TOSHIBA

6F8A0802

ELECTROMAGNETIC FLOWMETER DETECTOR

MODEL LF470

INSTRUCTION MANUAL

TOSHIBA CORPORATION

NOTICE

This Manual is designed to assist in installing, operating, and maintaining the LF470 separate type electromagnetic flowmeter. For safety reasons, and to obtain the optimum performance from the flowmeter, read this Manual thoroughly before working with the product. Keep the Manual within easy reach for reference whenever needed.

The flowmeter to which this Manual refers is NOT designed for applications in which the functioning of this product is critical to human safety, such as:

- Main control systems of nuclear power plants; safety systems in nuclear facilities or other critical control lines directly affecting human safety.
- Control systems of medical equipment, including life support machines.

NOTES

1. The reproduction of the contents of this Manual in any form, whether wholly or in part, is not permitted without explicit prior consent and approval.
2. The information contained in this Manual is subject to change or review without prior notice.
3. Be sure to follow all safety, operating and handling precautions described in this Manual and the regulations in force in the country in which this product is to be used.

Fifth Edition
January. 2001

SAFETY PRECAUTIONS

Safety signs and labels affixed to the product and/or described in this manual give important information for using the product safely. They help prevent damage to property and obviate hazards for persons using the product.

Make yourself familiar with signal words and symbols used for safety signs and labels. Then read the safety precautions that follow to prevent an accident involving personal injury, death or damage to property.

Explanation of signal words

The signal word or words are used to designate a degree or level of hazard seriousness. The signal words used for the product described in this manual are WARNING and CAUTION.

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injuries or in property damage.

Safety symbols

The following symbols are used in safety signs and labels affixed to a product and/or in the manual for giving safety instructions.

	Indicates an action that is prohibited. Simply DON'T do this action. The prohibited action is indicated by a picture or text inside or next to the circle
	Indicates an action that is mandatory. DO this action. The mandatory action is indicated by a picture or text inside or next to the circle.
	Indicates a potential hazard. The potentially hazardous situation is indicated by a picture or text inside or next to the triangle.

SAFETY PRECAUTIONS (continued)

Safety Precautions for Installation and Wiring

⚠ WARNING

■ Do not use the LF470 in an **explosive atmosphere.**

Using this product in an explosive atmosphere can cause **explosion.**

⚠ CAUTION

■ **Turn off mains power** before working on pipes.  Working on pipes while power is applied can cause **electric shock.**	■ Use an **appropriate device** to carry and install the LF470.  If this product **falls to the ground,** injury, or malfunction of or damage to the product, can be caused.
■ **Install a switch and fuse** to isolate the LF470 from mains power.  Power supply from mains power can cause **electric shock** or **circuit break-down.**	■ **Do not modify or disassemble** the LF470 unnecessarily.  Modifying or disassembling this product can cause **electric shock, malfunction of or damage to this product.**
■ **Turn off mains power** before conducting wiring work.  Wiring while power is applied can cause **electric shock.**	■ **Ground** the LF470 **independently from power equipment.**  Operating this product without grounding can cause **electric shock** or **malfunction.**
■ Do not conduct wiring work **with bare hands.**  **Remaining electric charge** even if power is turned off can still cause **electric shock.**	■ Use **crimped terminal lugs** for the terminal board and GND terminal.  Loose connections can cause **electric shock, fire from excessive current or system malfunction.**
■ Do not work on piping and wiring **with wet hands.**  Wet hands may result in **electric shock.**	 The label shown left is placed near the terminal board for power input. (A black border and symbol on yellow triangle) Be alert to **electric shock.**

SAFETY PRECAUTIONS (continued)

Safety Precautions for Maintenance and Inspection

<table>
<tr><th colspan="2">⚠ CAUTION</th></tr>
<tr><td>■ Do not touch the LF470 main body when high temperature fluid is being measured.
 
DON'T
The fluid raises the main body temperature and can cause burns when touched.</td><td>■ Do not conduct wiring work when power is applied.
 
DON'T
Wiring while power is applied can cause electric shock.</td></tr>
<tr><td>■ Do not conduct wiring work with wet hands.
 
DON'T
Wet hands may result in electric shock.</td><td> 
The label shown left is placed near the terminal board for power input.
(A black border and symbol on yellow triangle)
Be alert to electric shock.</td></tr>
<tr><td>■ Do not use a fuse other than the one specified.
 
DON'T
Using a fuse other than the one specified can cause system failure, damage or malfunction.</td><td>Use a rated fuse as follows:
Fuse rating:
• 1A/250V for 100 to 240Vac or 110Vdc
• 2A/250V for 24 V dc
Dimensions:
Diameter 5.2 mm × 20 mm
Melting time characteristic:
Normal blow</td></tr>
</table>

Disclaimer

Toshiba does not accept liability for any damage or loss, material or personal, caused as a direct or indirect result of the operation of this product in connection with, or due to, the occurrence of any event of force majeure (including fire or earthquake) or the misuse of this product, whether intentional or accidental.

Handling Precautions

■ To obtain the optimum performance from the LF470 flowmeter for years of continuous operation, observe the following precautions.

(1) Do not store or install the flowmeter in:
- places where there is direct sunlight. If this is unavoidable, use an appropriate sunshade.
- places where excessive vibration or mechanical shock occurs.
- places where high temperature or high humidity conditions obtain.
- places where corrosive atmospheres obtain.
- places submerged under water.

To put the flowmeter temporarily on the floor, place it carefully with something to support it so that the flowmeter will not topple over.

(2) Execute wiring securely and correctly.
Ground the flowmeter with 100 ohm or less ground resistance. Avoid a common ground used with other equipment where earth current may flow. An independent ground is preferable

(3) Seal the cable thoroughly at the cable gland of the converter so that the cable is kept airtight.

(4) The converter housing covers and the cable glands are tightened securely at the time of shipment. Do not remove these covers or glands. Otherwise, gradual deterioration of circuit isolation or damage to this product can be caused. Tighten the covers or cable glands securely again if they have been removed.

(5) Make sure the fluid to be measured will not freeze in the detector pipe. This can cause damage to the detector pipe.

(6) Select appropriate wetted materials suited for the process fluid to be measured. Otherwise, fluid leakage due to corrosion can be caused.

Handling Precautions (continued)

(7) Observe the following precautions when you open the converter housing cover:

- Do not open the cover in the open air unprotected against rain or wind. This can cause electric shock or cause damage to the flowmeter electronics.
- Do not open the cover under high ambient temperature or high humidity conditions or in corrosive atmospheres. This can cause deterioration of system accuracy or cause damage to the flowmeter electronics.

(8) This product may cause interference to radio and television sets if they are used near the installation site. Use metal conduits etc. for cables to prevent this interference.

(9) Radio transmitters such as transceivers or cellular phones may cause interference to the flowmeter if they are used near the installation site. Observe the following precautions when using them:

- Do not use a transceiver whose output power is more than 5 W.
- Move the antenna of a transceiver or a cellular phone at least 50 cm away from the flowmeter and signal cables when using it. Do not use a radio transmitter or a cellular phone near the flowmeter while it is operating online. The transmitter or cellular phone's output impulse noise may interfere with the flowmeter.
- Do not install a radio transmitter antenna near the flowmeter and signal cables.

(10) For reasons of flowmeter failure, inappropriate parameters, unsuitable cable connections or poor installation conditions, the flowmeter may not operate properly. To prevent any of these problems causing a system failure, it is recommended that you have preventive measures designed and installed on the flowmeter signal receiving side.

Table of Contents

1. Product Inspection and Storage

Upon arrival of the product package, open the package and check the items contained inside. If you do not intend to install the product soon after opening the package, store the product and other related items in a place such as described in 1.2 below.

1.1 Product Inspection

The LF470 electromagnetic flowmeter is shipped in a cardboard container filled with shock-absorbing materials. Open the package carefully and check as follows:

- Make sure the following items are included in the package.

  (1) Model LF470 Electromagnetic Flowmeter..... 1

  (2) Instruction Manual 1

- Inspect the flowmeter for indications of damage that may have occurred during shipment.
- Make sure the type and specifications of the flowmeter are in accordance with the ordered specifications.

If you cannot find the items listed above or any problem exists, contact your nearest Toshiba representative.

