Instruction Manual

ULTRASONIC FLOWMETER DETECTOR

TYPE: FSG (Detector)
FLY (Signal cable)

Fuji Electric Co., Ltd.

INF-TN1FSGb-E

PREFACE

We thank you very much for purchasing Fuji's ultrasonic flowmeter.
The instruction manual concerns the installation, operation, checkup and maintenance of the Detector (FSG) of ultrasonic flowmeter. Read it carefully before operation.

- Before using, be sure to read this instruction manual carefully to ensure correct installation, operation and maintenance of the flowmeter. Note that incorrect handling may lead to trouble or personal injury.
- The specifications of this flowmeter are subject to change for improvement without prior notice.
- Do not attempt to modify the flowmeter without permission. Fuji is not responsible for any trouble caused by modification without permission. If it becomes necessary to modify the flowmeter, contact our office in advance.
- This instruction manual should always be kept on hand by the operator.
- After reading, be sure to keep this manual in a place where it can easily be seen by the operator.
- Make sure that this manual is presented to the end user.
- If the instruction manual has been lost, request another one (with charge) to our local business office.

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SAFETY PRECAUTION

Before using, read the following safety precaution to ensure correct handling of the flowmeter.

- The following items are important for safe operation and must be fully observed. These items are classified into "DANGER" and "CAUTION".

Warning & Symbol	Meaning
⚠ DANGER	Incorrect handling may lead to a risk of death or heavy injury.
⚠ CAUTION	Incorrect handling may lead to a risk of medium or light injury, or to a risk of physical damage.

- The items noted under "⚠ **CAUTION**" may also result in serious trouble depending on circumstances.
- All the items are important and must be fully observed.

Caution on Installation and Piping	
⚠ DANGER	● This product has not an explosion-proof structure. Do not use it in a place with explosive gases, otherwise, it can result in serious accidents such as explosion, fire, etc.
⚠ CAUTION	● The unit should be installed in a place conforming with the installation requirements noted in this instruction manual. Installation in an improper location may lead to a risk of electric shocks, fire, malfunction, etc. ● The unit should be installed as noted in the manual. Improper installation will cause falling, trouble or malfunction of the unit. ● During installation, make sure that the inside of the unit is free from cable chips and other foreign objects to prevent fire, trouble, malfunction, etc. ● The items under "Caution on Installation" noted in the manual must be fully observed; careless installation may result in trouble or malfunction of the unit.

Caution on Wiring	
⚠ CAUTION	● Before performing the wiring work, be sure to turn OFF the main power to prevent electric shocks. ● Do not perform wiring work outdoors in rainy days to prevent insulation deterioration and dew condensation; otherwise, it can result in trouble, malfunction, etc. ● The unit must be earthed as specified to prevent electric shocks or malfunction. ● The analog output signal cable should be wired as far away as possible from high-voltage lines to prevent entry of noise signals as it will cause malfunction of the unit. ● To prevent malfunction of the unit, the analog output signal cable and power cable should be wired using separate conduits.

Caution on Maintenance/Inspection	
⚠ CAUTION	● The unit should be inspected everyday to always obtain good results of measurements. ● When measuring the insulation resistance between the signal cable and the detector, follow “Section 4.2.3 How to measure the insulation resistance” described in this manual.

CAUTION ON INSTALLATION LOCATION

⚠ CAUTION

(1) Sufficient space for daily inspection, wiring, etc.
(2) A place not exposed to direct sunshine nor weathering.
(3) Isolation from vibration, dust and moisture
(4) A place not subjected to radiated heat from a heating furnace etc.
(5) A place not subjected to corrosive atmosphere
(6) A place not to be submerged
(7) A place remote from electrical devices (motor, transformer, etc.) which generate electromagnetic induction noise, electrostatic noise, etc.
(8) A place not subjected to excessive fluid pulsation (pump discharge side)
(9) A place that provides enough place for the length of the straight pipe.
(10) A place where ambient temperature and humidity are –20 to +60°C and 95% RH or less.

CONTENTS

1. PRODUCT OUTLINE

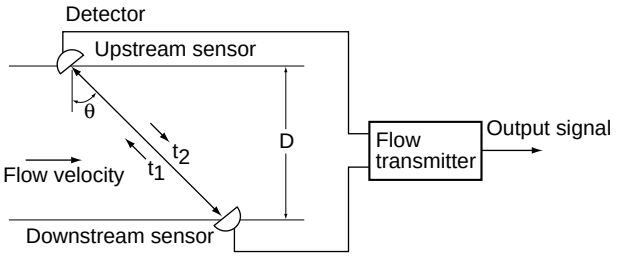
1.1. Outline

This detector is for clamp-on type ultrasonic flowmeters whose measurement principle is propagation time difference method. The flowmeter is ideal for clean liquids containing no air bubbles such as pure water. The easy-to-use compact and lightweight design is intended for integration into mechanical devices. Our detectors provide superior cost performance since they can be applied to the piping with bores ranging from 50 to 6,000 mm.

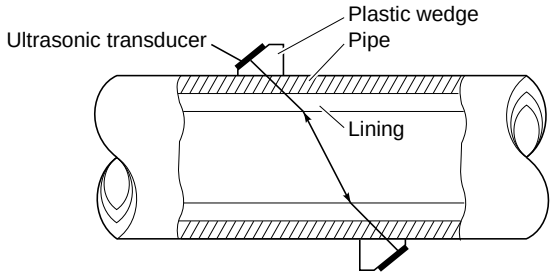
1.1.1. Measuring principle

Measuring principle

Ultrasonic pulses are propagated aslant from the upstream and downstream sides, and the time difference caused by the flow is detected to measure the flow rate.



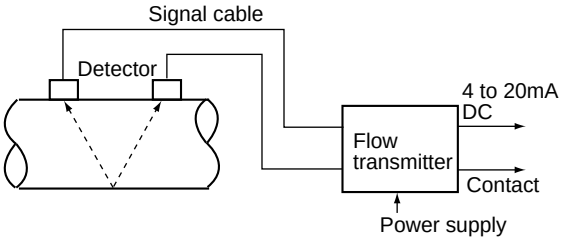
Mounting the detector



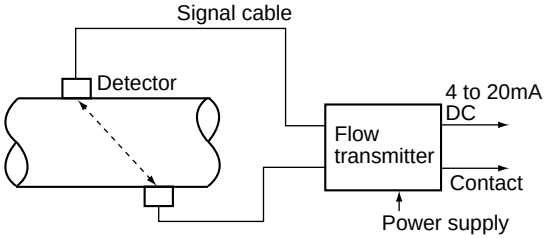
Note：It is an essential condition that the lining adheres tightly to the piping.

Configuration diagram

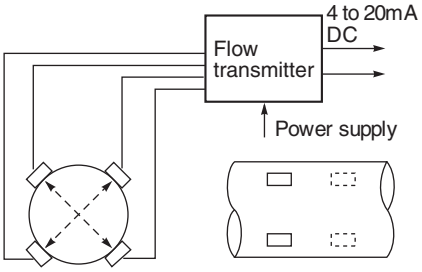
(1) Single-path system (V method)



(2) Single-path system (Z method)



(3) 2-path system



1.2. Checking the received products

- Detector (FSGS31,FSGS32)
  - Small size detector ····· 1 set
  - Chain ····· 1 set (2 pcs)
- Detector (FSGS41)
  - Middle size detector ····· 1 set
  - Wire rope ····· 1 set (2 pcs)
  - Mounting spring ····· 1 set (2 pcs)
- Detector (FSGS50,FSGS51)
  - Large size detector ····· 1 set (2 pcs)
  - Wire rope ····· 1 set (2 pcs)
  - Mounting spring ····· 1 set (2 pcs)
  - Detector installation set ····· 1 set
- Signal cable (FLY: length designated) ····· 1 set (2 pcs)

Detector (FSGS31, FSGS32)
Small size detector

Chain

Detector (FSGS41)
Middle size detector

Wire rope

Mounting spring

Detector (FSGS50, FSGS51)
Large size detector

Wire rope

Mounting spring

Signal cable (FLY) Note 2

Acoustic coupler

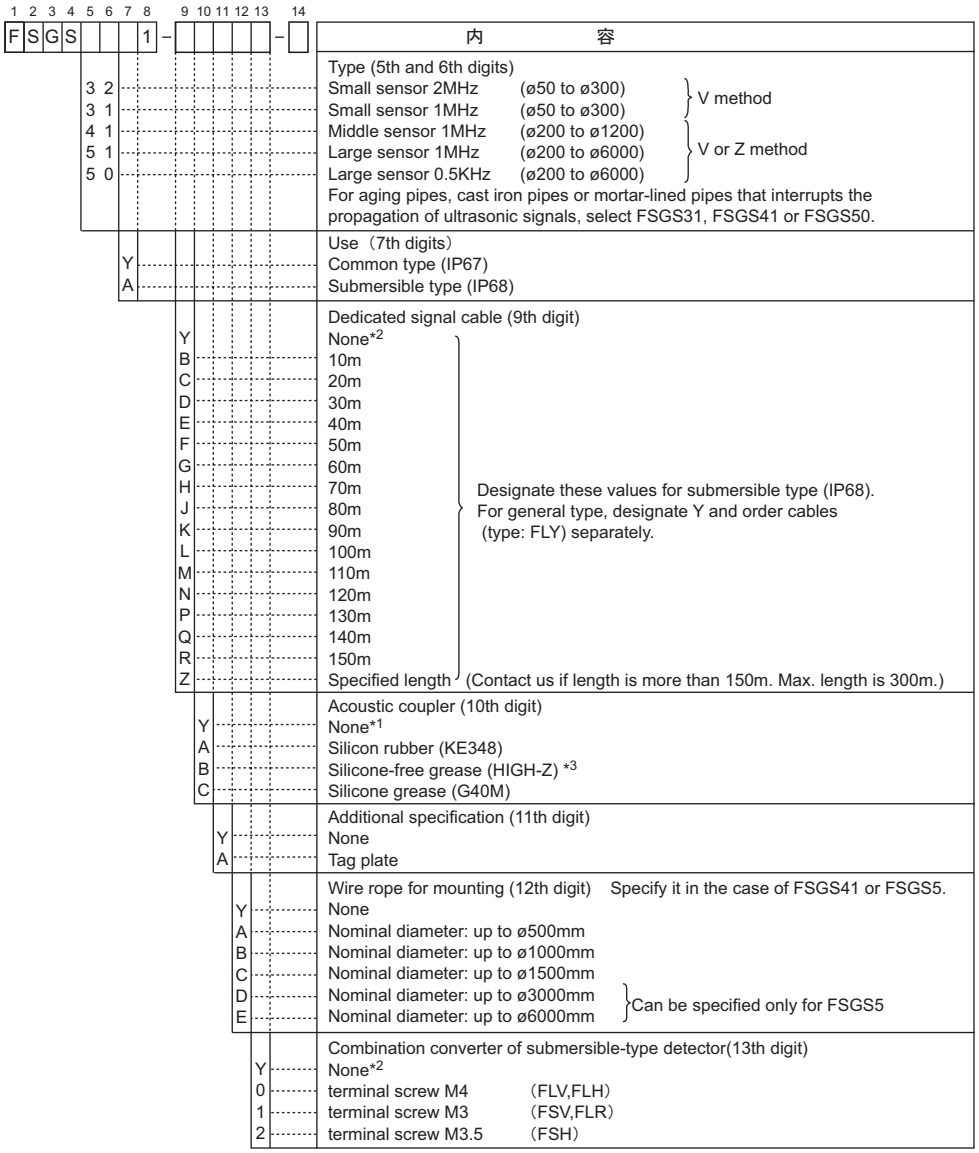
Detector installation set

Note 1) Silicone rubber (100 g) is a standard attached article for common type (IP67).
Note 2) Signal cable: Common type (IP67)····· We deliver the signal cable ordered separately.
Submersible type (IP68) ····· We deliver the signal cable attached to the detector.

