. It is capable of measuring flow rates up to F.S. 5 L/min. precisely.

- Clean structure with areas in contact with liquid made of New PFA.
- Straight type passage to cause no unnecessary pressure loss and facilitate maintenance.
- Small size and light weight. Compact
- Meter equipped with an indicator can be made ready for measurement only by connecting it to a 24 VDC power supply.
- Capable of measuring highly viscous fluid.

Principle of operation



A flow velocity is calculated by a difference in time between the arrival time of ultrasonic vibrations sent in the direction of flow of fluid and the arrival time of ultrasonic vibrations sent in the opposite direction of flow of fluid and then a flow rate of fluid is calculated by multiplying the cross sectional area of the tube used by the flow velocity.

4. Specifications

Standard specifications

Measuring fluids	Water, pure water (bubbles not included)　*For other liquids, please contact us.
Fluid sonic range	1300 m/s － 1600 m/s
Fluid temperature range	15 － 50℃
Measuring range	0 － 5 L/min
Measuring accuracy	See Table 1.
Materials of parts in contact with liquid	New PFA
Pressure resistance	0.5 MPa（at 20℃）
Process connection	6-mm tube end
Cable length	3 m
Cable sheath	PVC
Enclosure	Equivalent to IP64
Ambient temperature	5 － 50℃（No condensation）
Ambient humidity	10 － 85%RH max. (No condensation)
Installation	Vertical, horizontal, inclined

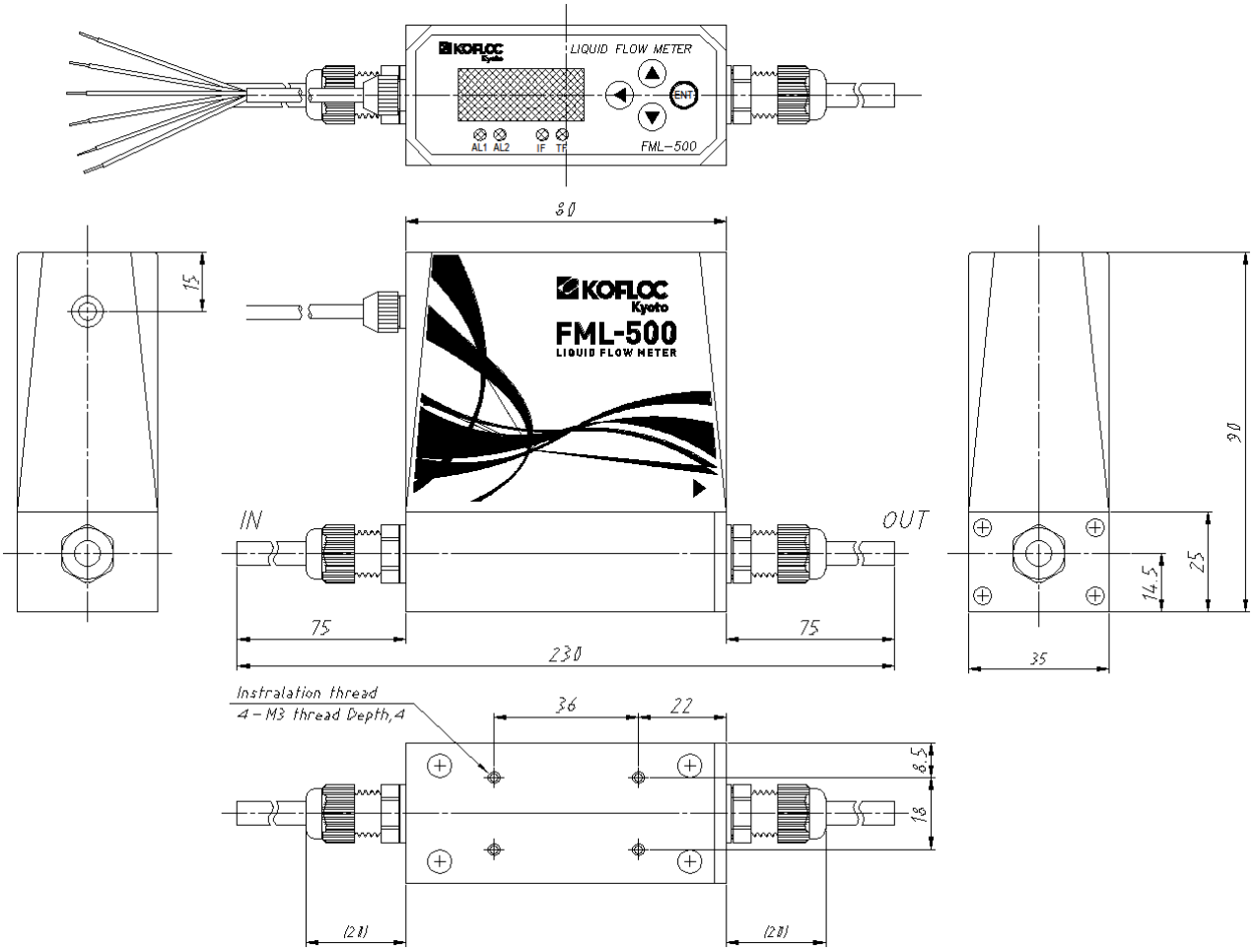
Table 1: Measuring accuracy (water 23℃)