1.2 Storage

To store the LF470 flowmeter after opening the package, select a storing place as follows and keep it under the conditions described below:

(1) Avoid places where there is direct sunlight, rain or wind.

(2) Store the product in a well-ventilated place. Avoid places of extremely high humidity or extremely high or low temperature. The following environment is recommended:

- **Humidity range: 10 to 90% RH (no condensation)**
- **Storage temperature: –15 to +65° C**

(3) Avoid places where vibrations or mechanical shock occur.

(4) Do not leave the converter housing cover open . Open the cover only when you actually start wiring cables. Leaving the cover open can cause gradual deterioration of circuit isolation.

(5) To put the flowmeter temporarily on the floor, place it carefully with something to support it so that the flowmeter will not topple over

2. Overview

The LF470 electromagnetic flowmeter measures the volumetric flow rates of electrically conductive materials on the basis of Faraday's Law of electromagnetic induction.
The device consists of two units: the LF470 detector, through which the fluid to be measured flows, and the converter, which receives the electromotive force signals from the detector, then converts the signals into the 4–20 mA dc signal.

Features

Every type of electromagnetic flowmeter has the following features:

- Fluid flow is not obstructed and pressure loss is negligible.
- The process fluid's temperature, pressure, density or flow conditions has no effect on the accuracy of the flowmeter.
- The flowmeter output is directly proportional to the process flow rate, thus it is easy to read its output.

The LF470 electromagnetic flowmeter detector has the following additional features:

(1) High accuracy, **±0.8% of rate** is possible for 1.0–10 m/s velocity range.
±0.8% FS is possible for 0.3–1.0 m/s velocity range.

(2) The flowmeter can be used to measure any fluids included acid and alkaline fluids, for the reasons stated below:
- **Ceramic is used for the detector pipe.**
- **Platinum is used for the electrode.**

(3) The flowmeter is very **small and light**. Because of it, the flowmeter can be mounted on panel.

(4) It is possible to connect to various pipes or tubes by using joints available in the market.

3. Names of Parts

The outline drawing of the LF470 flowmeter is shown in Figure 3.1.

■ **Outline Drawing**

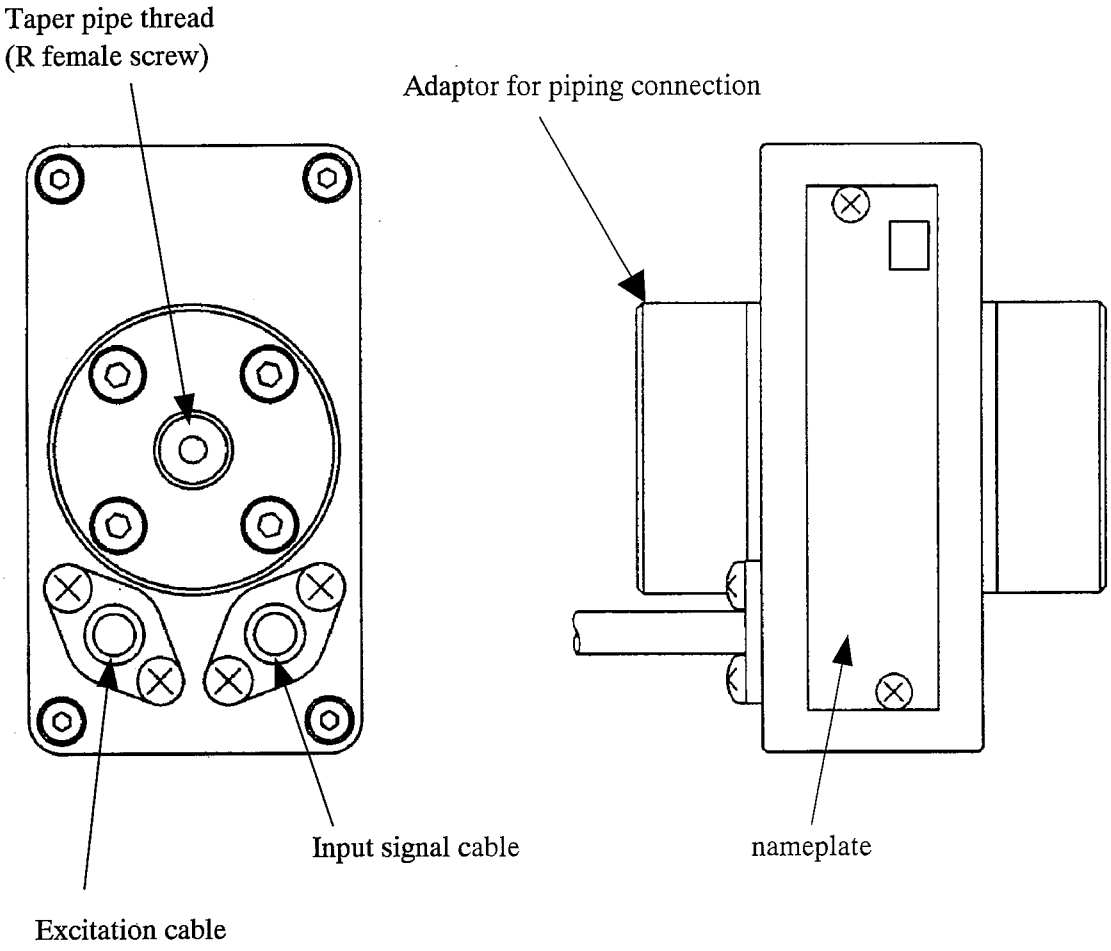


Figure 3.1 Outline drawing of LF470 Flowmeter Detector

4. Installation

Safety Precautions for Installation

⚠ WARNING

■ Do not use the LF470 in an **explosive atmosphere.**

DON'T

Using this product in an explosive atmosphere can cause **explosion.**

⚠ CAUTION

■ **Install a switch and fuse to isolate the LF470 from main power.**

DO

Power supply from main power can cause **electric shock** or **circuit breakdown.**

■ **Use an appropriate device to carry and install the LF470.**

DO

If his product **falls to the ground**, injury, or malfunction of or damage to the product, can be caused.

■ **Do not modify or disassemble the LF470 unnecessarily.**

DON'T

Modifying or disassembling this product can cause **electric shock, malfunction or damage to this product.**

■ **Ground the LF470 independently from power equipment.**

DO

Operating this product without grounding can cause **electric shock** or **malfunction.**

■ **Do not work on piping and wiring with wet hands.**

DON'T

Wet hands may result in **electric shock**

The label shown left is placed near the terminal board for power input.
(A black border and symbol on yellow triangle)
Be alert to **electric shock.**

4.1 Location

To select the installation site, follow the precautions described below:

- Avoid places where fluid runs in a pulsating form.
- Avoid places within the immediate proximity of equipment producing electrical interference (such as motors, transformers, radio transmitters, electrolytic cells, or other equipment causing electromagnetic or electrostatic interference).
- Avoid places where excessive pipe vibration occurs.
- Avoid places where there is direct sunlight. If this is unavoidable, use an appropriate shade
- Avoid places where corrosive atmospheres or high humidity conditions obtain.
- Avoid places of too great an elevation or constricted areas where clearance for installation or maintenance work is not provided.
- Design piping so that the detector pipe is always filled with fluid, whether the fluid is flowing or not.
- The LF470 detector has no adjustable piping mechanism. Install an adjustable short pipe where needed.
- Chemical injections should be conducted on the downstream side of the flowmeter.

4.2 Mounting Procedure

⚠ CAUTION	
■ **Use an appropriate device to carry and install the LF470.** DO If his product **falls to the ground**, injury, of malfunction of or damage to the product, can be caused.	■ **Turn off mains power before working on pipes.** DON'T Working on pipes while power is applied can cause **electric shock.**

4.2.1 Installation Procedure

To mount the LF470, see Figure 4.1 and follow the procedures below.

(1) In case of method of piping by nipple and union

(1-1) Connect the R female screw of the LF470 with the nipple.

(1-2) Connect the nipple with the pipe by the union.

(2) In case of method of piping by jont

(2-1) Connect the R female screw of the LF470 with the joint.

