

SURPASS

Eddy Flowmeter

E R L

Operation Manual

SURPASS INDUSTRY CO., LTD.

Before Using

- Before using this product, check the compatibility of the type of liquid to be used and the material of the product's wetted parts.
- All users are required to carefully read and understand this manual before operation of this product.
- Keep this manual in good condition and close at hand for quick reference whenever necessary.
- Use the product only as intended, and only as directed in this manual.
- Cautionary notes in this manual must be fully understood and complied with at all times

About This Operation Manual

- The contents of this manual are subject to change without prior notice, due to improvements in product functionalities and / or performance.
- No part of this manual may be reproduced in any form or by any means.
- Although this manual has been prepared with all possible care, please do not hesitate to contact Surpass Industry about errors, omissions, or any other points of doubt.

Important Safety Instructions

<Symbols in this Operation Manual>

Warnings and cautionary notes are provided in this manual to ensure this product is used correctly and to prevent personal injury and property damage. The meanings of the WARNING and CAUTION symbols in this manual are as described below. Please continue reading once you have understood the content well.



DANGER

This symbol indicates warnings against impending danger which, if not observed, may cause death or severe injury to the user.



WARNING

This symbol indicates warnings which, if not observed, may cause death or severe injury to the user.



CAUTION

This symbol indicates warnings which, if not observed, may physically impair the user or damage surrounding objects.



This symbol indicates important information required to operate this product correctly.

Warnings

WARNING

- This product is not explosion-proof. Never use it with flammable fluids such as solvents. Doing so may cause fire and or explosion and is highly dangerous.
- Never use this product with fluid which corrodes or permeates fluoroplastic or ozone. Failure to do so may cause the product to fail due to gas permeation.
- Never disassemble or alter the product. Doing so will cause breakage of the product and possible liquid leakage. The use of dangerous chemicals or solvents may cause physical impairment.
- Do not insert screwdrivers, wires, or other objects into the tube. Otherwise, the main body may fail and cause liquids to leak. The use of dangerous chemicals or solvents may cause physical impairment.
- Make sure your piping position does not place any excessive force or bending moment on the main body. Otherwise, the main body may be damaged and cause liquids to leak. The use of dangerous chemicals or solvents may cause physical impairment.

WARNING

- When mounting connector parts, comply with the instructions issued by each connector manufacturer. If the fittings are loosely attached, they may come off or liquids may leak. The use of dangerous chemicals or solvents may cause physical impairment.
- Do not use the product in areas where corrosive gases are being ejected. Otherwise, the body or fitting will corrode and cause liquids to leak. The use of dangerous chemicals or solvents may cause physical impairment.
- Obey these instructions.
 - Refrain from excessive tightening of the connector parts.
 - Do not install the product in areas of excessive vibration or shock.
 - Use the product only within the specified operating environment. Otherwise, the body or fittings will corrode and cause liquids to leak. The use of dangerous chemicals or solvents may cause physical impairment.
- Do not use the product outdoors since it is designed to be installed indoors.

Product Overview	ERL
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The liquid end of the Eddie Flowmeter is made of PFA, therefore it can be used for measuring the flow rate of chemical solutions.

It is light and compact since it doesn't have a display. Parallel piping with narrow intervals is possible and it is suitable for equipment design.