1.3. Check on type and specification

Type and specification are described on the specification name plate attached to the detector frame. Make sure the types are as ordered referring to the type diagrams given below.

< Detector (FSG)>

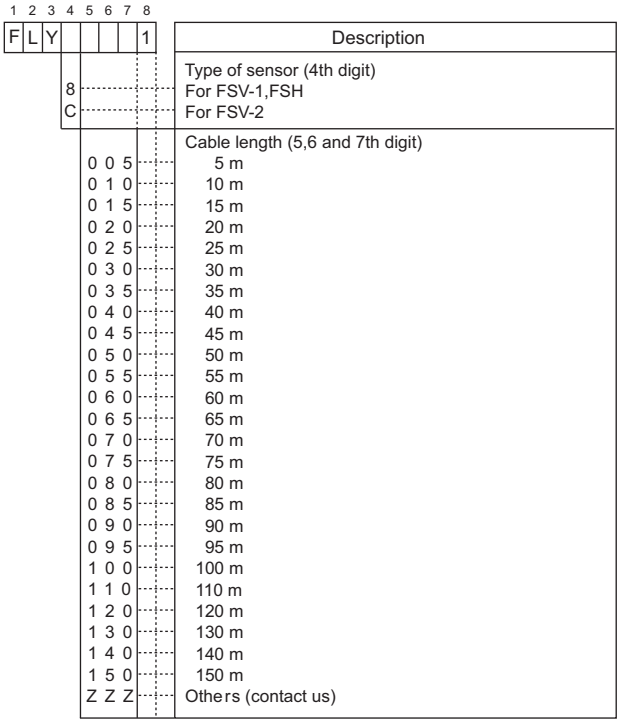


*1 : Silicone rubber (100 g, KE348W) for wiring mold is a standard attached article for common type (IP67).

*2 : If the 7th digit is “Y,” select “Y.”

*3 : Use silicone-free grease for the environments such as those with a semiconductor manufacturing facility, on which silicone has an adverse effect. Since this grease is soluble, it cannot be used for the environments exposed to water or in which condensation may occur on the piping surface. Perform periodical maintenance since this grease does not harden. (Perform cleaning and replenish grease about every six months in the case of use at room temperature.)

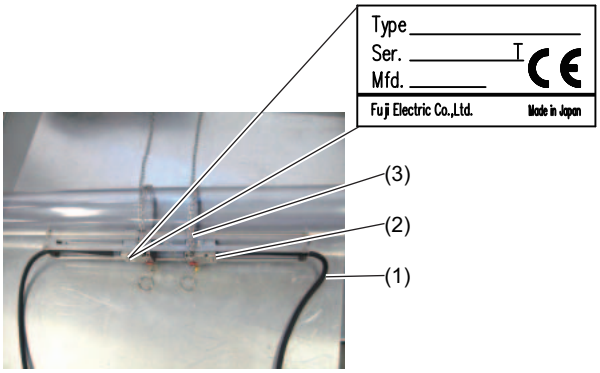
< Signal cable (FLY)>



1 2 3 4 5 6 7 8	Description
F L Y _ _ _ _ 1	
8	Type of sensor (4th digit) For FSV-1,FSH
C	For FSV-2
	Cable length (5,6 and 7th digit)
0 0 5	5 m
0 1 0	10 m
0 1 5	15 m
0 2 0	20 m
0 2 5	25 m
0 3 0	30 m
0 3 5	35 m
0 4 0	40 m
0 4 5	45 m
0 5 0	50 m
0 5 5	55 m
0 6 0	60 m
0 6 5	65 m
0 7 0	70 m
0 7 5	75 m
0 8 0	80 m
0 8 5	85 m
0 9 0	90 m
0 9 5	95 m
1 0 0	100 m
1 1 0	110 m
1 2 0	120 m
1 3 0	130 m
1 4 0	140 m
1 5 0	150 m
Z Z Z	Others (contact us)

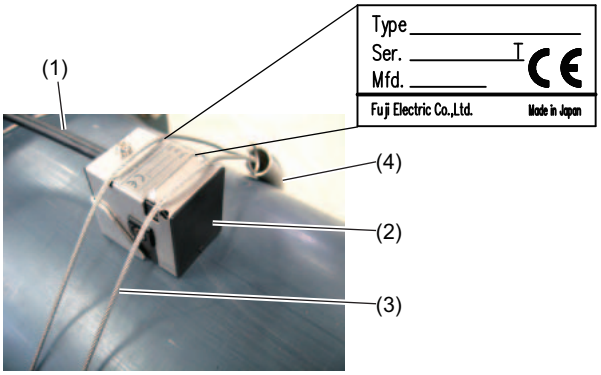
1.4. Names and functions of each part

1.4.1. Small size detector (FSGS3)



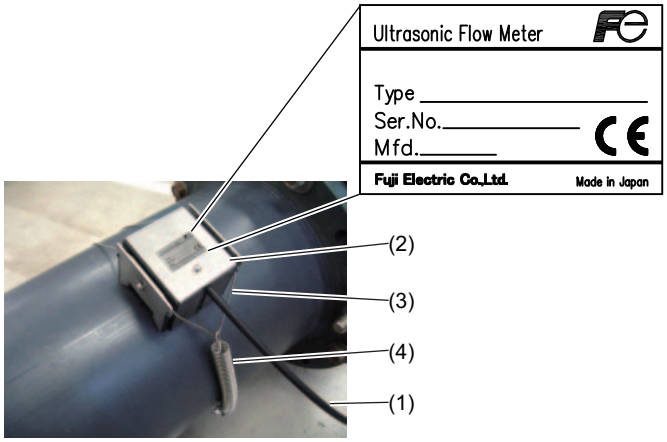
No.	Name	Description
(1)	Signal cable	Transmits the send/receive signals.
(2)	Small size detector	Sends and receives an ultrasonic wave.
(3)	Chain	Fastens the detector on pipe.

1.4.2. Middle size detector (FSGS41)



No.	Name	Description
(1)	Signal cable	Transmits the send/receive signals.
(2)	Middle size detector	Sends and receives an ultrasonic wave.
(3)	Wire rope	Fastens the detector on pipe.
(4)	Mounting spring	Removes the play of wire rope.

1.4.3. Large size detector (FSGS5)



No.	Name	Description
(1)	Signal cable	Transmits the send/receive signals.
(2)	Large size detector	Sends and receives an ultrasonic wave.
(3)	Wire rope	Fastens the detector on pipe.
(4)	Mounting spring	Removes the play of wire rope.

2. SELECTION OF INSTALLATION PLACE

Select an installation place taking into account the following matters from the viewpoint of easiness of maintenance and checkup, instrument life and securing the reliability.

⚠ CAUTION

(1) Sufficient space for daily inspection, wiring, etc.
(2) A place not exposed to direct sunshine nor weathering.
(3) A place not exposed to much vibration, dust, dirt, humidity, salinity, or iron.
(4) A place not subjected to radiated heat from a heating furnace etc.
(5) A place not subjected to corrosive atmosphere.
(6) A place not to be submerged
(7) A place remote from electrical devices (motor, transformer, etc.) which generate electromagnetic induction noise, electrostatic noise, etc.
(8) A place not subjected to excessive fluid pulsation (pump discharge side)
(9) A place that provides enough place for the length of the straight pipe.
(10) A place where ambient temperature and humidity are –20 to +60°C and 95% RH or less.

2.1. Installation space

Detector mounting location, i.e., the conditions of the pipe subjected to flow rate measurement exert a great influence on measurement accuracy. So select a location meeting the conditions listed below.

(1) Straight piping greater than 10D must exist on the upstream side and greater than 5D on the downstream side.
(2) Elements (pump, valve, etc) on the upstream side must be greater than 30D away to prevent disturbances.
(3) The piping must be filled with fluid free from air bubbles and foreign objects.
(4) There is an ample maintenance space around the pipe to which the detector is to be mounted (see Fig. 2-1).
Note) A space should be provided so that maintenance work can be made with workers standing on both sides of the piping.