(2-2) Connect the Joint with the pipe

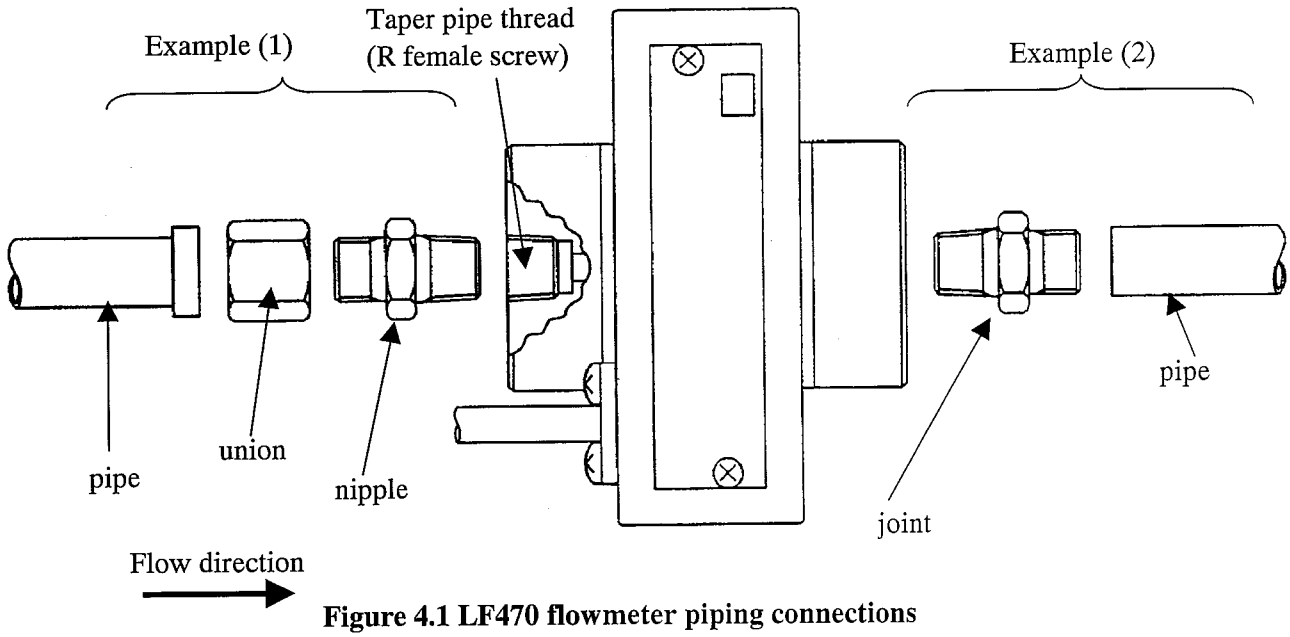


Figure 4.1 LF470 flowmeter piping connections

NOTES:

(1)Preventing from leaking, seal up R male screw with sealant which is appropriate material to the process fluid to be measured.

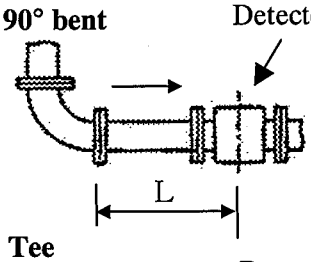
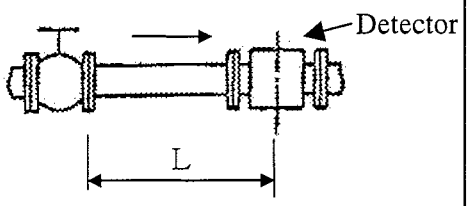
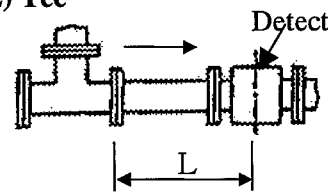
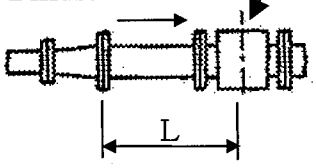
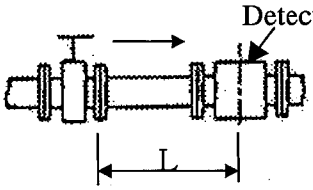
(2)Keep that the inner diameters of the nipple, the joint and pipe on the sides of the detector larger than that of LF470. If not, the air bubbles will stagnate in the measuring pipe and they may disturb the normal measurement of flow rate.

4.3 Piping Connections

(1) Required Pipe Length

If various joints are used upstream of the detector outlet, the straight pipe length as shown in Table 4.2 is required.

Table 4.2 Required straight pipe length on the upstream side

L = 5D	L = 10D
(1) 90° bent 	(5) Other valves (not fully opened) 
(2) Tee 	
(3) Diffuser 	
(4) Fully opened sluice valve 	

L: Required straight pipe length—straight pipe length plus half length of the detector.
D: Nominal bore size (diameter)

NOTES

1. The length of a reducer, if connected, can be counted as a part of the straight pipe length.
2. No straight pipe length is needed on the downstream side. If a butterfly valve is installed downstream of the detector, do not let the valve plate protrude into the pipe of the detector

(2) Pipe Orientation

The detector may be installed in horizontal, vertical or sloping pipe runs as shown in Figure 4.2. However, except for horizontal installation, fluid should flow from lower to upper directions. See Figure 4.3.

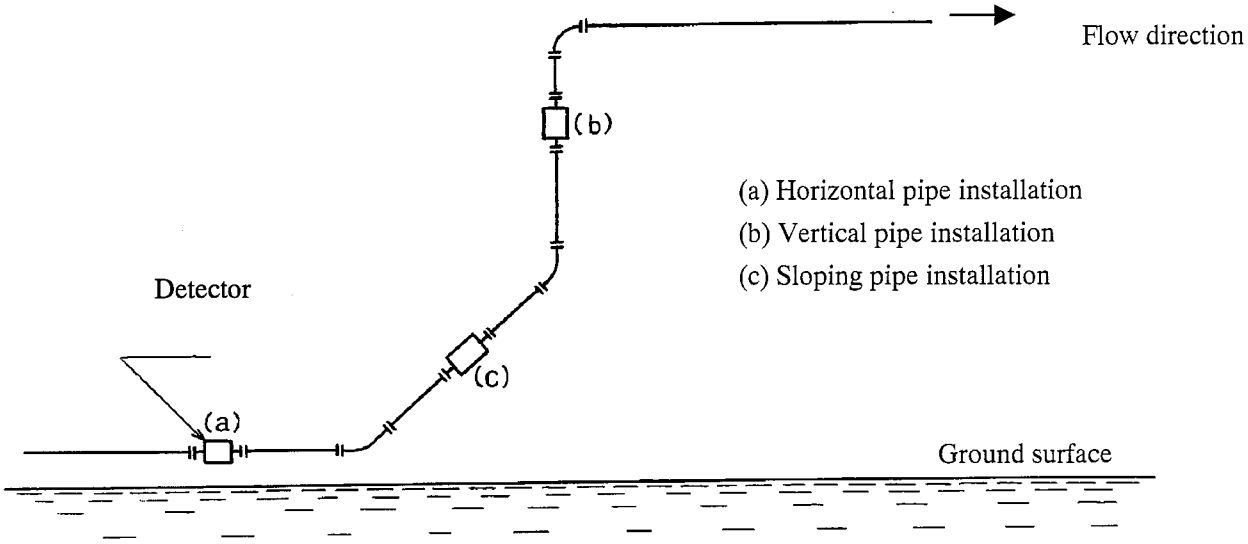


Figure 4.2 Detector Piping Orientation

The electrodes should be positioned horizontally against the ground surface in any piping installation. See Figure 4.3.