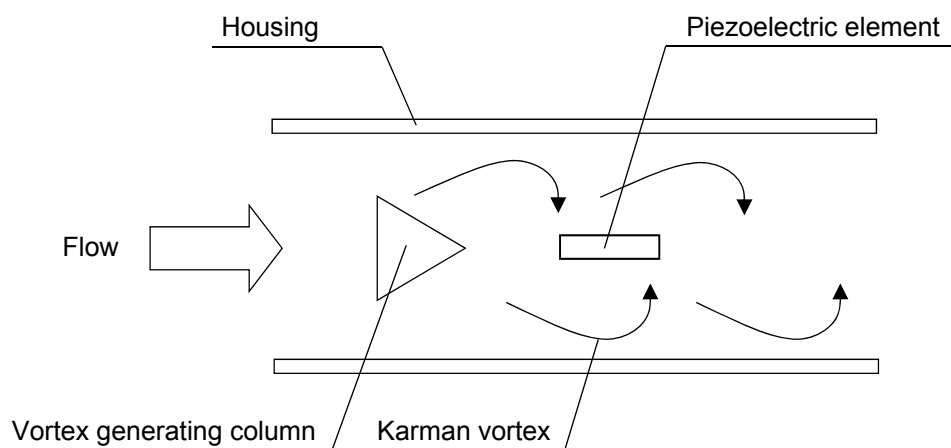
<Principal>

Regular vortex called Karman vortex alternately occurs downstream of the vortex generator placed in the flow. Assuming that the occurrence frequency of the Karman vortex is f , the width of the vortex generator is d , and the flow velocity is v , there is the following relationship between them.

$$f = St \cdot v / d$$

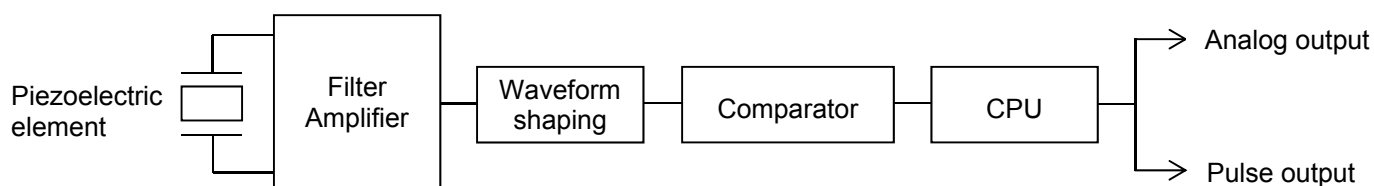
St is a dimensionless number called Strouhal number and is constant depending on the shape of the vortex generator in the range of constant Reynolds number. Therefore, v is determined by measuring the occurrence frequency f , and the volume flow rate can be calculated from v .

In this flowmeter, the piezoelectric element is attached to the downstream of the vortex generation column as shown below. The flow rate can be measured by detecting the change of the voltage of the piezoelectric element applied by the generated Karman vortex.



Principle of measurement

<Schematic diagram>



Schematic diagram

Specification

Model		ERL-6	ERL-10	ERL-10H	ERL-15
Applicable Fluid		Fluid which does not corrode or permeate fluoroplastic (excluding ozone)			
Flow range ^(*1)		0.3 to 2.5L/min (at 1×10 ⁻⁶ m ² /s)	0.4 to 4L/min (at 1×10 ⁻⁶ m ² /s)	0.4 to 7L/min (at 1×10 ⁻⁶ m ² /s)	2 to 16L/min (at 1×10 ⁻⁶ m ² /s)
Measurement Accuracy (^{*2})		±2%F.S. (DI Water at 25°C)			
Ambient humidity		5 to 80%RH (no condensation)			
Ambient temperature		15 to 60°C			
Fluid temperature		15 to 85°C			
Fluid pressure ^(*3)		Max.800kPa (at 25°C)			
Connection tube diameter		φ1/4” (φ6.35×φ3.95)	φ3/8” (φ9.53×φ6.35)		φ1/2” (φ12.7×φ9.53)
Material of wetted parts		PFA			
Direction of installation		Horizontal, vertical, diagonal			
Analog output	Output	DC 4 to 20mA			
	Response time	Approx. 2s			
	Load resistance	500Ω or below			
Pulse output	Output	NPN open collector			
	Applied voltage/current	Max.DC30V/80mA			
	Pulse unit	10mL/P			
	Pulse width	5ms			
Power supply voltage		DC 24V±10%			
Current consumption		110mA or below			
Standard cable length		2m			



Do not use the product under conditions that cause sudden change in fluid temperature because the product will be damaged.



Abnormal output may result if the pressure in the piping becomes non-pressurized state with water flow stopped.
To prevent this, be sure to apply 100kPa or higher pressure if the water flow is stopped.