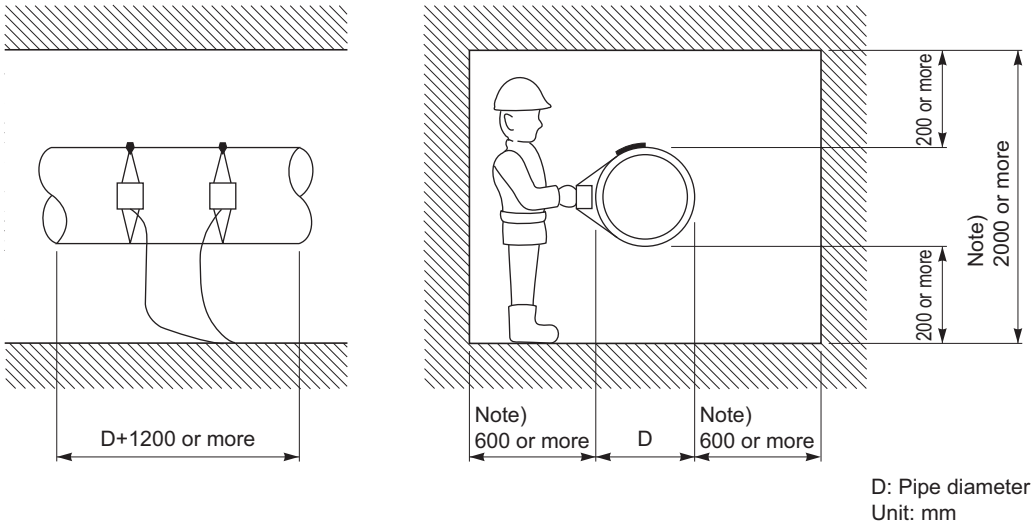
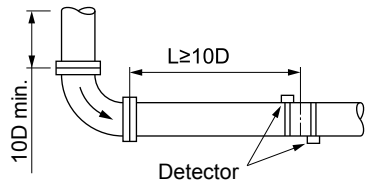
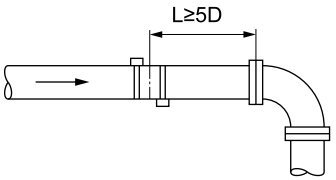
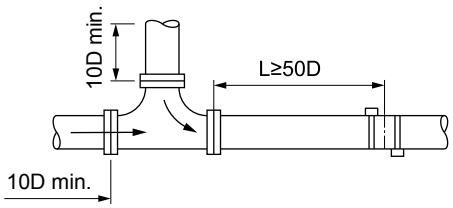
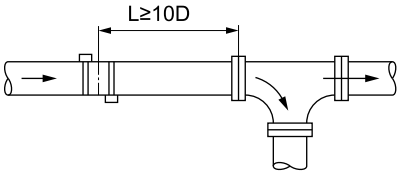
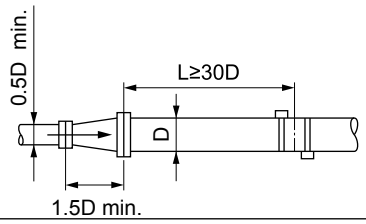
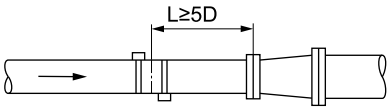
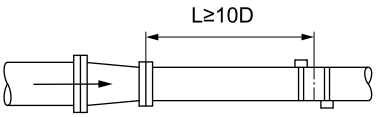
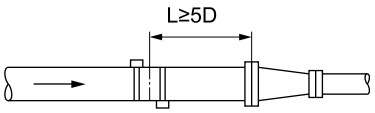
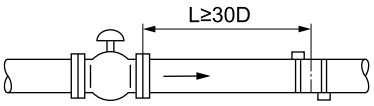
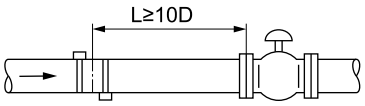
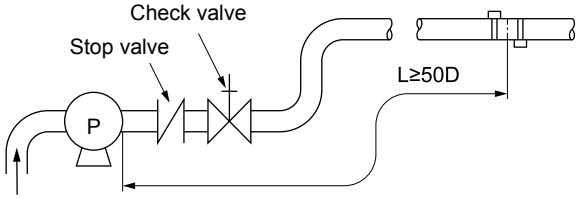


Fig. 2-1 Necessary space for detector mounting position

2.2. Length of straight pipe

The length of upstream and downstream straight pipe of the ultrasonic detector should be long enough to ensure accurate measurements.

(D: Nominal diameter of pipe)

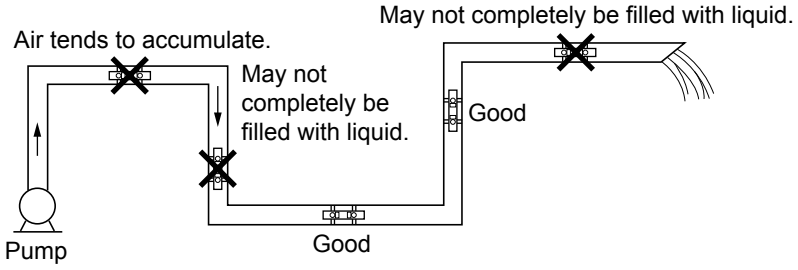
Name	Straight length of upstream piping	Straight length of downstream piping
90□ bend		
Tee		
Diffuser		
Reducer		
Valve	 Flow controlled upstream	 Flow controlled downstream
Pump		

Note: Quoted from JEMIS-032

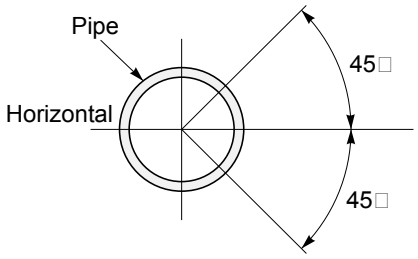
2.3. Mounting position

The detector can be installed vertical, horizontal or at any posture provided that attention is paid to the following things.

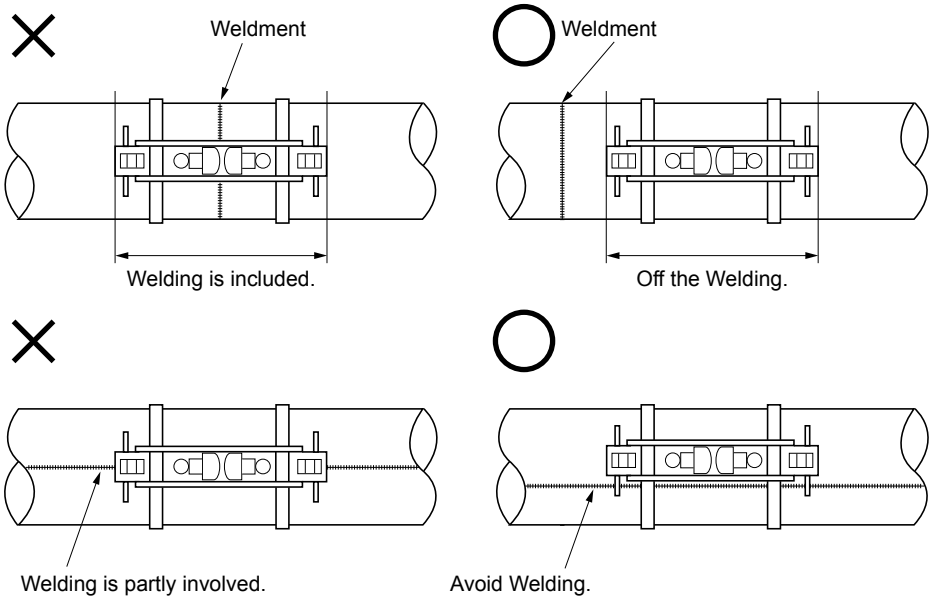
(1) The measuring pipe should always fill with fluid which flows in the piping.



(2) In case of horizontal piping, mount the detector within ±45° from the horizontal plane. Otherwise, the measurement could be impossible if bubbles stay in the upper part of piping or if deposits are accumulated in the lower part of piping. In case of vertical piping, the detector may be mounted at any position on its periphery provided that the flow is upward.



(3) Do not mount the detector on a distorted part, flange or welding.



3. INSTALLATION AND PROCEDURE PRIOR TO RUNNING

3.1. Outline of installation procedure

(1) Set the piping parameters, and calculate the sensor unit spacing (* if with parameter setting, check the sensor unit spacing).
(2) Check the condition of the surface to which the detector is mounted. (If the surface is rough, grind it.)
(3) Install the detector in the measuring piping.
(4) Adjust zero point.
(5) Start a measurement.

3.1.1. Installation procedure of the detector

Follow the procedure below for the process before starting measurement.

Type	Reference section	Work item	Description
All types	3.1.2	Installation pitch calculation	(1) Input piping information into the converter and perform calculation. (2) Calculate from our website.
All types	3.3.1	Checking of detector mounting method	Checking of V/Z method, piping bore, and detector.
All types	3.3.2	Processing of detector mounting surface	Checking of the piping surface to which the detector is mounted.
FSGS41 FSGS50,51	3.3.2	Determination of mounting position	In mounting by the Z method, prepare the paper gauge, and wrap it around the pipe, and put a mark on the sensor mounting position.
All types	3.3.3	Selection of acoustic coupler	Select silicone rubber or silicone grease depending on the intended use.
All types	3.3.4	Cable termination	Perform this operation if adjusting the length of the signal cable.
FSGS31,32,41 FSGS50,51	3.4.1 3.5.1	Connection of signal cable	Connect the signal cable to the detector.
FSGS31,32	3.4.2	Assembly of detector	Install the sensor in the frame.
FSGS31,32 FSG41 FSGS50,51	3.4.3 3.4.4 3.5.2	Mounting method on the pipe	Apply the acoustic coupler to the detector and install it in the piping. Connect the sensor cable to the converter.
All types	3.6	Confirmation of received signal	Check the received signal.
All types	—	Adjust zero point.	Adjust the zero point depending on the condition of the converter.
All types	—	Start a measurement.	Make a measurement depending on the condition of the converter.

3.1.2. Sensor mounting dimensions

For sensor spacing, select either of method in advance.

・Calculate from flow transmitter

Turn ON the flow transmitter.

Input information on piping and the like described in the instruction manual of the converter and display it.

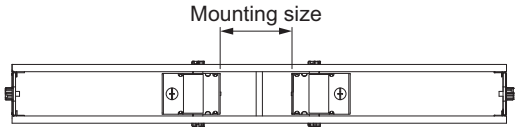
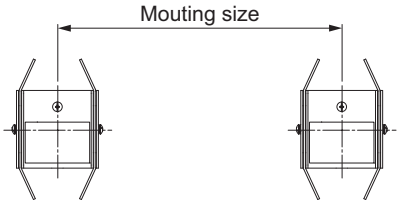
Display example: PROCESS SETTING S= 48mm

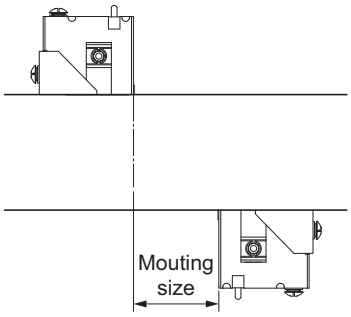
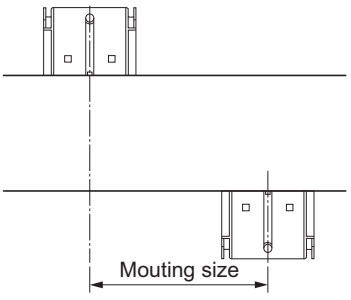
・During wiring work, be sure to turn the power off.

・Calculate from our website.

URL http://www.fujielectric.com/products/instruments/

3.1.3. Image figure of mounting dimension

Typel	FSGS31,32	FSGS50,51
Mounting method	V method	V method
Explanation drawing		

Type	FSGS41	FSGS50, 51
Mounting method	Z method	Z method
Explanation drawing		

3.2. Selection of mounting method

3.2.1. Outline of detector installation procedure

(1) Selection of detector mounting method
(2) Processing of detector mounting surface
(3) Determination of mounting position
(4) Cable end treatment
(5) Connection of cable to small size detector
(6) Mounting of small size detector on pipe

3.2.2. Selection of mounting method

There are two ways for mounting the detector, the V method and the Z method (See Fig. 3-1 Installation).