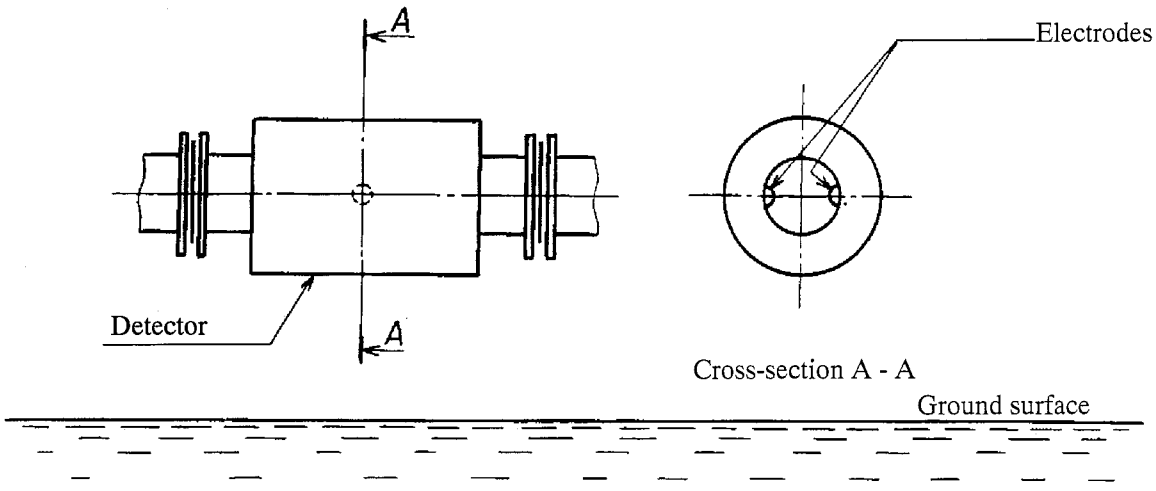


Figure 4.3 Installation position of the detector

(3) Flow Direction

Install the detector in accordance with the flow direction arrow on the detector. See Figure 4.4.

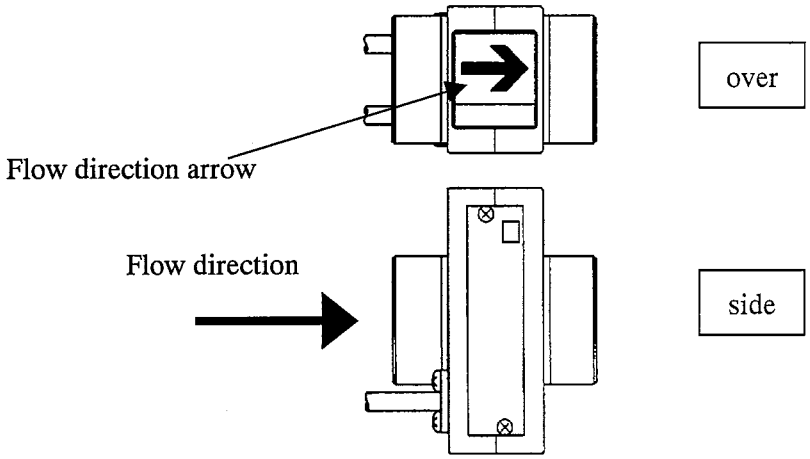


Figure 4.4 Flow direction arrow on the detector

(4) Preventing an Empty Pipe Condition

Design an upright pipe run (Figure 4.5) or sufficient head pressure (Fig. 4.6) at the downstream detector outlet if there is a possibility of the detector pipe becoming emptied.

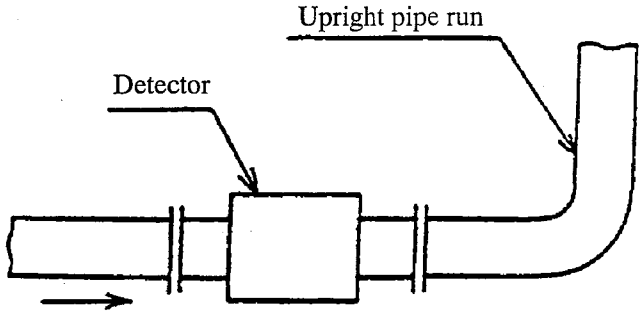


Figure 4.5 Detector with an upright pipe run at downstream outlet

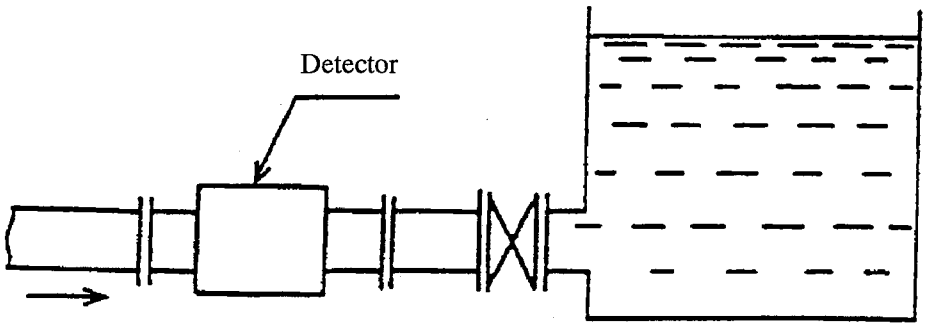


Figure 4.6 Detector with sufficient head pressure at downstream outlet

(5) Supporting Pipe

Fix the relevant pipes installed on both sides of the detector by attach fittings, etc. to support the pipe. By supporting the pipes, not only the pipe vibration is reduced but also the damage to the pipes by the electromagnetic flowmeter's weight and the fluid mass. And it protect from fluid leakage at flange face (see Figures 4.7 and 4.8).

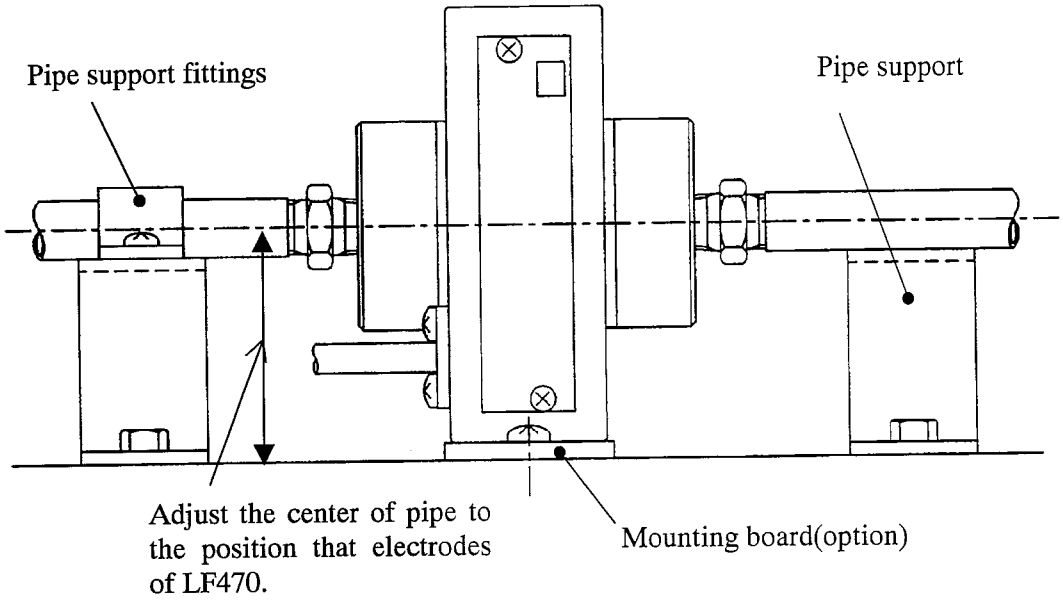


Figure 4.7 Example of Pipe Fixing Procedure

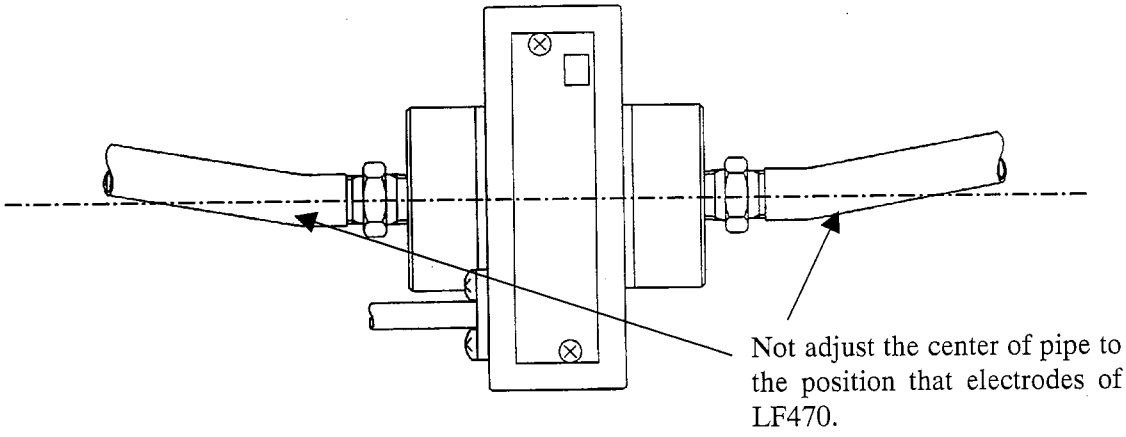


Figure 4.8 Model Diagram of Unsupported Pipes

5. Wiring

⚠ CAUTION	
■ **Do not work on piping and wiring with wet hands.**  DON'T Wet hands can cause **system failure.**	■ **Ground the LF470 properly.**  DO Operating this product without a grounding can cause **system malfunction.**
■ **Do not modify or disassemble the LF470 unnecessarily.**  DON'T Modifying or disassembling this product can cause **electric shock, malfunction of or damage to this product.**	 The label shown left is placed near the terminal board for power input. Be alert to **electric shock.**

Flowmeter accuracy may be affected by the way wiring is executed. Proceed with wiring taking the following precautions:

(1) Select the cable runs away from electrical equipment (motors, transformers, or radio transmitters) which causes electromagnetic or electrostatic interference.