*1 Flow range

Liquid kinematic viscosity [$\times 10^{-6} \text{m}^2/\text{s}$]	1	2	3	4	5	6	7	8	9	Maximum flow [L/min]
Minimum flow of ERL-6 [L/min]	0.3	0.6	0.9	1.2	1.5	1.8	2.1	2.4	—	2.5
Minimum flow of ERL-10 [L/min]	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4.0
Minimum flow of ERL-10H [L/min]	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	7.0
Minimum flow of ERL-15 [L/min]	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0	—	16.0

Note: Each minimum value with liquid kinematic viscosity equal to or greater than 2 [$\times 10^{-6} \text{m}^2/\text{s}$] is a theoretical value, and may be different from the actual flow rate.

*2 Precision

Because, the measurement unit of this flow gauge is made of PFA resin, the inner diameter dimension of the pipeline of the measuring unit changes due to the change in the measured liquid temperature causing a slight change in the flow rate measurement characteristics.

If the liquid temperature exceeds 50°C, and the specification precision is required, correct the flow meter output with the following formula.

$$\text{Actual flow rate during use} = a(I-4) \times \{1 + (0.0006 \times (T-25))\}$$

T : Liquid temperature during use [°C]

I : Flow meter current output [mA]

a : Coefficient

Model	Coefficient (a)
ERL-6	0.15625
ERL-10	0.25
ERL-10H	0.4375
ERL-15	1

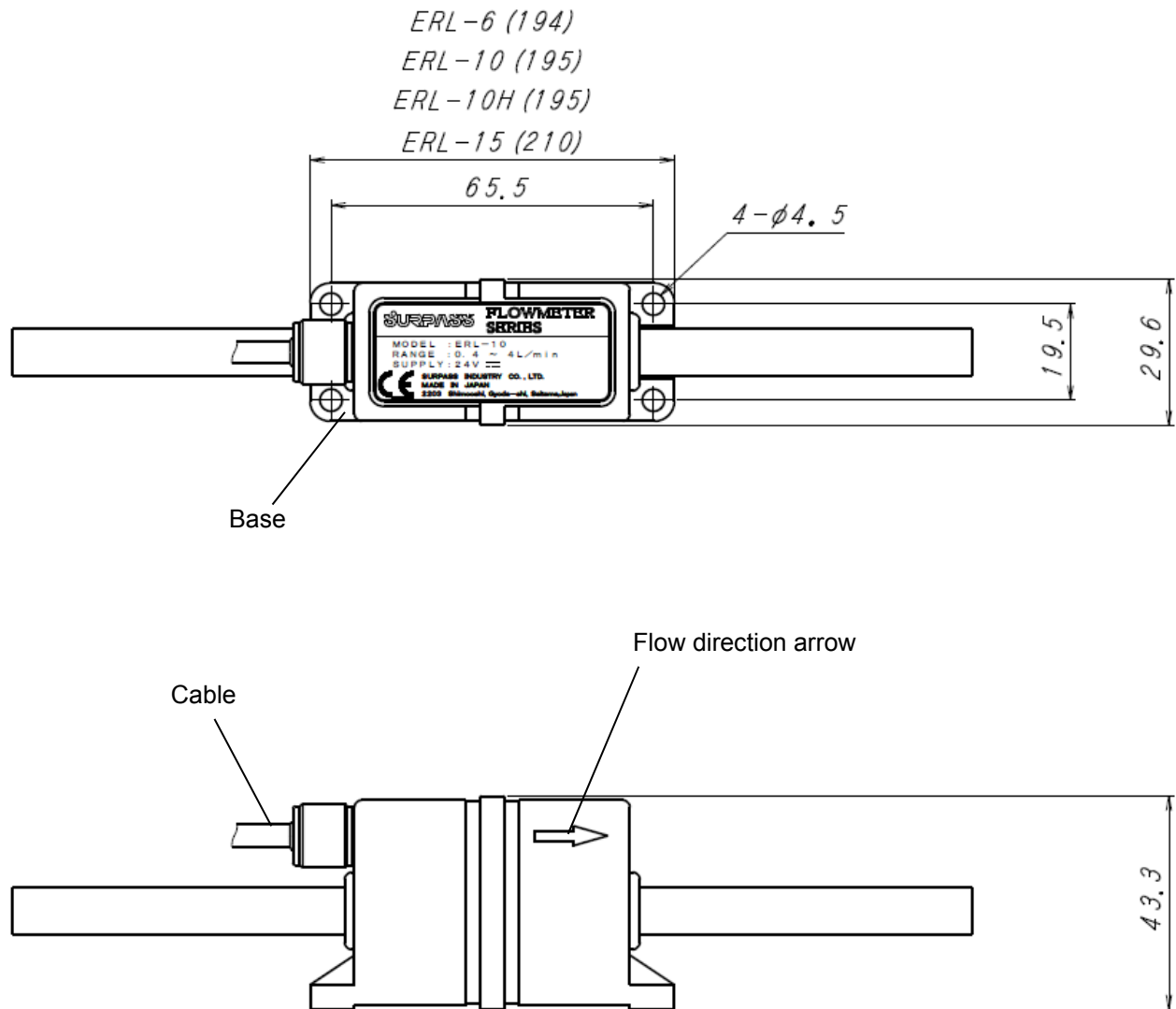
*3 Used liquid pressure

The maximum available pressure varies with the liquid temperature. Please determine from the following formula.

$$\text{Used maximum pressure} = 800 \times \{1 - ((T-25) \times 0.0043)\} \text{ [kPa]}$$

T : Liquid temperature during use [°C]

Eternal dimensions



Installation instructions and fitting connections

If you wish to anchor the flowmeter, always use the mounting holes in the base.

In order to install the fitting correctly, always refer to the catalog or operation manual provided by the fitting manufacturer.

Warning