Measuring range	0 － 5 L/min		
Flow range	0 – 0.20 L/min － 0 – 5.00 L/min		
Measuring accuracy	Flow velocity	Below 1 m/s (below 0.8 L/min)	±30 mL/min
		1 － 2 m/s（0.8 － 1.5 L/min）	±2.5%F.S
		2 － 3 m/s（1.5 － 2.2 L/min）	±2.0%F.S
		3 － 6.6 m/s（2.3 － 5 L/min）	±1.5%F.S

Electrical specifications

Measuring method		Ultrasonic wave propagation time difference calculation
Output	Flow output	4 – 20 mA（Load resistance 500 Ω max.）
	Flow alarm output	Open collector output 2 points Load rating: 30 VDC, 20 mA, operation: comparison
Indicator		4-digit, 7-segment LEDs
Indication		Instantaneous flow rate, integrated flow rate
Alarm output monitor		LED 2-point indication (Instantaneous flow rate alarm, integrated flow rate alarm)
Parameter setting		Four key switches on the panel
Power supply		24 VDC±5%
Power consumption		150 mA max.

External dimensions



Signal table

Pin No.	Signal Name	Core Color
1	Power supply +24V	Red
2	Power supply/current output COM	Black
3	Current output	White
4	Alarm output 1	Green
5	Alarm output 2	Yellow
6	Alarm COM	Brown

5. Installation

5-1 Installation place

① This equipment is designed for indoor use.
Never install the equipment in a place where it is likely to be wetted by water or rain. The equipment may fail. Install the equipment in a place where sufficient ventilation is provided and changes in temperature and humidity are minimal.

② Install the equipment in a place free of vibration and impact.

③ Do not use the equipment under direct sunlight or at high temperature/humidity.

④ Install the equipment in a place free of dust.

⑤ Install the equipment in a place free of corrosive gases.

⑥ Install the equipment in a place free of a strong electric/magnetic field.

⑦ After installation, be sure to conduct leak test on piping.

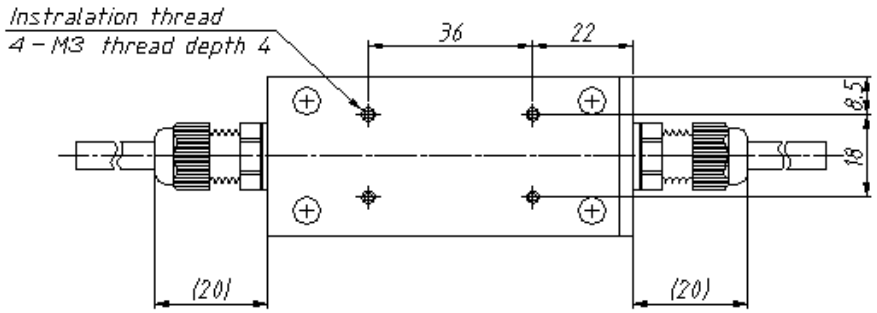
⑧ Install the equipment in a place where the operating temperature is 15 to 35℃.

The use of the equipment in a condition deviating from the conditions described in the specifications is a cause of failure.

5-2 Installation method

Install the meter using the threaded holes (M3) on the bottom of the body.

Bottom of body



5-3 Precautions for piping

① The measuring tube must be filled with measuring fluid.

② Avoid such piping as fluid flows downward.
Bubbles in the measuring tube are a cause of deterioration of the accuracy.

③ Be sure that the length of piping in the upstream is longer than 10D and the length of piping in the downstream longer than 5D.

④ Be sure that the flow direction matches the arrow shown on the body.

⑤ When a flow rate adjust valve is to be installed, it is recommended that it be installed on the secondary side of the meter.
If it is installed in the upstream, bubbles may be produced due to pressure drop to cause deterioration of the accuracy.