(2) Deterioration of flowmeter circuit insulation occurs if the converter interior or cable ends get wet or humidified. This in turn causes malfunction of flowmeter or noise problems. Avoid a rainy day if the flowmeter is to be installed outdoors. Even indoors, prevent water from splashing over the flowmeter. Try to finish the wiring as quickly as possible

(3) The excitation and input signal cables transmit extremely minute signals. Pass each of them alone and independently through a thick walled steel conduit, and loacate it at as much a distance as possible from other great-current cabling, nor in parallel with such cabling.

(4) The converter has a surge-absorbing barrier installed inside. Therefore, do not conduct a withstand voltage test for the converter. To check the insulation of the converter, use a voltage of 250 V dc or less.

(5) After wiring, attach the terminal cover of the converter.

5.1 Cables

(1) Standard cable

The standard cable shown in Figure 5.1 is connected when shipped.

The cable length can be ordered (option).

Table 5.1 Cables

Name	Cable type	Length	Nominal cross-sectional area	Overall diameter
Excitation cable	Three-core chloroprene cabtyre cable	5m	0.5 mm^2	6 to 8 mm
Input signal cable	Two-core sheathed chloroprene cabtyre cable	5m	0.3 mm^2	6 to 8 mm

(2) Elongate cable longer than 5m

By using scotch cast, the cable shown in Figure 5.2 can be connected with standard cable (5m).

Table 5.2 Cables

Name	Cable type	Nominal cross-sectional area	Overall diameter
Excitation cable	Three-core chloroprene cabtyre cable	2 mm^2	11 to 13 mm
Input signal cable	Two-core sheathed chloroprene cabtyre cable	0.75 mm^2	11 to 13 mm

Note: Total cable length must be within 30m .

5.2 External Device Connections and Grounding

The connections for the LF470 detector are shown in Figure 5.1 and 5.2.

Proceed with wiring as described in Section 5.3, "Wiring Procedure."

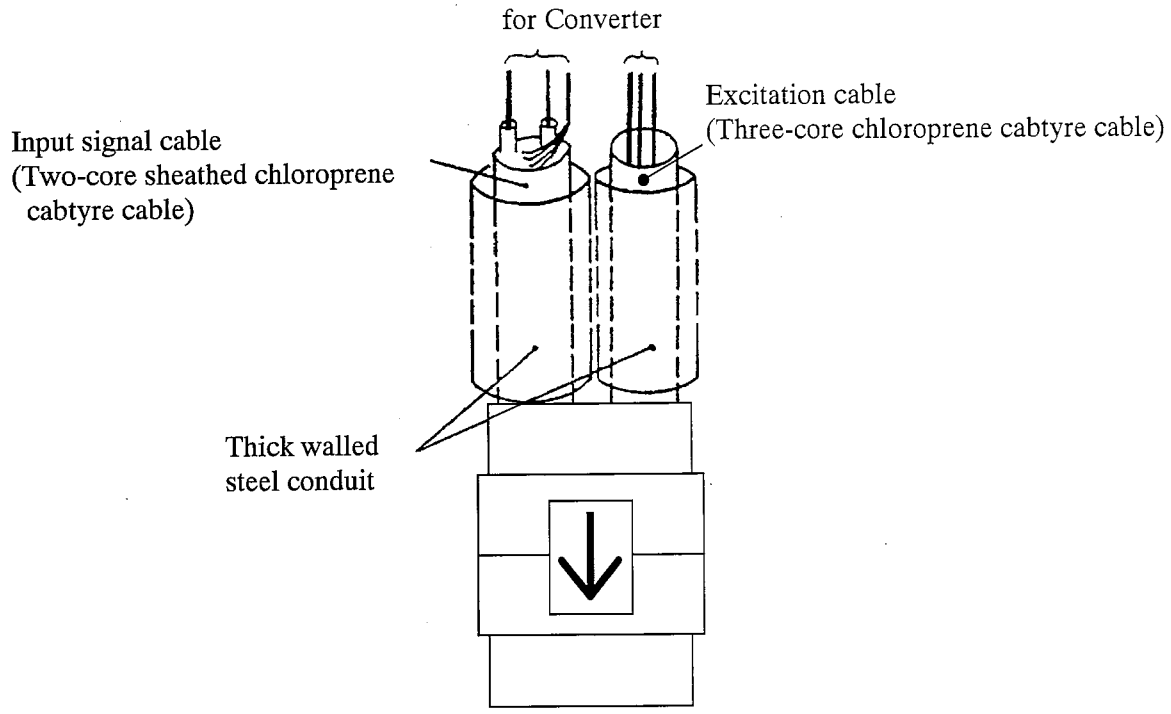
IMPORTANT

(1) The input signal cable and excitation cable are attached to the detector. Be sure to use the attached cable, check the specification of the detector.

(2) The converter side ends of the attached cables are covered with caps to prevent exposure to humidity. Do not remove the caps from the cable until directly before wiring to the converter.

(3) Be sure to use thick walled steel conduit (22mm) for each the signal cable and the excitation cable between the detector and the converter, and locate it as far as possible from other great current cabling and it is not parallel with such cabling. Use flexible conduits at the cable outlets of the detector.

(4) The FG terminal of the converter should be grounded with 100 ohm or less ground resistance. Use a heavy copper braid or wire (cross-sectional area 5.5 mm^2 minimum) to ground the terminal and make it as short as possible.



● Grounding:

Ground the FG terminal (or the external grounding terminal) of the converter securely with 100 ohm or less ground resistance as shown in Figure 5.2. (The E terminal of the converter is connected internally to the FG terminal and the converter case.)
Furthermore, if the pipeline is not of conductive material, grounding rings are needed for the detector to stabilize fluid potential as the fluid potential is unstable and may cause incorrect measurement.

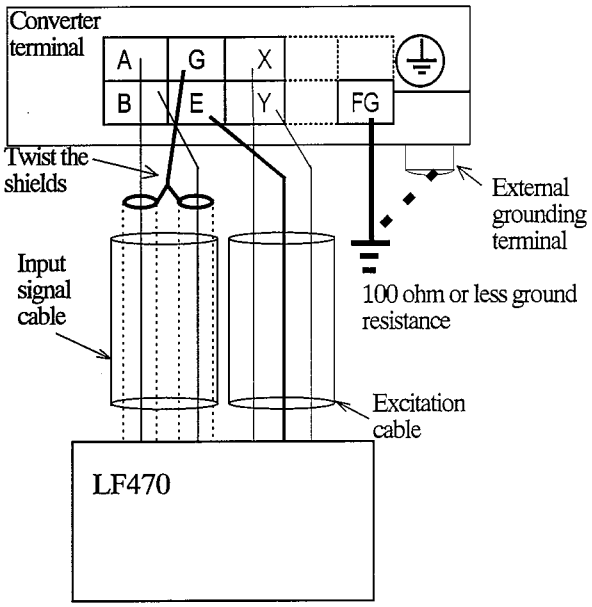


Figure 5.2 Wiring between the detector and the converter

5.3 Wiring Procedure

Cable termination and cable connections are described below.
Use cables as specified in Table 5.1 and Table 5.2.