- Check the flow direction indicated at the side of the flowmeter main body (IN-->OUT). If the flowmeter is piped incorrectly, the main body may be damaged and cause liquids to leak. It may cause physical impairment when dangerous chemicals or solvents are used.
- Align the piping axis before and after the flowmeter before the attachment so that excess force is not applied to the flowmeter. Otherwise, the main body may be damaged and cause liquids to leak. It may cause physical impairment when dangerous chemicals or solvents are used.
- Use tubing of a designated size. Using a tube of different size may cause liquid leakage. It may cause physical impairment when dangerous chemicals or solvents are used.
- When mounting fittings, comply with the instructions issued by each fitting manufacturer. If the fittings are loosely attached, they may come off or cause liquids to leak. The use of dangerous chemicals or solvents may cause physical impairment.
- Do not excessively tighten the fitting. Otherwise, the body or connectors may corrode and cause liquids to leak. The use of dangerous chemicals or solvents may cause physical impairment.

Caution

- Error may result when the internal diameter of the piping before and after the flowmeter is smaller than that of flowmeter.
- Be sure to bleed the piping before using the product. Incorrect flow rate may be indicated when there is any air.
- When there are air bubbles in the liquid, bubbles may remain in the Karman vortex generating section inside the main body, preventing accurate measurement.

- The product may be installed horizontally, vertically and diagonally. However in any cases, always fill the piping with liquid.
- Provide a straight pipe section at the front and back of the flowmeter. The length of the upstream straight pipe should be at least 7 times the inner diameter and the length of the downstream straight pipe shall be at least 5 times the inner diameter.

<About downstream pressure >

In order to prevent cavitation (*4), the pressure on the downstream side pressure of the flowmeter should be no less than the pressure obtained from the following formula.