⑥ For connecting tube joints, follow the procedures furnished by the manufacturer.
During connection, hold the tubes to prevent breakage.

CAUTION

When washing the inside of piping of the product, exercise caution not to damage the inside. If it is damaged, the accuracy will deteriorate.

WARNING

Check to see if the connections of piping are not leaking. If such a check is omitted and unsafe liquid is used, serious accidents may occur.

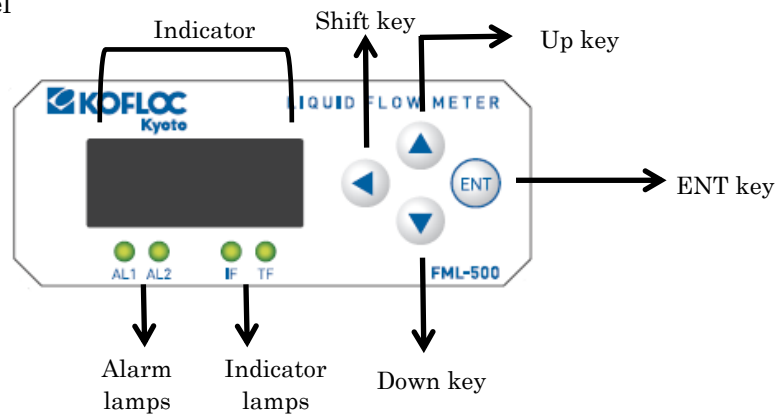
6. How to Use

6-1 Warming up

Warm up the equipment for at least 15 minutes after it was powered on.

6-2 Operating procedure

・Operation panel



・Indicator

Indicates an instantaneous flow rate or integrated flow rate.
During setting, the mode No. or set value is shown here.

・Alarm lamps

When the alarm output 1 is on, “AL1” lights and when the alarm output 2 is on, “AL2” lights.

・Indicator lamps

When an instantaneous flow rate is being indicated, “IF” lights and when an integrated flow rate is being indicated, “TF” lights.

・Shift key [＜]

Measurement: Switches over the indication of flow rates between the instantaneous flow rate and the integrated flow rate.
Setting: Moves the flashing digit to left.
Returns to the flow rate indication when the mode No. is being indicated.

・Up key [∧]

Measurement: Not used.
Setting: Increments the value of the flashing digit.

・Down key [∨]

Measurement: Not used.
Setting: Decrements the value of the flashing digit.

・ENT key

Measurement: Not used.
Setting: Accepts an entered value.

6-3 Description of the indicator

Shown in Manual	Status	Shown on Indicator
AUTO	Auto zero selected	 Flashing
- - - A	Auto zero being executed	 Flashing Character move
SUM	Integrated flow rate reset selected	 Flashing
WIN1	Re-measure mode selected	 Flashing
- - - W	Re-measurement being executed	 Flashing Character move
AVR0	Auto AVR selected	 Flashing
AVR1	Auto AVR selected (Factory-set value)	 Flashing
- - - R	Auto AVR being executed	 Flashing Character move
YES	Flow rate set value update selected after parameter set mode P-02 has been run	 Flashing
NO	Flow rate set value cancel selected after parameter set mode P-02 has been run	 Flashing

6-4 Zero adjustment (Zero offset)

With the piping filled with water fully and an instantaneous flow rate being indicated, stop the flow of liquid completely. In this state, press and hold the down key [∨] and [ENT] key for approx. 3 seconds. Then the indicator will show AUTO. Next, pressing the [ENT] key once executes the zero adjustment. While it is being executed, - - - A is shown and when the zero adjustment has been completed, the instantaneous flow rate will be indicated again. (If flickering of a figure near 0 is annoying, select the low cut function.)

Pressing the shift key [<] while AUTO is being shown on the indicator cancels the zero adjust function and the instantaneous flow rate will be indicated again.

6-5 Flow rate indication

① Switching over flow rates to indicate

Each time the shift key [<] on the operation panel is pressed, indication is switched over in the order of instantaneous flow rate → integrated flow rate (lower 4 digits) → integrated flow rate (upper 4 digits). The upper four digits are not indicated, however, when the integrated flow rate value does not reach upper four digits. When an instantaneous flow rate is being indicated, the "IF" lamp lights and when an integrated flow rate is being indicated, the "TF" lamp lights.

② Units of flow rates

The units of the instantaneous flow rate and integrated flow rate are the units set in each setting mode.