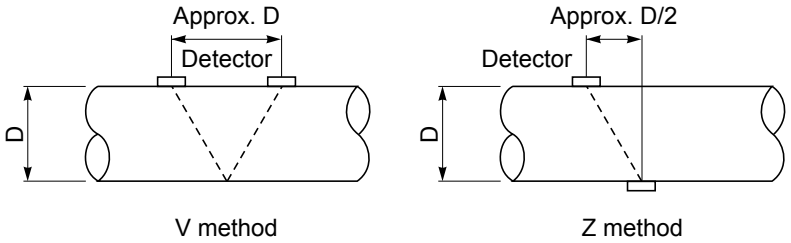


Fig. 3-1 Installation

The Z method should be used in the following cases.

- Where a mounting space is not available. (As shown in the figure above, the mounting dimension with the Z method is about half of that with the V method).
- When measuring fluid of high turbidity such as sewage.
- When the pipe has a mortar lining.
- When the pipe is old and has a thick accumulation of scale on its inner wall.

Selection standard

The Z method for large size sensor is recommended for outer diameter 300mm or more.

Type	Fluid temperature [°C]	Mounting method	Inner diameter of piping ø (mm) 13 25 50 100 200 250 300 400 1000 3000 6000
FLSE12□2-Y	-20 to 100	V	25 P 100
FLSE12□2-A	0 to 120	V	50 M 100
FLSE22□2-Y	-20 to 100	V	50 P, M 225
FLSE22□2-A	0 to 120	V	50 P, M 150
FSGS32 Note) FSGS31	-40 to 80	V	50 Px, P, M 300
FSGS41	-40 to 80	V	200 Px, P, M 600
FSGS41	-40 to 80	Z	200 Px, P, M 1200
FSGS51 Note) FSGS50	-40 to 80	V	200 Px, P, M 3000
FSGS51 Note) FSGS50	-40 to 80	Z	200 Px, P, M 6000
FLD22	-40 to 100	V	13 Px, P, M 100
FLD32	-40 to 200	V	50 Px, P, M 250
FLD32	-40 to 200	Z	150 Px, P, M 400

Classification of piping materials
- Px : PP, PVDF
- P : Plastic (PVC, etc.)
- M : Msetallic piping (steel pipe, copper pipe, aluminum, etc.)

Note: If ultrasonic waves cannot pass through the piping because the piping material category is Px or the turbidity of the fluid is high, it is recommended to use FSGS31, 41, or 50 types.

3.3. Preparation before installing the detector

3.3.1. Processing of detector mouting surface

Using thinner and/or sandpaper, remove pitch, rust and unevenness over a width of (L) + 200mm on the pipe circumference where the detector is mounted (Fig. 3-2).
If using new piping or piping with a clean outer surface, simply remove the dust on it.
Note) If there is a jute winding on the pipe circumference, remove it and carry out the above processing.

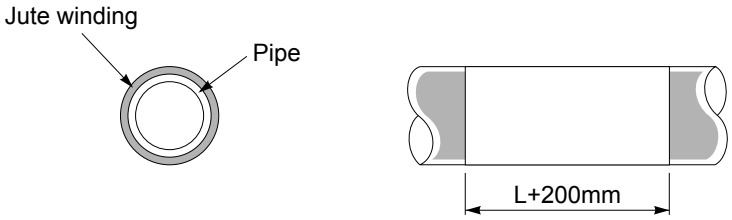
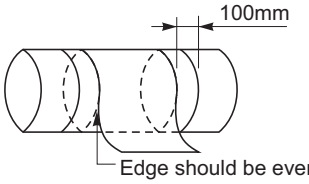


Fig. 3-2

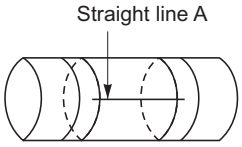
3.3.2. Determination of mounting position (with Z method)

Carry out the following to determine the mounting position.
Gauge paper is necessary for this work. (Refer to 5.4 How to make gauge paper.)

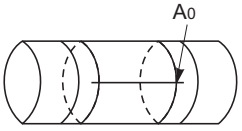
(1) Align the edge of gauge paper with a point about 100mm from one end of the processed section, and wrap the paper aroundthe pipe so that the line drawn on the paper is parallel with thepipe shaft. (The paper should be taped to prevent slipping.)
At this time, make sure that the paper edge is even.



(2) Extended the line drawn on the paper and mark a straight line A on the pipe.

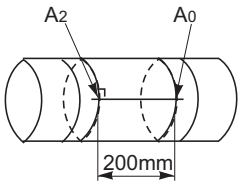


(3) Mark a line along on edge of the paper. Assume the intersection of the line and the straight line A is A_0.



V method

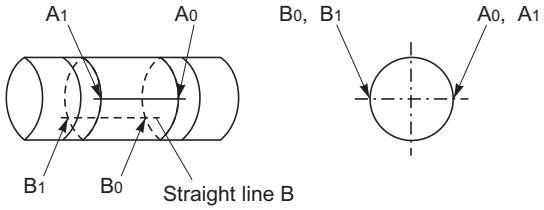
Example) L = 200mm



(4) Remove the gauge paper and measure the mounting dimension from A_0.
Then , draw a line which crosses the straight line A (determine the position A_2).

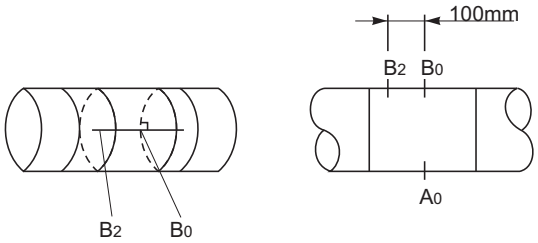
A_0 and A_2 are the mounting position.

Z method



(4) Measure the circumference of the pipe from the point A_0, and mark a line (straight line B) between the point B_0 and B_1 obtained at 1/2 of the circumference.

Example) L = 100mm



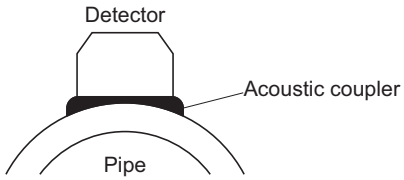
(5) Put a mark at point B_0 and remove the gauge paper.
Measure the mounting dimension from B_0 and mark a line crossing the straight line B (determine the position B_2).
In this way, the mounting position is determined.

A_0 and B_2 are the mounting position.

3.3.3. Selection of acoustic coupler

⚠ CAUTION

Acoustic coupler is a media that eliminates a gap between the detector and the pipe.
If there is a gap between the detector and pipe or there are many bubbles in the acoustic coupler, measurement may not be performed.



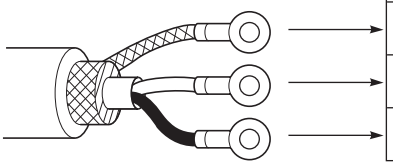
There are 3 types of acoustic coupler. Select a suitable one using the following table for reference.

Type	Silicon rubber (KE-348W)	Silicon-free grease (HIGH Z)	Silicon grease (G40M)
Fluid temperature	–40 to +150°C	0 to +60°C	–40 to +150°C
Teflon tube	Unusable	Usable	Usable

3.3.4. Signal Cable end treatment

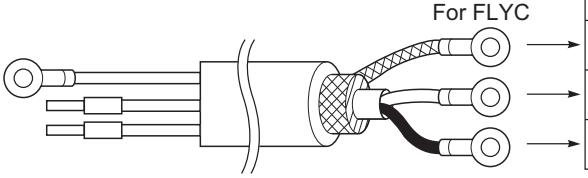
The end of coaxial cable is treated at the factory prior to delivery.
If the cable needs to be cut before use, the conductor and the shielding wires should be treated using clamp terminals.
Note: When cutting the coaxial cable, make sure that the upstream side and the downstream side are the same in length.

3.3.4.1. Signal Cable end treatment for FSV-1, FSH (FLY8)



Kind of clamp terminal	FLY8	
Name	Flow transmitter side (For M3/M3.5 screw)	Detector side (For M4 screw)
Outer shielding (Green)	1.25-3.7	R1.25-4
Conductor (White,+)	1.25-3.7	R1.25-4
Shielding (Black,G)	2-MS3.5	R2-4

3.3.4.2. Signal Cable end treatment for FSV-2 (FLYC)

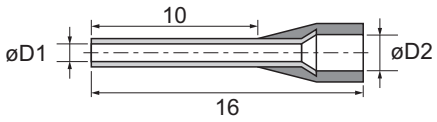


Kind of clamp terminal			
Name	Flow transmitter side (for M3 screw)	Detector side	
		FLYC (for M4 screw)	FLYD
External shielding wire (green)	R1.25-3	R1.25-4	BNC Connector
Conductor (White, +)	Bar terminal note)	R1.25-4	
Shielding wire (Black, G)	Bar terminal note)	R2-4	

Wire size (mm^2)	AWG	øD1 (mm)	øD2 (mm)	Type
0.5	20	1	2.6	H0.5/16
0.75	18	1.2	2.8	H0.75/16
1	17	1.4	3	H1/16
1.5	16	1.7	3.5	H1.5/16

Recommended bar terminal

* • Weidmuller
  www.weidmuller.com



Note1) Make sure to use PZ6/5 (H0.25 to H6 for sleeve) as a crimp tool for caulking.
Note2) Applicable sleeve is required for electric wire.
Note3) Insert the electric wire to the end of H sleeve so as to crimp.
Note4) Length of stripped wire is 12mm.

3.4. Mounting small size and middle size detector (FSGS32, 31, 41)

3.4.1. Connection of signal cable

(1) Remove the detector cover with a Phillips-head screwdriver.

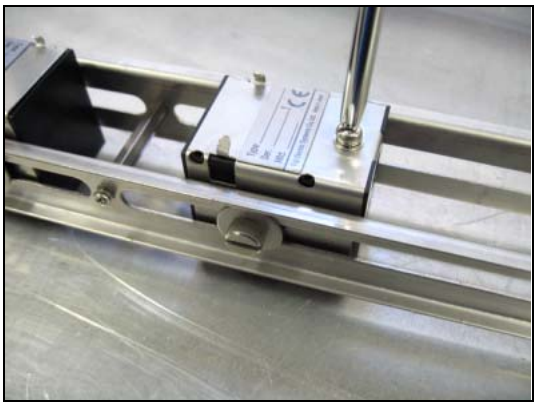


Fig. 3-3

(2) Remove the internal cable clamp.
Note: In case of removing the cable clamp, be sure not to lose the nut.