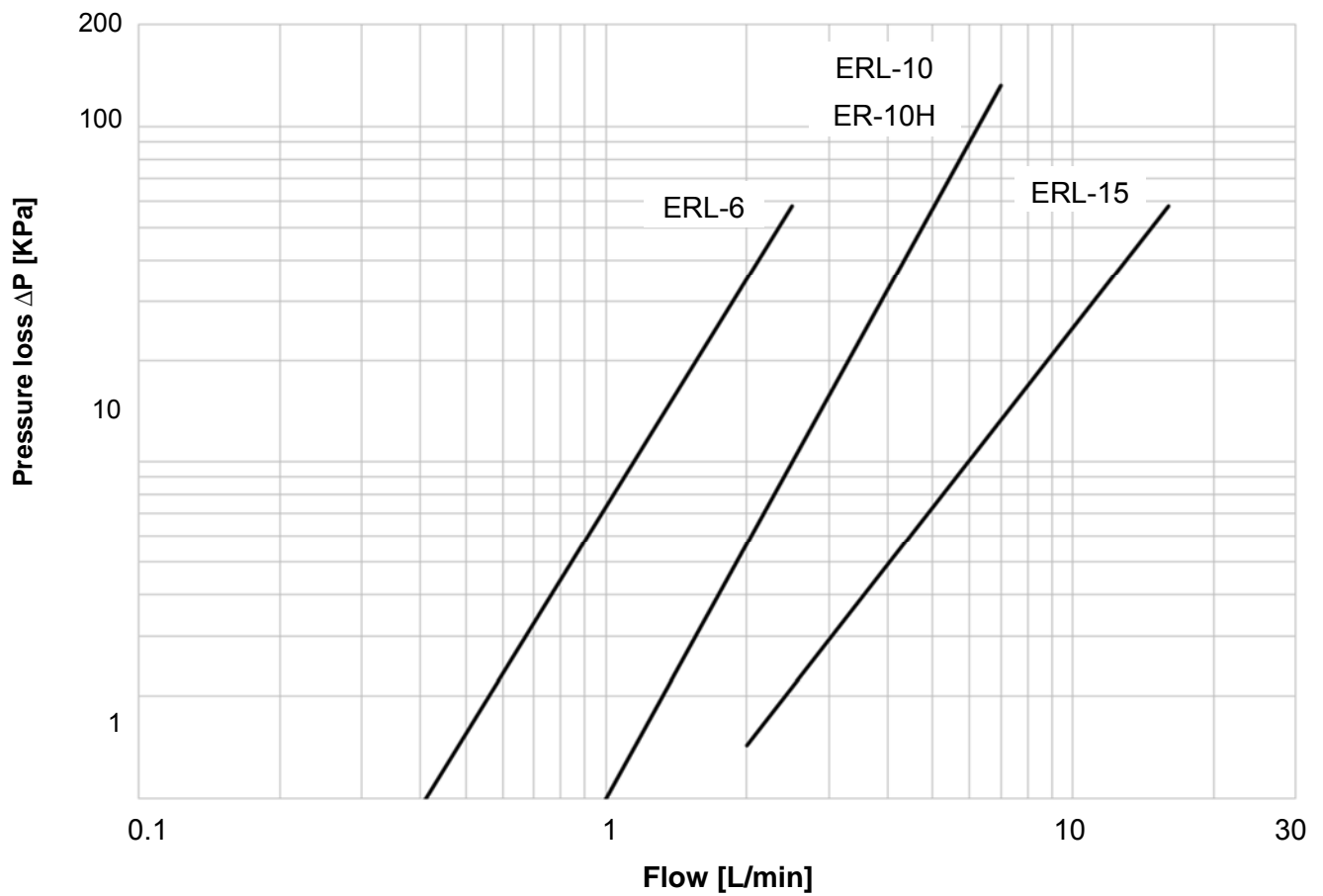
$$P_d = 2.7\Delta P + 1.3P_0$$

P_d : Downstream pressure [KPa]

ΔP : Pressure loss [KPa]

P_0 : Liquid vapor pressure [KPa abs]