5.3.1 Cable Termination

⚠ CAUTION	
■ Do not conduct wiring work when **power is applied.**  DON'T Wiring while power is applied can cause **electric shock.**	■ Do not work on piping and wiring **with wet hands.**  DON'T Wet hands may result in **electric shock.**

■Input signal Cable

Remove each core coating for cable as shown in Figure 5.3. Next, attach the insulating sleeve crimp-style terminals **(Note)**. Then, connect to the converter's terminal block A and B and twist the shields together. Cover with the terminal contraction tubes before attaching the crimp-style terminal and connecting to the converter's terminal block G .

Note: Set the size of insulating sleeve crimp-style terminal as below.

Converter type	size of insulating sleeve crimp-style terminal
LF420	M3.5
LF230	M4

Insulating sleeve crimp-style terminals

A Black
G Shield
B White

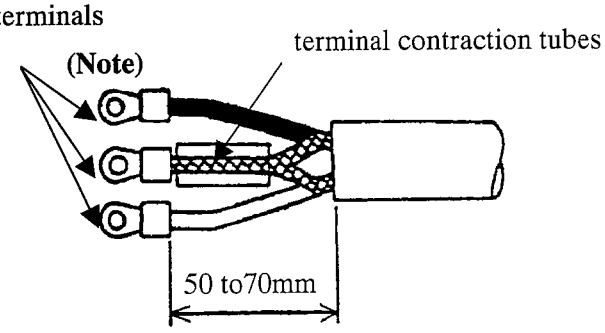


Figure 5.3 Input signal cable end processing

Notes:

Removing core coating for cable, be careful not to scratch and not to cut off cable and shield.

Untying shields from cables as shown in Figure 5.4.

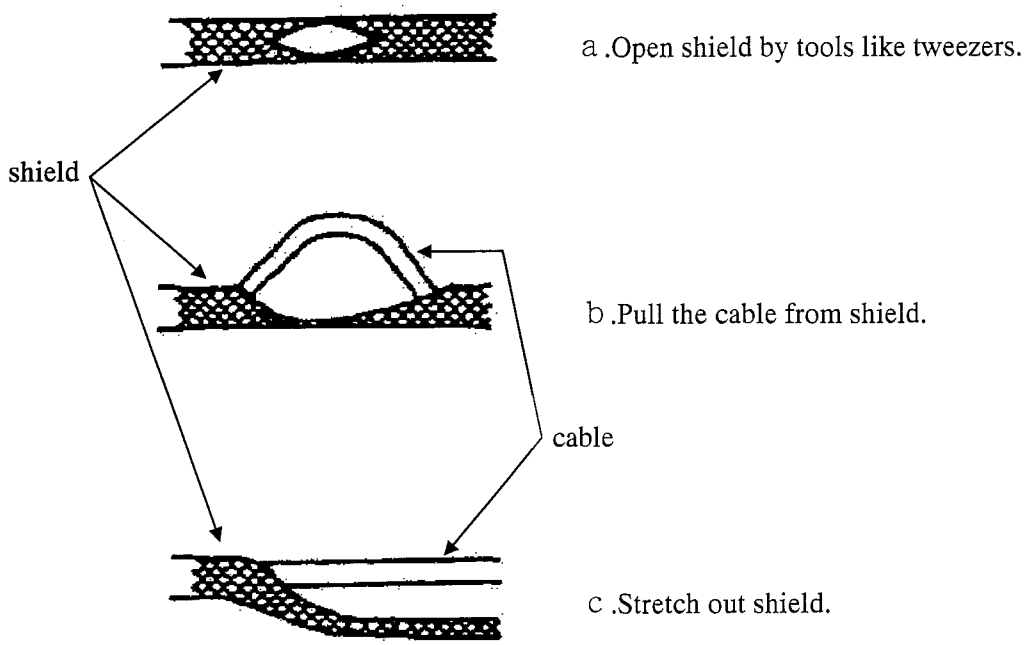


Figure 5.4 Untying shields from cables

■Excitation Cable

Remove each core coating for cable as shown in Figure 5.5. Next, attach the insulating sleeve crimp-style terminals **(Note)**. Then, connect to the converter's terminal block X and Y. Also, connect the red cable core to converter's terminal block E.

Note: Set the size of insulating sleeve crimp-style terminal as below.

Converter type	size of insulating sleeve crimp-style terminal
LF420	M3.5
LF230	M4

Insulating sleeve crimp-style terminals

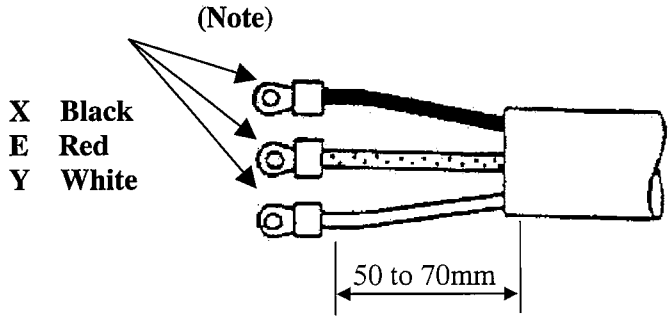


Figure 5.5 Excitation cable end processing

5.3.2 Cable Connections

Refer to the converter instruction manual, to connect the terminated cable wires to the converter's terminal board.

IMPORTANT

Connect the wires securely to the terminal board. A loose connection may result in unsatisfactory flowmeter performance. Make sure the wires are securely connected.

6. Operation

⚠ CAUTION

■ **Do not touch the LF470 main body when high temperature fluid is being measured.**

DON'T

The fluid raises the main body temperature and can cause **burns** when touched.

6.1 Preparatory check

Follow the procedure described below to prepare before starting the flow measurement.

System Check

- Check the wiring between the converter and related instruments.
- Check the wiring between the converter and the detector.
- Make sure all the bolts of connection flanges on which the flowmeter is mounted securely tightened.
- Make sure the direction of flow arrow is in accordance with actual flow.
- Make sure the flowmeter is grounded with 100 ohm or less ground resistance.
- Make sure the converter housing covers are securely tightened.

Placing System On-Stream

- Let the fluid go through the detector pipe. When the detector is filled with the fluid, stop the fluid and keep it still in the detector pipe.

Supplying Electric Power

- Make sure the power supply is as specified.

Checking Converter Parameters

- Check the configuration parameter settings. Refer to Chapter 7, "LCD Display and Controls," Chapter 8, "Configuration Parameter Setting," and Chapter 11, "Communications Function."

Zero Adjustment

- Wait for 30 minutes to warm up the flowmeter. Then making sure the fluid holds still in the detector pipe, starts the zero adjustment.
  Refer to 6.2, "Zero Adjustment."

On-line measurement

After checking the items and conducting the zero adjustment as listed above, let the fluid go through the detector pipe. Output (4–20 mA dc) directly proportional to the flow rate can be obtained.

7. Maintenance and Troubleshooting

⚠ CAUTION	
■ **Do not conduct wiring work when power is applied.**  DON'T Wiring while power is applied can cause electric shock.	■ **Do not touch the LF470 main body when high temperature fluid is being measured.**  DON'T The fluid raises the main body temperature and can cause burns.

7.1 Maintenance

IMPORTANT

It is recommended that the detector pipe be cleaned once a year.

.

■ **Cleaning the pipe wall inside of detector**

If the fluid to be measured contains slurry; a high concentration of electrically conductive solids, the slurry may accumulate as sticking on the pipe wall inside of detector.

The sticking causes a reduction of flow measuring outputs when it is not cleaned inside pipe of detector for a long time.

The flowmeter needs to make sure it remains around the wall inside pipe or not when the following condition had happened.

(1) The flowmeter becomes a reduction of its output.

(2) The flowmeter cannot improve its output in spite of being calibrated.

The flowmeter is required to remove along with clean it using a soft brush. It will be come back the usual and stable flow measurement after cleaning.

The pipe wall is never scratched when cleaning.

*Toshiba recommends to clean inside pipe periodically when this condition will become easily.

*It is better to choose the suitable diameter which becomes more than 3 m/s as its flow velocity to avoid this condition generally.