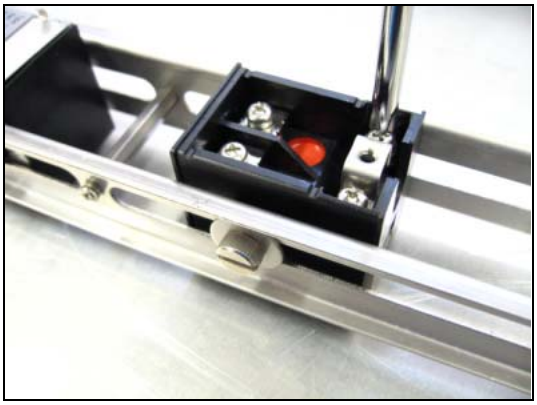


Fig. 3-4

(3) Remove the terminal (+/–) screws and place the signal cable.

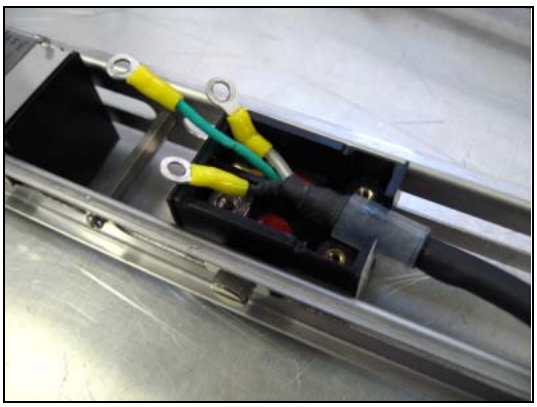


Fig. 3-5

(4) Attach the screw to the one side of the cable clamp.

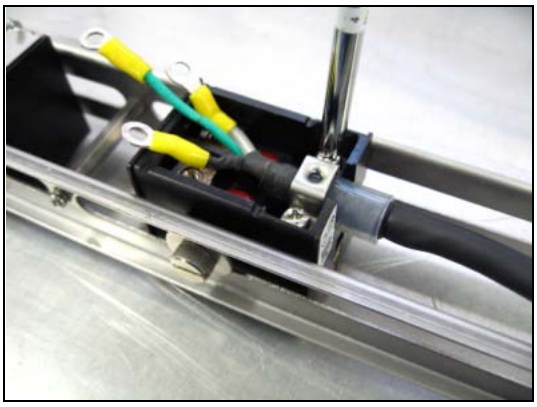


Fig. 3-6

(5) Connect signal cable.
Note: Connect the cable to the terminal (black to G terminal, white to + terminal).

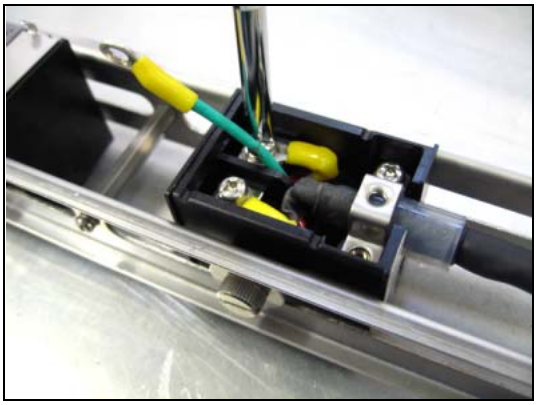


Fig. 3-7

(6) Attach the screws to the one side of the cable clamp and tighten them while fastening the ground wire (green) with them.

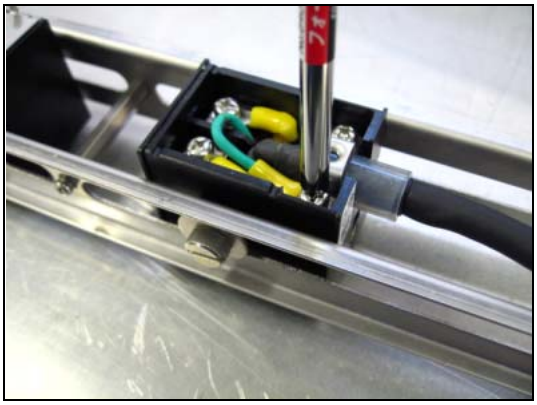


Fig. 3-8

(7) Arrange the wiring. Fill the whole terminal area with provided silicone filler and dry the surface.

Note: Apply the silicone filler while pressing it against the terminal area in order to prevent bubbles from entering, otherwise insufficient insulation may result.

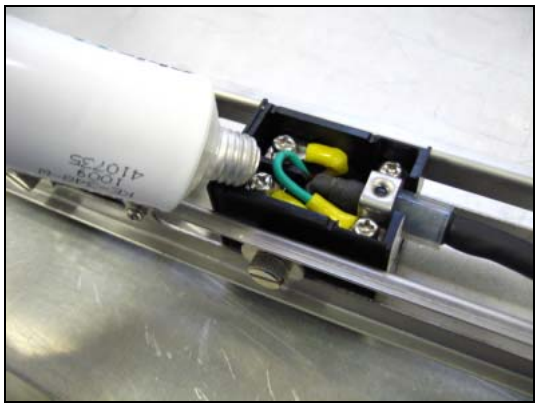


Fig. 3-9

(8) After the filler surface dries, attach the cover and screws.

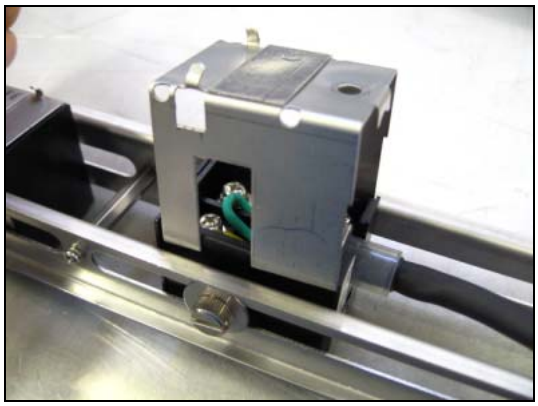


Fig. 3-10

3.4.2. Assembling procedure of the detector

If you order a small detector (FSGS31 or 32) with a cable (submersible type) whose length is 10 m or more, a sensor and frame will be delivered separately.
Assemble them following the procedure below before installing the detector to the piping.

⚠ CAUTION

Avoid applying bending or tensile stress to the base of the signal cable, otherwise the cable may be damaged.

(1) Remove the sensor fixing screw.

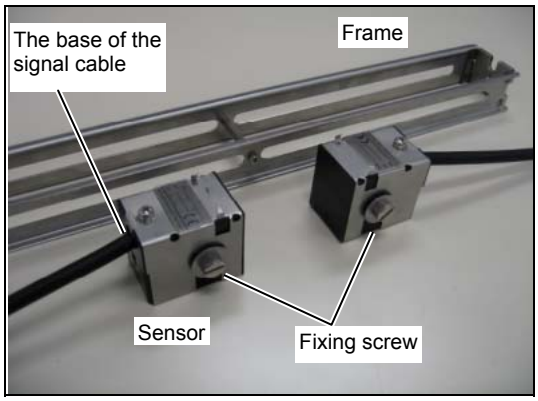


Fig. 3-11

(2) Loosen the screws on the center of the frame.

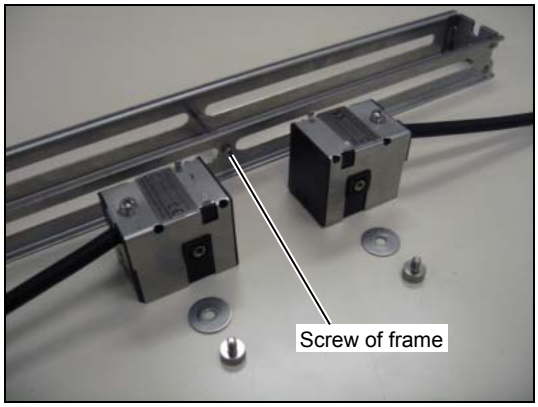


Fig. 3-12

(3) Open the frame to insert the sensor and tighten the screws on the frame.
Check that the sensor is inserted in the frame.

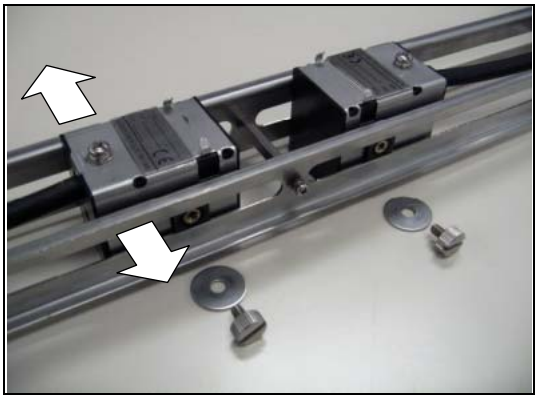


Fig. 3-13

(4) Attach the fastening screws for the sensor to complete the assembly.

Fig. 3-14

3.4.3. Mounting of small size detector on pipe (FSGS3)

The small type detector is mounted on pipe with a diameter of ø50 to 300 (V method)
Mounting the detector using the following procedure
For mounting, prepare a scale or a slide calipers.

(1) Loosen the fixing screw (4 places), slide the detector so as to match the mounting dimension, place a scale on the mounting dimension reference surface and adjust the dimension, then tighten the fixing screw.

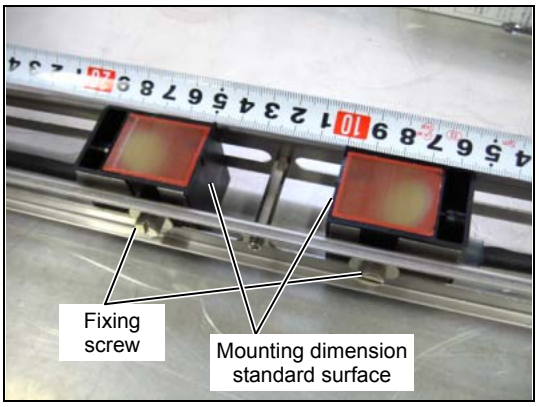


Fig. 3-15

(2) Spread silicone filler over the whole transmitting side of the detector. Care should be taken to prevent entry of air bubbles.
Clean the surface of the pipe, then mount the detector.

Fig. 3-16

(3) Pull the frame end and fix it in that condition.
Press the detector against the piping and put the yellow ring of the chain on the hook.