<Pressure Loss>

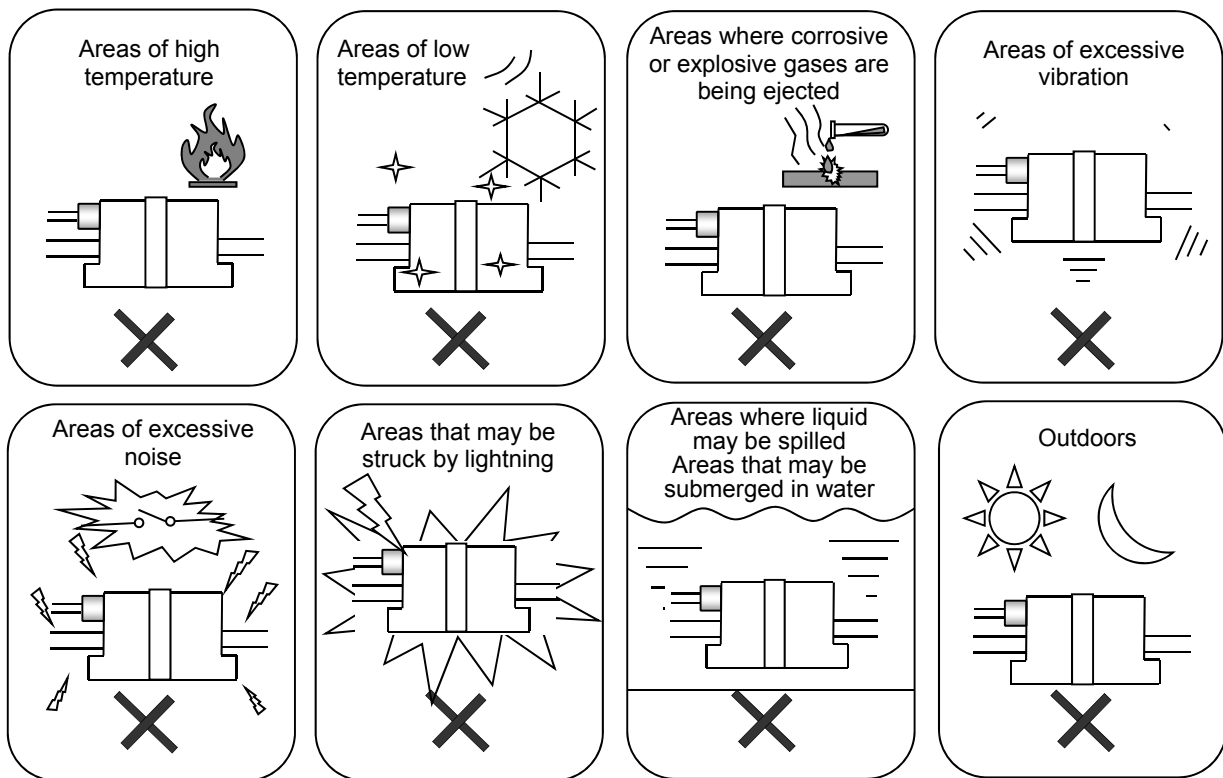


*4 About cavitation

When liquid pressure drops below saturated vapor pressure, liquid evaporates and bubbles occur.

Points to Observe When Installing

To prevent erroneous operation or premature wear, do not install in:



- Measurement may be impossible with a gas-liquid two-phase flow or a flow containing air bubbles.
- Install the product so that air bubbles do not enter or gather in the flowmeter main body.
- Please do not use this product with slurry liquid or liquids containing foreign substances. It will lead to performance deterioration.
- Do not install a heat exchanger etc. in the immediate upstream of the flowmeter. Measurement may become impossible when the liquid temperature fluctuates drastically. Move the heat exchanger etc. away so as to reduce the temperature fluctuation.
- Do not install the product in areas where temperature gradient or temperature fluctuation is large if possible.
- If the pulsation is large such as in bellows pump, errors may occur. Reduce the pulsation by, for example, using a damper.
- Install the product in the place where you can easily check or pipe.
- Route cables by avoiding noise sources such as motor with high capacity, transformer, power source, and high voltage or high current source. Otherwise, it may cause a malfunction due to induction.