Notes: Before uninstalling the flowmeter(detector) from the pipe, necessarily confirm the fluid of temperature and chemical property, and empty the fluid from detector. Prepare the way to protect operator and system from bad influence; high temperature fluid and chemical property

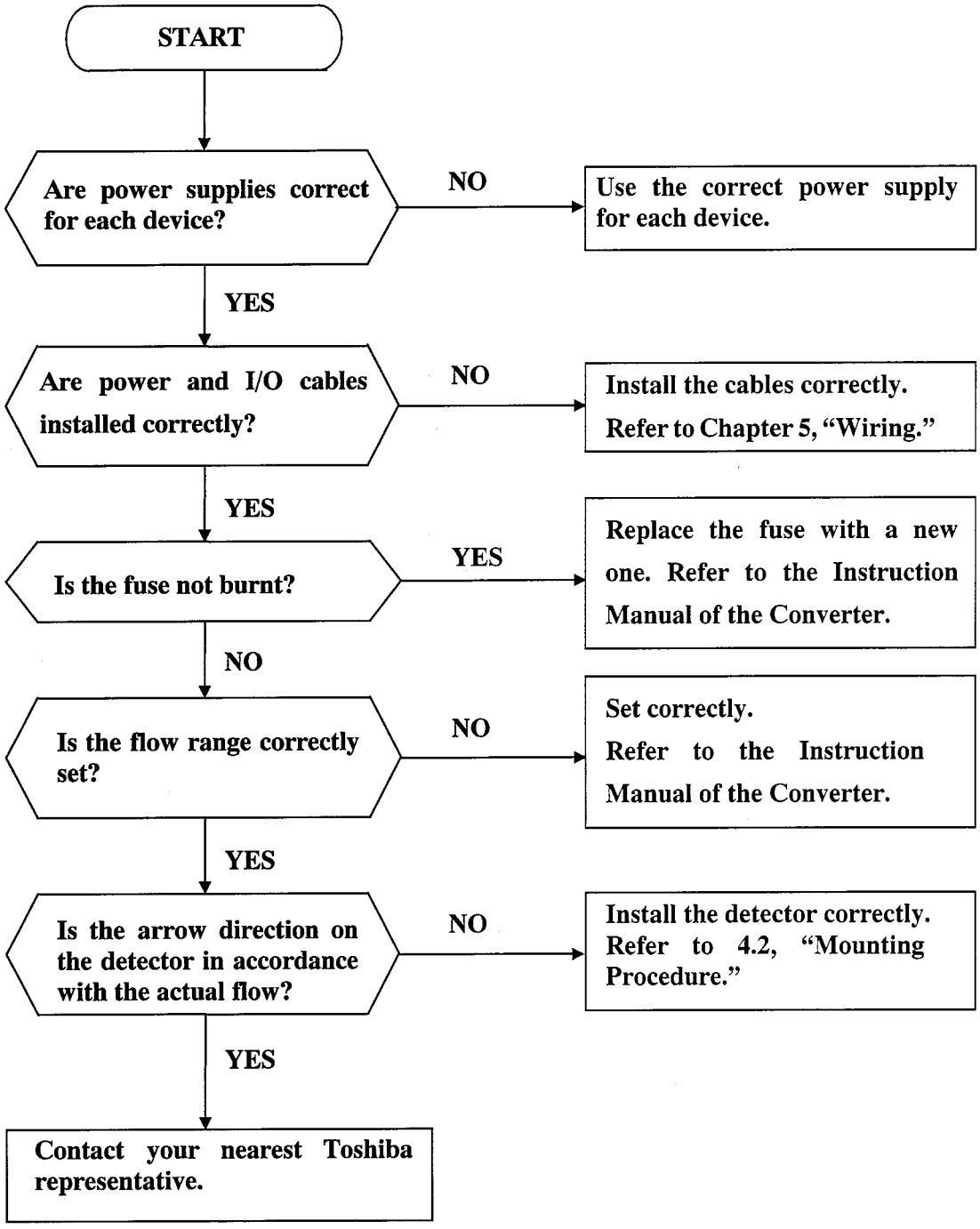
■ **Operative life**

The operative life of this flowmeter is 10 years from the date of shipment. The life of the flowmeter differs depending on the environmental conditions and the way it was used. To extend the life of the flowmeter, inspect the flowmeter periodically and clean or replace components if necessary.

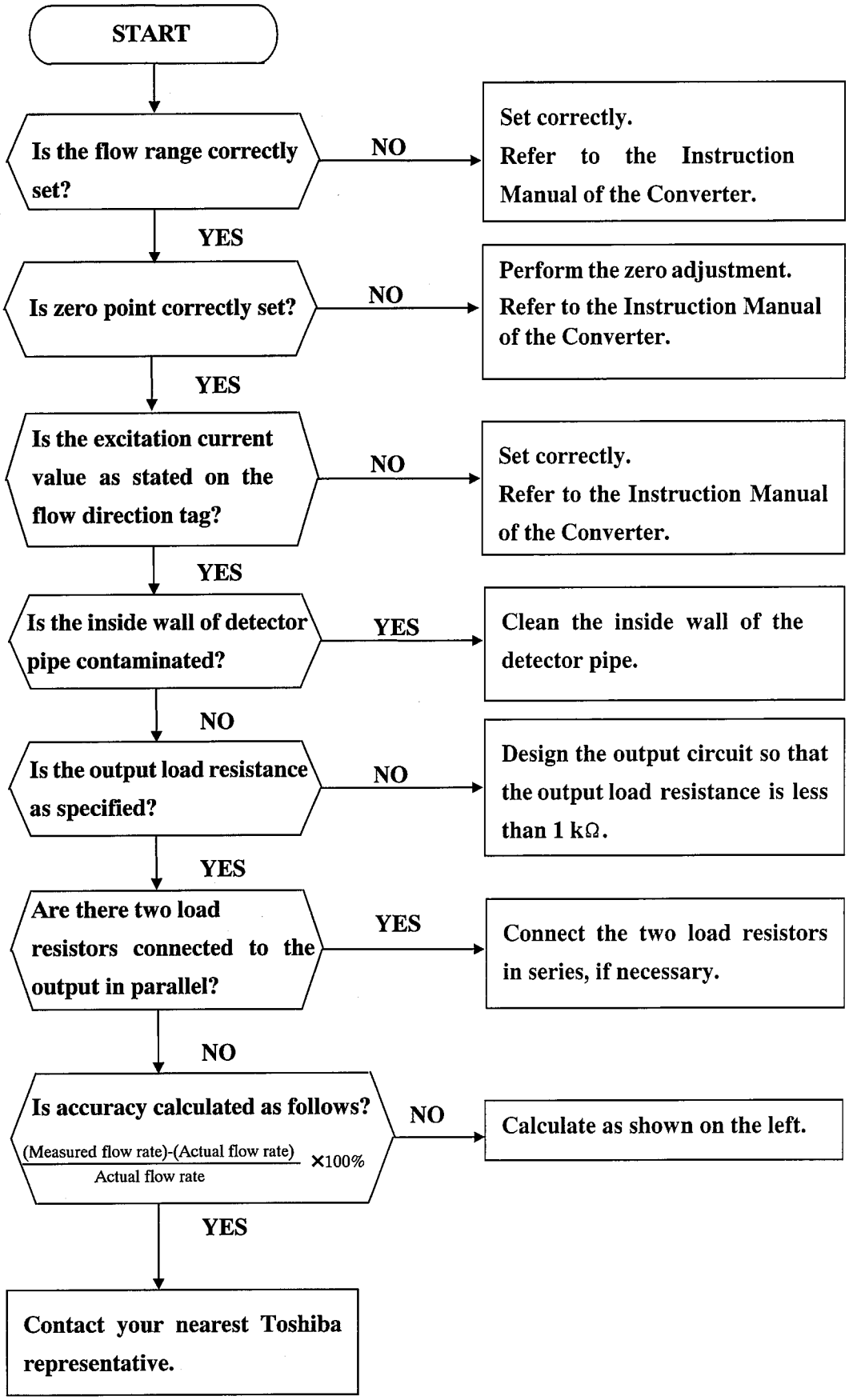
7.2 Troubleshooting

If a problem occurs while using the LF470, follow the flowcharts described below. You may find a way to solve the problem. The flowcharts are based on three symptoms (1) to (3). If you cannot solve the problem, contact your nearest Toshiba representative.