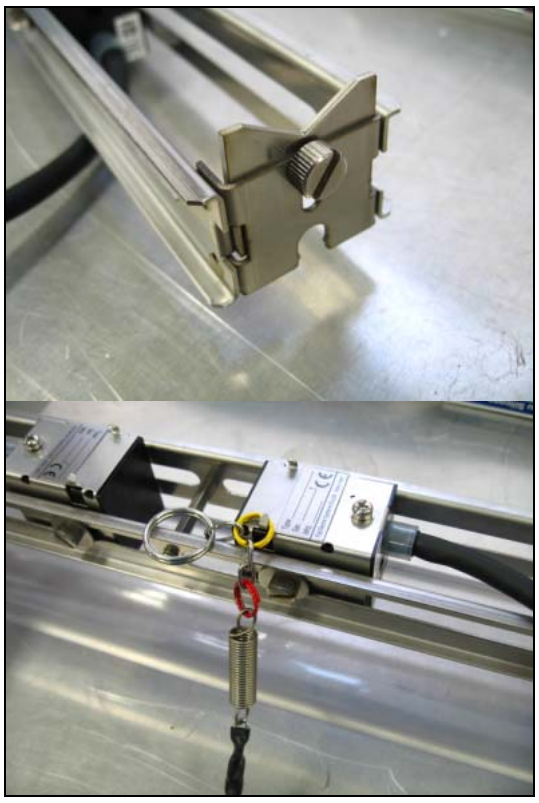


Fig. 3-17

(4) Attach the other chain to the other hook of detector, and secure it loosely.

Fig. 3-18

(5) Pull the red ring and attach it to the hook. Use the same procedure for the other sensor.

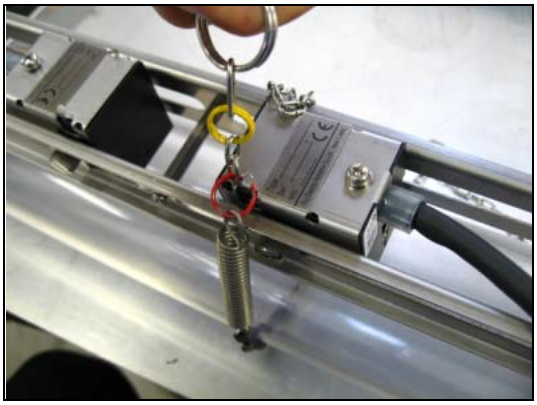


Fig. 3-19

(6) Loosen the screws on the frame end and attach the detector to the piping tightly.

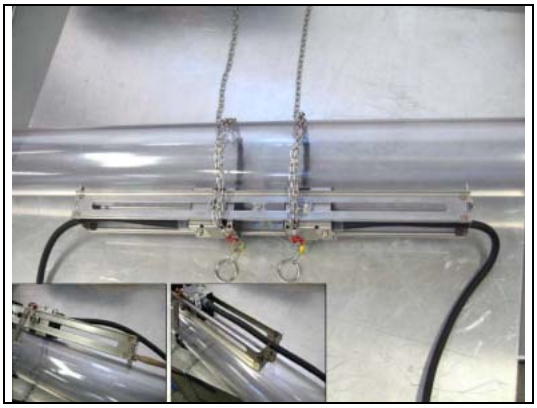


Fig. 3-20

(7) Press the sensor firmly against the pipe. Ensure that the sensor makes a close contact with the pipe.
Note: Adjust the sensor so that it faces the center of the piping, otherwise measurement may not be performed.

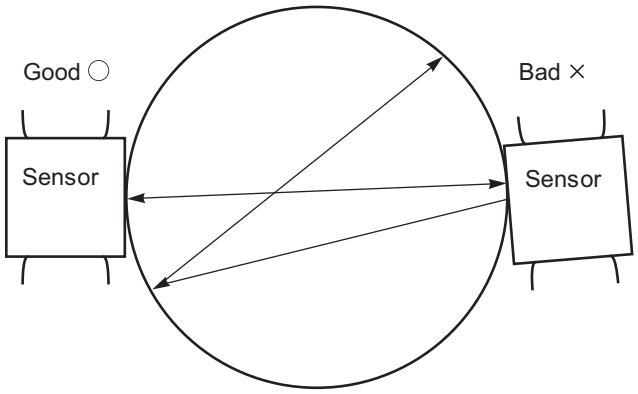


Fig. 3-21

3.4.4. Mounting of middle size detector on pipe (FSGS41)

Mounting the detector using the following procedure

(1) Provide wire rope for the upstream and the downstream detectors.
Make sure that the length of the wire rope is longer than the circumference of the pipe.

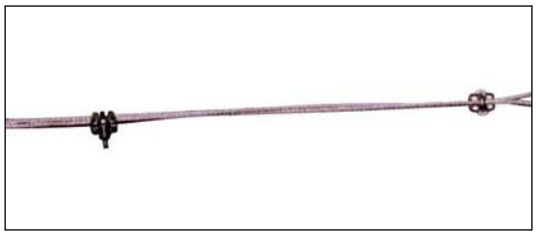


Fig. 3-22

(2) Lay the wire rope around the pipe at the position of the upstream detector. Then hook the mounting spring into the wire rope.

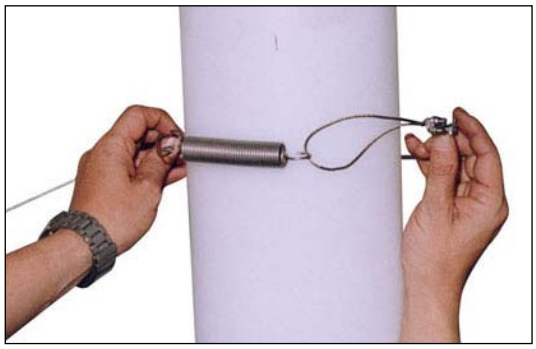


Fig. 3-23

(3) Loosen the guide frame fixing screw and slide the guide frame until its edge and transmitting surface touch the surface of pipe.

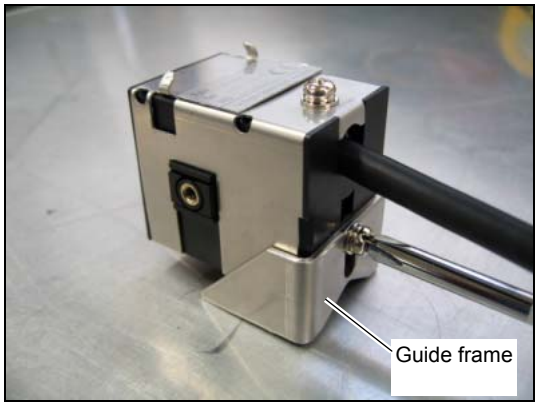


Fig. 3-24

(4) Spread silicone filler over the whole transmitting side of the detector. Care should be taken to prevent entry of air bubbles.

Fig. 3-25

(5) Clean the surface of the pipe, then mount the detector.

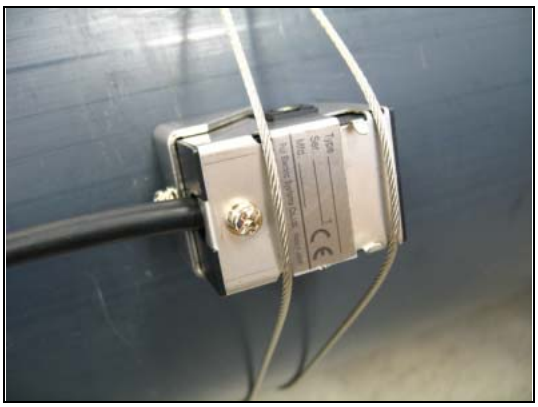


Fig. 3-26

(6) Press the detector against the pipe. Align the center of the detector with the intersection of the marking line. Make sure that the matching mark on the detector is aligned with the marking line.

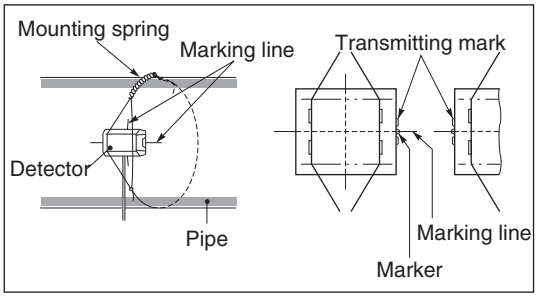


Fig. 3-27

(7) Make sure that the center mark on the detector is aligned with the marking line. Then, connect the co-axial cable to the transmitter.
Note: Do not pull the coaxial cable.
If it is pulled, the detector is shifted which results in incorrect measurements due to poor contact with the pipe.

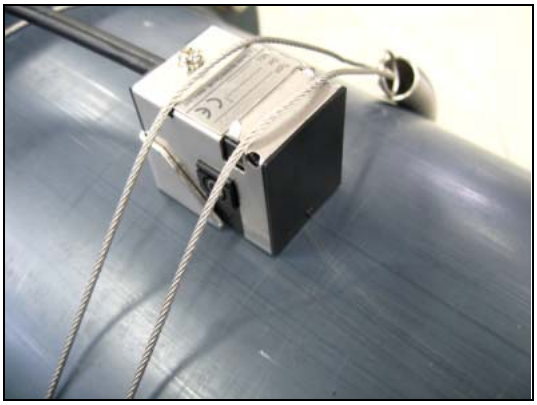


Fig. 3-28

(8) After mounting the upstream sensor, mount the downstream sensor in the same mounting dimensions.

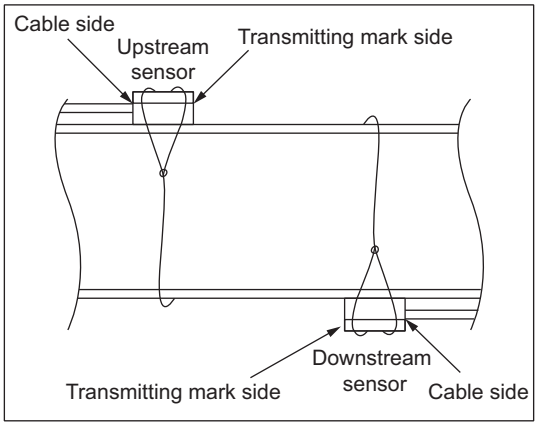


Fig. 3-29

3.5. Mounting large size detector (FSGS50, FSGS51)

3.5.1. Connection of signal cable

⚠ CAUTION

When engaging or disengaging the cover, be sure to wear protective gloves. Otherwise, you may cut a hand.

(1) Remove the M4 screws on the detector cover. Remove the cover while opening it.

Fig. 3-30

(2) Confirm the mounting position on the pipe.
- Align the transmitting direction marks so that they are facing with each other.