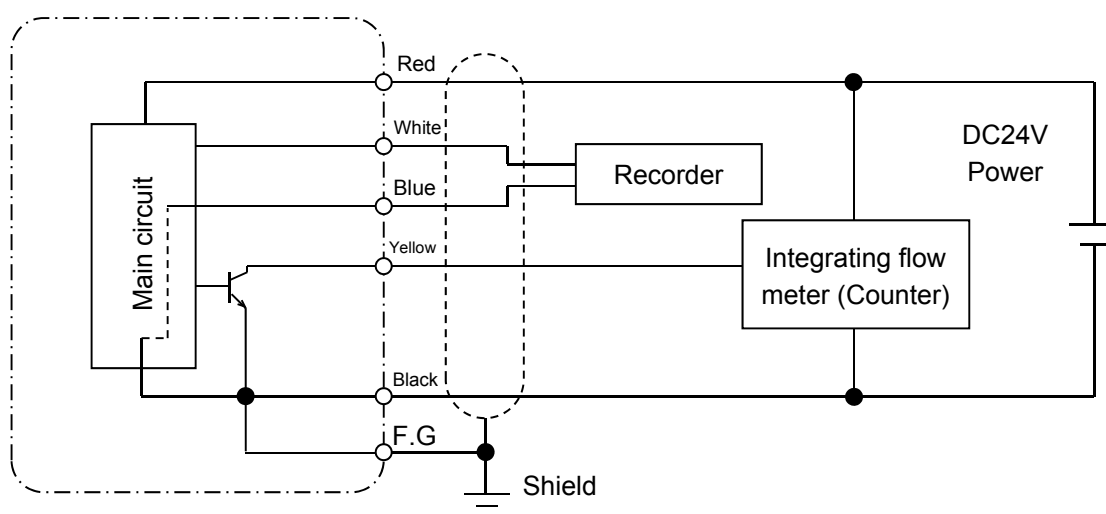
Wiring

Observe these precautions to connect the leads correctly.

Caution

- Never do wiring work when power supply is on. Doing so may cause electrical shock.
- Do not excessively pull or bend the cables. Doing so may cause disconnections which may cause electrical shock and fire hazards.
- Make sure to connect all leads correctly. Failure to do so may cause the product to fail.
- Do not energize higher than the usage range. Otherwise, smoke and/or fire may be caused.
- Do not apply voltage or current greater than the capacity to the pulse output (open collector output) because it may be damaged.

Wiring diagram



* Black, blue cable and FG are connected inside the circuit.

Signal Name	Line Color
24V DC power supply	Red
0V power supply	Black
4 to 20mA output (+)	White
4 to 20mA output (-)	Blue
Pulse output (+)	Yellow

<Power connection>

Connect the product to the DC24V power supply. Warm up the equipment for at least 20 minutes after turning on the power in order to achieve the specified precision.

<Analog Output>

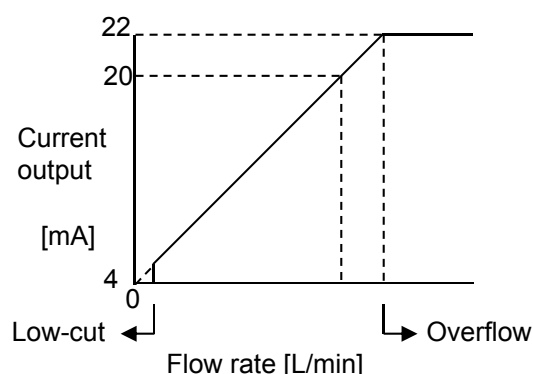
Connect the load resistor between 4 and 20mA output (+) and 4 and 20mA output (-). Load resistance is 500Ω or less.

<Pulse Output >

The pulse output is an NPN open collector output. Connect the load resistor between the pulse output (+) and the power supply (24V). Here is an example of load resistance:

Example)	Load resistance	1kΩ	1W
		10kΩ	1/4W

< Analog output for the flow rate >



- Analog output is proportional to the increase of flow rate.