③ Integrated flow rate resetting

In the state of integrated flow rate indication, press and hold the up key [∧] and down key [∨] for approx. 3 seconds. Then the indicator will show SUM. Next, pressing the [ENT] key once resets the integrated flow rate value. Pressing the shift key [<] while SUM is being indicated cancels resetting.

6-6 Re-measure mode

Use this function when measurement has been performed while the piping was not full of water or when the conditions or types of liquid change.

In the state of integrated flow rate indication, press and hold the up key [∧] and [ENT] key for approx. 3 seconds. Then the indicator will show WIN1. Next, pressing the [ENT] key once runs measurement again. Pressing the shift key [<] while WIN1 is being indicated cancels this mode.

6-7 Auto AVR function

Try this function if the indicator does not change from - - - W to flow rate indication when the piping is full of water.

When the shift key [<] is pressed, - - - W on the indicator will be canceled. In this state, press and hold the up key [∧] and shift key [<] for approx. 3 seconds. Then the auto AVR mode will be activated and the indicator will show AVR0. Pressing either the up key [∧] or down key [∨] causes the indicator to change to AVR1.

When the [ENT] key is pressed while AVR0 is being shown on the indicator, the auto AVR function will be executed and - - - R will be shown. After - - - R has been canceled, run the re-measure mode.

Pressing the [ENT] key while AVR1 is being shown sets the factory setting again. (Auto AVR cancel)

6-8 Parameter setting

When an instantaneous flow rate/integrated flow rate is being indicated, pressing and holding the shift key [<] and [ENT] key for approx. 3 seconds sets the parameter setting mode. Each time the up key [∧] or down key[∨] is pressed, the mode No. changes. To change the set value, change the digits with the shift key [<] and change the figures with the up key [∧] or down key [∨].

After setting a parameter, pressing the [ENT] key registers the set value and returns the mode to the mode No. indication mode. Pressing the shift key [<] while the mode No. is being indicated returns the indication to either the instantaneous flow rate or integrated flow rate.

① Default values

Mode No.	Default Value				Set Item
ABCD	A	B	C	D	
P－01			1.	0	Damping constant setting
P－02				3	Unit of flow rate setting
	0	5.	0	0	Full scale flow rate setting
P－03	Factory-set value				K factor value setting
P－04			0	0	Low flow rate cut setting
P－05		0	1.	0	Liquid viscosity setting
P－06			0.	0	J value (temperature coefficient) setting
P－07		1.	0	0	Liquid density setting
P－08	0	1.	0	0	Liquid kinematic viscosity coefficient setting
P－09	0	5.	0	0	Upper limit flow rate alarm setting
P－10		0.	0	0	Lower limit flow rate alarm setting
P－11				3	Unit of integrated flow rate setting
P－12			0	5	Integrated flow rate (lowest region cut) setting
P－13				1	Alarm output 1 type assignment setting
P－14				2	Alarm output 2 type assignment setting
P－15	0	0.	0	0	Integrated flow rate alarm setting
P－16		0	0	1	Equipment address setting

Description of mode No. and set values

Mode No.	Damping constant setting
P－01	A B C D 1. 0 Set range: 0.0 － 25.0 s

Mode No.	Unit of flow rate setting and full scale flow rate setting
P－02	Unit of flow rate setting A B C D 3 1・・・mL/s 2・・・mL/min 3・・・L/min 4・・・L/h
	Full scale flow rate setting A B C D 0 5. 0 0 Input range: mL/s・・・3.14 － 99.99 mL/min・・・188 － 9999 L/min・・・0.18 － 11.30 L/h・・・11 － 678
	※After a full scale flow rate has been set, when YES is selected with the up key [∧], the value will be registered. If NO is selected, the value will not be changed and the indicator will return to mode No. indication.

Mode No.	K factor value setting
P－03	A B C D 1. 0 0 0 Set range: : 0.500 － 5.000

Mode No.	Low flow rate cut setting
P－04	A B C D 0 0 Set range: 0 － 20%

Mode No.	Liquid viscosity setting
P－05	A B C D 0 1. 0 Set range: 0.0 － 99.9 cP

Mode No.	J value (temperature coefficient) setting
P－06	A B C D 0. 0 Set range: －9.9 － 9.9

Mode No.	Liquid density setting
P－07	A B C D 1. 0 0 Set range: 0.00 － 9.99 g/cm^3

Mode No.	Liquid kinematic viscosity coefficient setting
P－08	A B C D 0 1. 0 0 Set range: 0.00 － 99.99 cSt

Mode No.	Upper limit flow rate alarm setting
P－09	A B C D 0 5. 0 0 Set range: Up to 2 times the full scale flow rate value