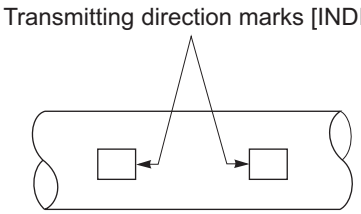


Fig. 3-31

(3) Remove the two M4 screws to remove the cable clamp.
Put the cable and fix the signal cable with the cable clamp (one side only).
Note: Connect the signal cable to the terminal (black to G terminal, white to + terminal).
Note: Connect to the M4 crimp terminal side

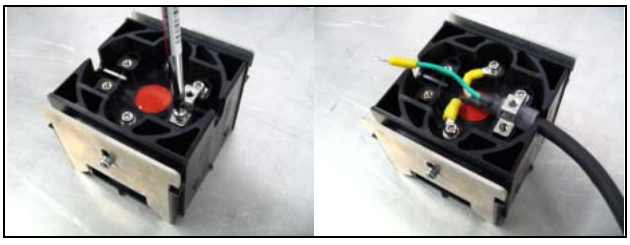


Fig. 3-32

(4) Attach the screws to the one side of the cable clamp and tighten them while fastening the ground wire (green) with them.

Fig. 3-33

(5) Remove foreign matters from the terminals, and mold them while terminal block with silicone filler.
- Cut off the tip of the silicone filler tube. Apply silicone to the terminal block while pressing the head of the tube against the bottom of terminals.
At this time, care should be taken to prevent entry of air bubbles.
Put the cover on the sensor.

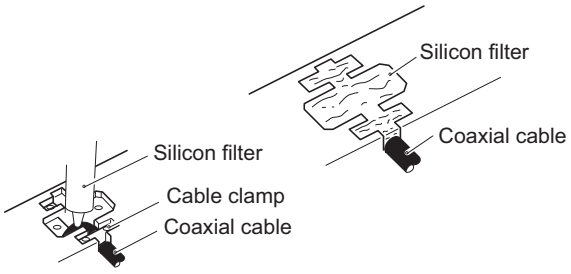


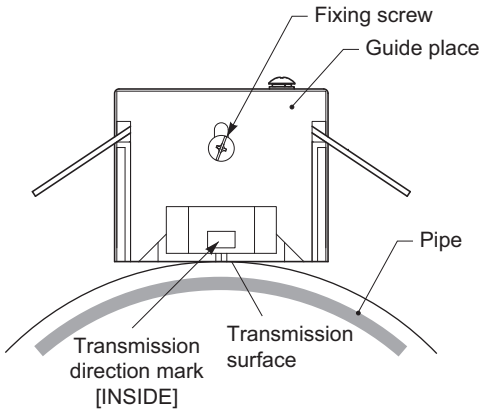
Fig. 3-34

(6) Attach the cover and fasten it with the screws.

Fig. 3-35

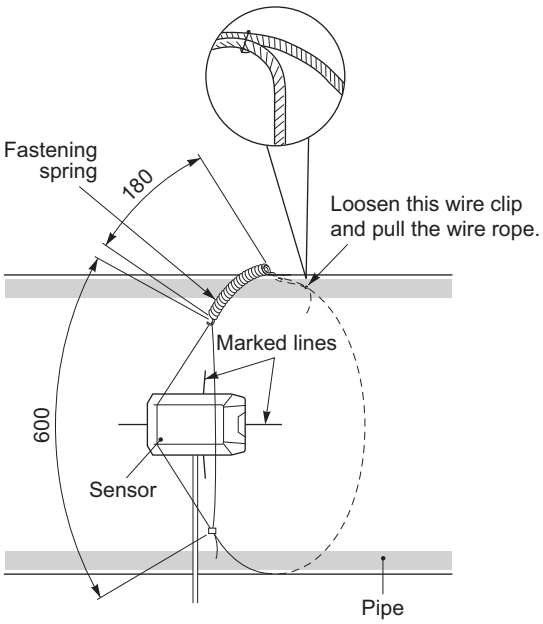
3.5.2. Mounting method on the pipe

(1) Adjustment of guide plate height
Place the sensor on the pipe surface in parallel with the pipe axis.



Loosen the guide plate fixing screw and slide the guide plate until its edge and transmitting surface touch the surface of pipe.
Tighten the retaining screw.

(2) Setting of wire rope length
Place the sensor on the marked lines and fit the wire rope and fastening spring.



Loosen the wire clip and pull the wire rope until the overall length of fastening spring approximates 180mm. Then tighten the wire clip. (The fastening spring has a free length of 110mm.)
Remove the sensor with the wire rope fixed in place.

(3) Mounting of sensor

- Clean the sensor transmitting surface and pipe mounting surface.
- Spread silicone filler over the whole transmitting surface of the sensor.
- The thickness of silicone filler should be about 3mm.

- Spread the wire rope near the marked lines in the left-right direction, bring the sensor in close contact and fit the wire rope.

- Make sure that the matching mark on the sensor is aligned with the marking line. In addition, make the transmitting direction marks of sensors face each other.

- Make sure the matching mark of sensor is aligned with the marked line and connect the signal cable to the flow transmitter.

Note: Do not pull the signal cable. Otherwise, the sensor will be activated to disturb measurement.

3.6. Confirmation of received signal

Connect the signal cable to the flow transmitter to be used and check that the receiving signals are normal. For the checking method, refer to the instruction manual of the converter.

Flow transmitter type	How to check the received signals
FLR / FSV	It is normal if the LED on the front of the flow transmitter changed from red to green.
FSH	It is normal if a mark “E1~E4” is not displayed on the LCD of the flow transmitter.

4. MAINTENANCE AND CHECKUP

Refer to the operation manual of the transmitter in use for the operation method of the transmitter.

4.1. Routine checkup

Visually check the following items

- Whether cable glands are loose. ⇒ Retighten.
- Whether the wire rope or chain of the detector is not loose. ⇒ Teghten
- Whether received wave is abnormal. ⇒ Check whether piping is filled or not. Remove bubbles or foreign matters, if mixed in measurement pipe. Also check if detector mounting and wiring are normal.
  ⇒ Please perform the electrical connection check of a signal cable, and the check of insulation resistance.

4.2. Periodic checkup

4.2.1. Checking the zero point

Stop the fluid flow, fill the measurement pipe fully, and check the zero point.

4.2.2. Checking the acoustic coupler

Check the acoustic coupler depending on the use environment.

Acoustic coupler	Checkup contents
Silicon rubber Silicon grease	Check the transmission surface for peeling or removal. If any, repair it.
Silicon-free grease	Replenish the transmission surface of the sensor unit with silicone-free grease about every six months. Reapply it on the transmission surface of the sensor unit approximately once every 6 months.

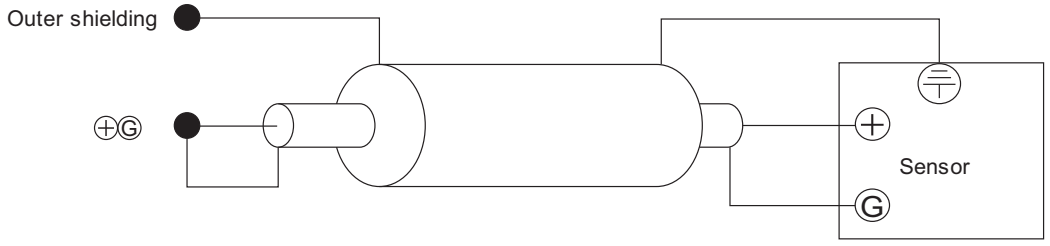
4.2.3. How to measure the insulation resistance

⚠ CAUTION

Turn off power before opening the flow transmitter cover.

(1) Turn off power of the flow transmitter.
(2) If the signal cable was already attached, remove it from the terminal block of the converter.
(3) Measure the insulation resistance between the batch (+) (G) wire of the signal cable and the outer shield wire.

Reference value of the insulation resistance: 10 MΩ or more/500 V DC



4.2.4. Check points for abnormal measurement of the detector

Causes	Check method.
Signal cable is faulty.	Check the continuity, and measure the insulation resistance.
Polarity of connected terminals is inverted.	Check the connection.
Detector bonding surface is peeling.	Check the connection.
Detector mounting failure (degradation of S/N)	Take countermeasures, referring to the section “The measured value does not change even if the flow rate changes.” in “Abnormal measurement” in the instruction manual of the converter.
Influence by external noise.	
Detector bonding surface is peeling.	Peel off the detector and recommence the mounting.
Wiring is poor.	Whether special signal cable is passed through metal conduit. Check whether the wiring of the detector is installed together with the power cable or power line. Wired together with power cable or heavy duty line.

5. APPENDIX

5.1. Specifications

Operational specifications

- System configuration:
  Single-path system of a flow transmitter (Model FSV) and a detector (Model FLS/FSG/FLD)

  Applicable fluid: Homogenous liquid where the ultrasonic signal can be transmitted
  Bubble quantity: 0 to 12vol% (for pipe size 50A, water, velocity 1m/s)
  Fluid turbidity: 10000mg/L max.
  Type of flow: Fully-developed turbulent or laminar flow in a full-filled pipe
- Flow velocity range:
  0 to ±0.3 ... ±32m/s
- Signal cable (between detector and converter):
  Coaxial cable (5m standard, 300m (60m for popular detector (FLS)) max.)
  Heat resistance: 80°C
- Installation environment:
  Non-explosive area without direct sunlight, corrosive gas and heat radiation.
- Ambient temperature:
  Detector: -20 to +60°C
- Ambient humidity:
  95%RH max.
- Applicable piping and fluid temperature:

Detector		Pipe size (inner diameter)	Applicable pipe material	Mounting method	Fluid temperature range (Note 3)
Common type	FSGS3	ϕ50 to ϕ300mm	Plastic (PVC, etc.) (Note 1) Metal pipe (SS, steel pipe, copper pipe, aluminum pipe, etc.) (Note 2)	V method	–40 to 80°C
	FSGS41	ϕ200 to ϕ1200mm		V or Z method	
	FSGS5	ϕ200 to ϕ6000mm			

Note 1: If the pipe material is PP or PVDF, select FSGS31, FSGS41 or FSGS5.
The standard of the measurement limit in FSGS32.
PP .....Pipe thickness is 15 mm or less.
PVDF.....Pipe thickness is 9 mm or less.

Note 2: For cast iron pipe, lining pipe, old steel pipe or others through which the ultrasonic signal could not be transmitted easily, select FSGS31,FSGS41 or FSGS50.Lining material: Tar epoxy, mortar, rubber, etc.
* In case the lining is not glued to a pipe, the measurement may be impossible.
Straight pipe length: Typically 10D for upstream and 5D for downstream. (D: Pipe inner diameter)
Refer to conditions on straight pipe for details (Japan Electric Measuring Instruments Manufacturers' Association Standard JEMIS-032).

Note 3: If silicone-free grease is used as acoustic coupler, the fluid temperature range is 0 to 60°C regardless of the detector.

Note 4: When the 9th digit in the code symbol is “A”, the applicable piping diameter is upto 150mm.