Current output[mA]		4	20
Flow rate [L/min]	ERL-6	0	2.5
	ERL-10	0	4
	ERL-10H	0	7
	ERL-15	0	16

*The flow rate is subject to low-cut at the following value.

<Low cut range>

ERL-6, ERL-10, ERL-10H	Lower than 0.2 L/min
ERL-15	Lower than 1.8 L/min

- In the case of low-cut, the current at the time of maximum flow rate is output.

<Overflow range>

ERL-6	2.8 L/min or higher
ERL-10	4.5 L/min or higher
ERL-10H	7.8 L/min or higher
ERL-15	18 L/min or higher

Maintenance / Inspections

The flowmeter should be inspected regularly, about twice a year depending on the usage.

Items to check during periodic inspection

- External appearance
- Corrosion, clogging, or leakage at the fitting connection

<Cautions during Maintenance / Inspection>

⚠ DANGER Be sure to observe the following!

- If using dangerous chemicals or solvent etc., make sure to wear protective, chemical resistant gear (protective gloves, mask, and clothing) to protect your entire body. Ejected liquids may result in physical impairment.
- Before disconnecting this product from the piping system, make sure the line is depressurized. Otherwise, the fluid inside will eject and may result in physical impairment.
- When replacing parts, or when performing maintenance or inspection, turn off the switch, and release the fluid inside the piping to depressurize the line. Otherwise, the fluid inside will eject and may result in physical impairment.

Storage

When storing the product, make sure to store it in the place meeting the following conditions.

- No rain or water ingress
- No vibration or impact
- Temperature range is 5 to 60°C, humidity 5 to 80%RH (no condensation)
- No dust
- No direct sunlight

Check points in the case of possible breakdowns

Symptom	Cause	Action
No output is given when there is a flow	Incorrect wiring	Check the wiring diagram and correct the wiring.
	Incompatible power, voltage	Check the power supply and voltage.
	Piping is not filled with fluid	Fill the piping with fluid.
	Flow out of range	Check the specification and choose an appropriate product.
Output is given when there is no flow	Piping is not filled with fluid	Fill the piping with fluid.
	There was a high pulsation and the fluid in the piping is shaking	Reduce the pulsation by such as using a dumper so that the fluid in the piping does not shake.
Output error is large	Incompatible power, voltage	Check the power supply and voltage.
	Load resistance is not appropriate	Load resistance value must be 500Ω or less.
	There is noise-generating equipment nearby	Move the noise-generating equipment from the vicinity.
	There is something that disturbs the flow in immediate upstream	Move the position of the flowmeter. (Maintain prescribed straight pipe length) Upstream: At least 7 times the inner diameter Downstream: At least 5 times the inner diameter
	Cavitation is occurring	Ensure the specified line pressure to avoid cavitation.
	There are air bubbles in the fluid	Pipe the line so that bubbles do not enter.
	Foreign matter is sticking to the vortex generator or the piezoelectric element	Remove the sticking foreign matter.

Notify your nearest sales office for problems not listed above.

Regarding the Warranty

This product has been submitted to strict tests and inspections prior to delivery, and is covered with a free-repair guarantee for the period of one year from date of product delivery. During this period, SURPASS INDUSTRY CO., LTD. will provide free repair service for all breakdowns, which we recognize as designer/manufacturer's responsibility.

We are not responsible for the compensation of any direct or indirect loss or damages, personal injuries or any other issues resulting from the usage of the SURPASS INDUSTRY CO., LTD. product alone or in combination with other products, beyond the product's specification conditions. The SURPASS INDUSTRY CO., LTD. warranty's compensation is limited to the replacement of products.

However, the warranty is voided (i.e. the customer pays for repairs) in case of the following.

- Breakdown or damage caused by product handling or usage that does not comply with the product's operation manual.
- Breakdown or damage caused by careless handling or usage of the product.
- Breakdown or damage caused by disassembly or alteration, or inappropriate adjustment or repair of the product.
- Breakdown or damage caused by natural disasters or other acts of God.
- Replacement of consumable articles or accessories.

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