Mode No.	Lower limit flow rate alarm setting
P－10	A B C D 0 0 0 0 Set range: 0 up to full scale flow rate value

Mode No.	Unit of integrated flow rate setting
P－11	A B C D 2 1・・・mL 2・・・L

Mode No.	Integrated flow rate (lowest region cut) setting
P－12	A B C D 0 5 Set range: 0 － 10

Mode No.	Alarm output 1 type assignment setting
P－13	A B C D 1 0・・・No alarm output 1・・・Instantaneous flow rate (upper limit) alarm 2・・・Instantaneous flow rate (lower limit) alarm 3・・・Instantaneous flow rate (upper/lower limit) alarm 4・・・Integrated flow rate alarm 5・・・No received wave alarm

Mode No.	Alarm output 2 type assignment setting
P－14	A B C D 2 0・・・No alarm output 1・・・Instantaneous flow rate (upper limit) alarm 2・・・Instantaneous flow rate (lower limit) alarm 3・・・Instantaneous flow rate (upper/lower limit) alarm 4・・・Integrated flow rate alarm 5・・・No received wave alarm

Mode No.	Integrated flow rate alarm setting
P－15	A B C D 0 0 0 0 Set range: mL・・・0 － 99999999 L・・・0 － 999999.99

Mode No.	Equipment address setting
P－16	A B C D 0 0 1 Set range: 1 － 127

7. Troubleshooting

Symptom	Probable Cause	Check Item and Corrective Action
1. The indicator shows nothing.	a. The power is not on.	1. Check to see if the power has been turned on. 2. Check to see if wires have been connected correctly.
2. The indication does not change from - - - W to flow rate.	a. The piping is not full of water.	1. Fill the piping with measuring liquid fully.
	b. The liquid may be out of the specification range.	1. Check liquid specifications such as temperature of measuring liquid. 2. Try the auto AVR function. If the indication does not change to flow rate when the auto AVR function is executed, it is possible that the liquid in question is unmeasurable liquid. Please contact us.
3. The indicated value is not stable.	a. The piping is not full of water.	1. Fill the piping with measuring liquid fully. 2. Check the piping installation direction. It is recommended that the equipment be installed in such a direction that liquid flows upward in order to prevent trapping of air bubbles.
	b. Measuring liquid contains bubbles or foreign matter.	1. Eliminate bubbles and foreign matter as much as possible by, for example, installing a deaerator in the upstream.
	c. The flow pulsates.	1. If responsiveness is not affected, increase the damping constant.
	d. Measuring liquid is not uniform.	1. Keep entire liquid in the uniform state by, for example, stirring it fully.

Symptom	Probable Cause	Check Item and Corrective Action
4. The indicated flow rate does not match the actual flow rate.	a. The piping line is leaking.	1. Retighten the leaking places due to a failure to tighten the nuts or insufficient tightening of the nuts of the piping line to prevent leak.
	b. The zero point is not correct.	1. Conduct the zero adjustment.
	c. The meter is used in a way deviating from the specification.	1. Refer to the specification label attached to the meter.
	d. Measuring liquid contains bubbles or foreign matter.	1. Eliminate bubbles and foreign matter as much as possible by, for example, installing a deaerator in the upstream.

＊If the problem cannot be solved by the above corrective actions, please contact the dealer.

8. Product warranty

Thank you very much for usually using Kofloc products regularly.
Now, when ordering our products by this catalog and when there is no statement of special mention matters, such as estimate, contract and specifications, we apply following requirements and the following contents of a warranty.

1. The contents of warranty

① Warranty period

The warrant period shall be one year after the shipment.

② Warranty range

If a malfunction of the product you purchased occurs because of our responsible reasons, offer of substitute or it will be charge-free repaired in our factory. But if a malfunction of the machine occurs due to the following reasons, even within the warrant period, it becomes the outside for a warranty.

(a) Malfunctions due to erroneous applications, repairs or remodeling.
(Including the case in which the manufacturing specification differs from the application conditions.)
(b) Malfunctions due to the falling after the purchase.
(c) Malfunctions caused by natural disasters such as fire, earthquake, water disaster and lightning stoke, or riots or wars.
(d) Malfunctions caused by mixing-in of foreign matters out of the piping.
(e) Malfunctions caused by the peculiar problems due to combinations with other built in equipment.

In addition, a warranty here means the warranty of the product simple substance of our company.
So the damage induced by failure of the products of our company shall be eliminated from the object of warranty.

KOFLOC Corp.

URL : http://www.kofloc.co.jp