Performance specifications

- Rated accuracy

Detector		Pipe size (diameter)	Applicable pipe material	Flow velocity	Accuracy
Common type	FSGS32 FSGS51	ϕ50 to below ϕ300	Plastic, metal pipe	2 to 32m/s	±1.0% of rate
				0 to 2m/s	±0.02m/s
		ϕ300 to ϕ6000		0.75 to 32m/s	±1.0% of rate
				0 to 0.75m/s	±0.0075m/s
	FSGS31 FSGS41 FSGS50	ϕ50 to below ϕ300		2 to 32m/s	±1.5% of rate
				0 to 2m/s	±0.03m/s
		ϕ300 to ϕ6000		0.75 to 32m/s	±1.5% of rate
				0 to 0.75m/s	±0.015m/s

Physical specifications

- Type of enclosure: Detector:
  FSG (common type):
  IP67 (Silicone compound is filled on the terminal part when wiring)
  FSG (submersible type):
  IP68 (submersible in water for 5 days)
- Mounting method: Detector: Clamped on pipe surface
- Acoustic coupler: Silicone rubber, silicone grease or silicone-free grease
  Note: The acoustic coupler is a medium that eliminates a gap between detector and pipe
- Type of acoustic coupler:

Type	Silicone rubber (KE-348W)	Silicone grease (G40M)	Silicone-free grease (HIGH Z)
Fluid temperatur	–40 to +150°C	–30 to +150℃	0 to＋60℃
Teflon piping	×	○	○

In case of Teflon piping, use grease.
Procure silicone grease (G40M), if necessary, as an optional accessory.

- Material: Detector

Detector	Sensor housing	Sensor cover	Guide dail
FSGS3	PBT	SUS304	SUS304
FSGS41 FSGS5	PBT	SUS304	–

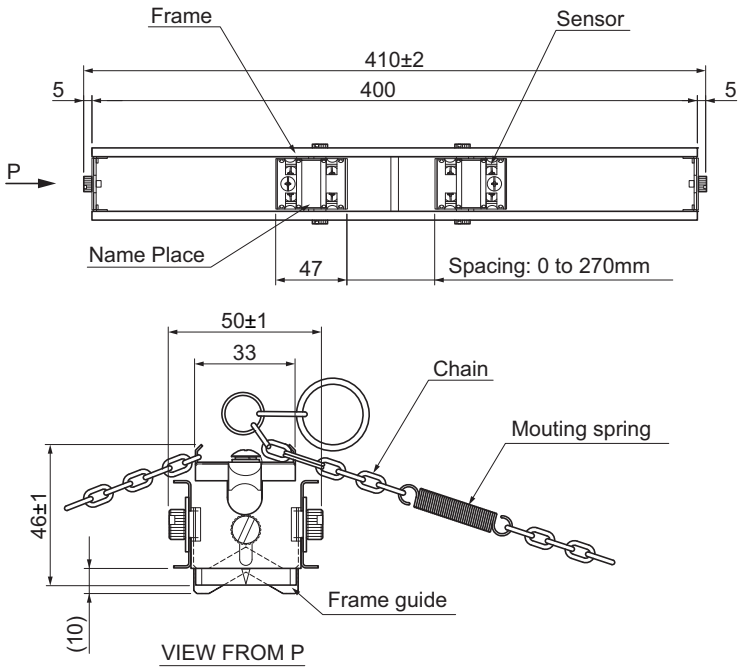
- Signal cable:

Type	Applicable flow transmitter	Construction	Outer diameter	Terminal treatment (amplifer terminal)		mass
				Flow transmitter side	Detector side	[g/m]
FLY8	FSV-1, FSH	High-frequeny coaxial cable (double Shielded)	ϕ7.3	M3/M3.5	M4	90
FLYC	FSV-2			M3, Bar terminal		

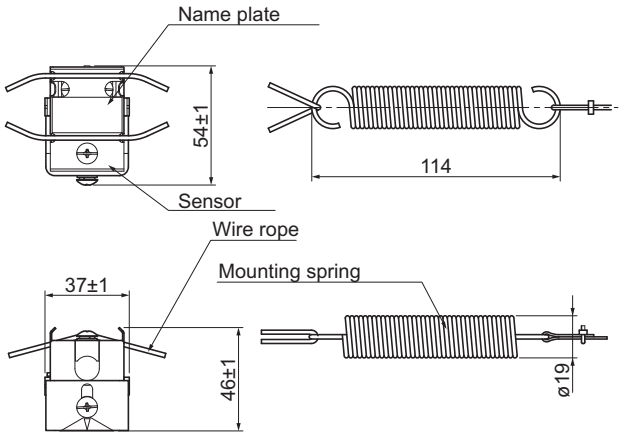
- Dimensions Detector: H46×W410×D50mm (FSGS3)
  H46×W54×D37mm (FSGS41)
  H67×W78×D84mm (FSGS5)
- Mass Detector: 0.6kg (FSGS3)
  0.3kg (FSGS41)
  1.2kg (FSGS5)

5.2. Dimension diagram

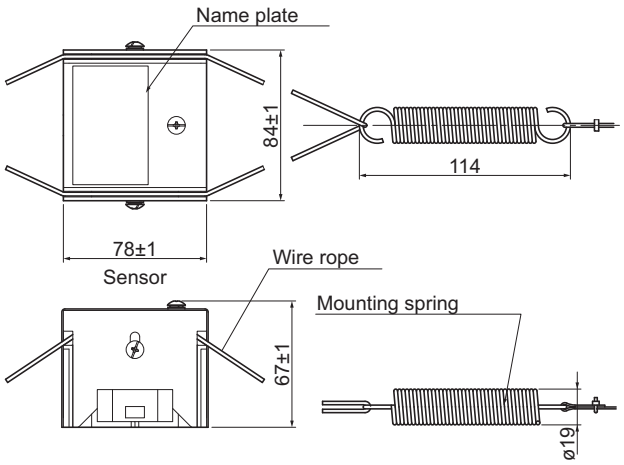
Detector (Type: FSGS3)



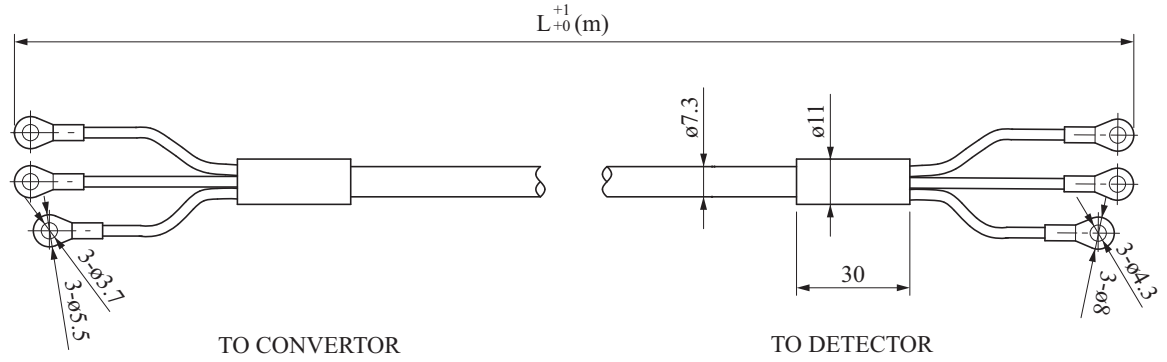
Detector (Type: FSGS41)



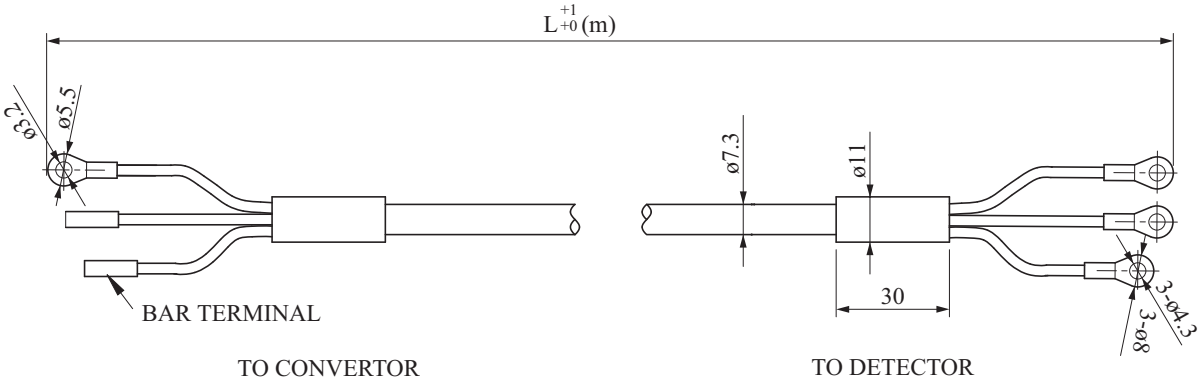
Detector (Type: FSGS5)



Signal cable (TYPE: FLY8)



Signal cable (TYPE: FLYC)

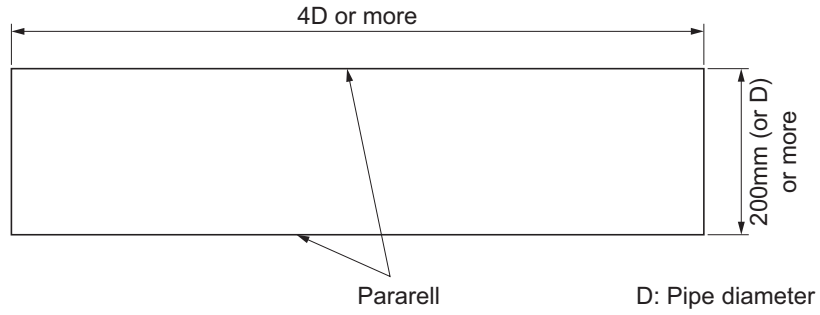


5.3. Items to be specified at order

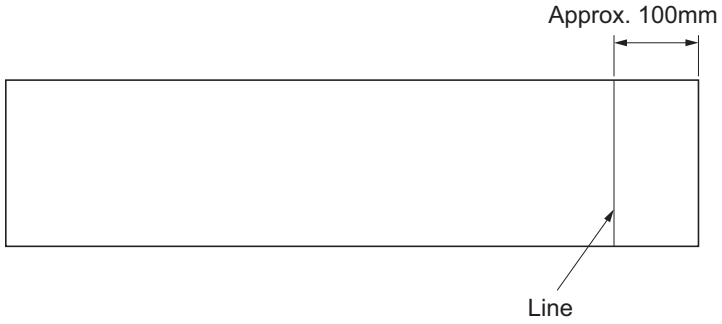
1. Detector type
2. Signal cable type
3. Tag No. (When tag plate is specified only)

5.4. How to make gauge paper

Provide a sheet of paper (or vinyl) having the length of 4D and width of 200 mm (D if possible) or longer, with long sides parallel to each other.



Draw a line that intersects with the long sides at right angles at a place about 100 mm from one end.



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