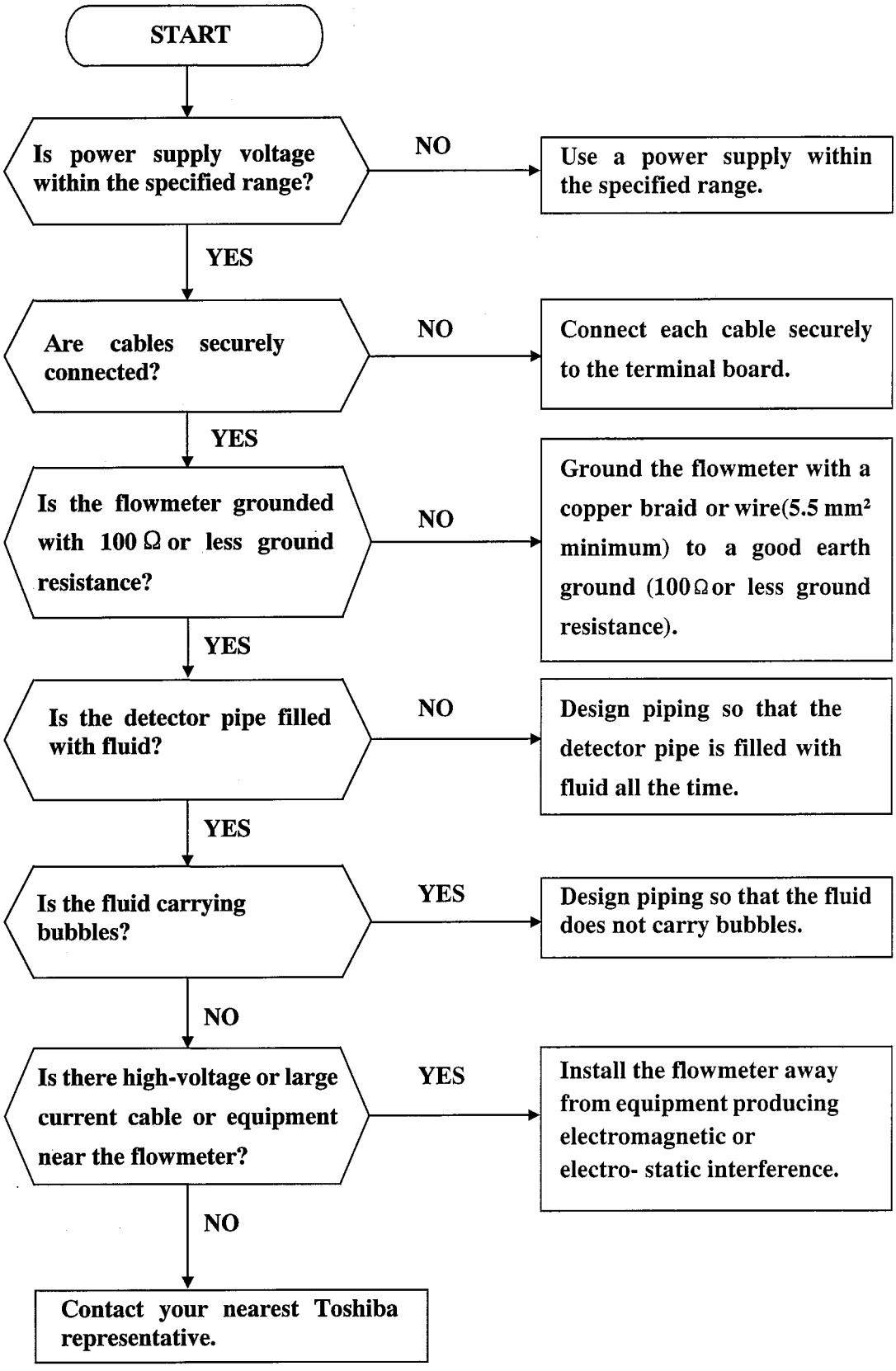
(1) Flow rate is not indicated.



(2) Flow rate indication is not correct.



(3) Flow rate indication is not stable.



8. Principle of Operation

The operating principle of the electromagnetic flowmeter is based on Faraday's Law of electromagnetic induction and it is designed to measure the volumetric flow rate of fluid. An insulated pipe of diameter D is placed vertically to the direction of a magnetic field with flux density B (see Figure 8.1). When an electrically conductive fluid flows in the pipe, an electrode voltage E is induced between a pair of electrodes placed at right angles to the direction of magnetic field. The electrode voltage E is directly proportional to the average fluid velocity V.

The following expression is applicable to the voltage.

$$E = K \times B \times D \times V \text{ [V]} \quad \text{..... (Eq. 8.1)}$$

E = induced electrode voltage [V]
K = constant
B = magnetic flux density [T]
D = meter pipe diameter [m]
V = fluid velocity [m/s]

Volumetric flow rate Q [m^3/s] is:

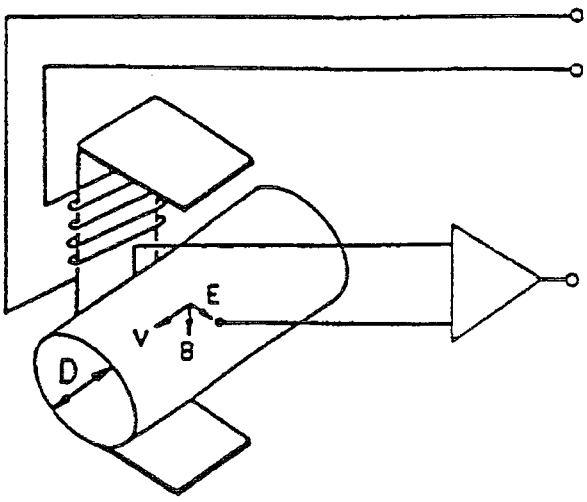
$$Q = \frac{\pi \times D^2}{4} \times V \quad \text{.....(Eq. 8.2)}$$

Using the Equation 8.1 and 8.2

$$E = K \times B \times D \times \frac{4}{\pi \times D^2} \times Q$$

$$E = \frac{4 \times K \times B}{\pi \times D} \times Q \quad \text{.....(Eq. 8.3)}$$

Therefore, volumetric flow rate is directly proportional to the induced voltage.



Square-Wave Excitation

Figure 8.1 Principle of Operation

The LF470 electromagnetic flowmeter uses the square-wave excitation method, which provides long-term stable operation. With square-wave excitation, the LF470 offers reliable measurement without being affected by electrostatic or electromagnetic interference, or electrochemical polarization between the electrodes and the fluid to be measured.

9. Specifications

The flowmeter specifications and the type specification code used when ordering the flowmeter are described in this chapter.

9.1 Flowmeter Specifications

■ Overall Specifications

Meter size: 2.5mm(0.1"), 4mm(0.16"), 6mm(0.25")

Measurement range in terms of flow velocity:

0–0.3 m/s to 0–10 m/s

System accuracy: See the following table.

Table 9.1 System accuracy

Flow rate as a percentage of range	Accuracy	
	0.3 – 1.0 m/s	1.0–10 m/s
50 to 100%	±0.8% of FS	±0.8% of rate
0 to 50%		±0.4% of FS

Note: The accuracy above is measured under standard operating conditions at Toshiba's calibration facility.

Fluid conductivity: 50 μS/cm minimum

Fluid temperature:

Adaptor Material	Fluid temperature
Stainless steel and other metal (Standard)	–10 to +120 °C
Polyvinyl chloride (shock-resistant) (Option)	–10 to +60 °C

Ambient temperature: –10 to +60 °C

Structure: IP67(NEMA4) Watertight

Power consumption:

Converter type	Power supply
LF420	Approx.10W(17VA)
LF230	Approx.14W(25VA)

Fluid pressure: –0.1MPa to 1MPa

Pipe joints:
Rc(PT)1/4 female screw (Standard)
Rc(PT)1/8 female screw (Option)
Rc(PT)3/8 female screw (Option)
Rc(PT)1/2 female screw (Option)
NPT 1/4 female screw (Option)

Principal materials

Case— Cast Aluminum

Lining— Ceramic

Electrodes—Pt-Ir

See Table 9.3 Type Specification Code for optional materials and other related information.

Coating: Phthalic acid resin coating pearl-gray colored

Mass: Approx. 1.0kg (for each size excluding cables)

Table 9.2 Relation between liquid velocity and flow rate at each meter size

Meter size		Flow velocity		
mm	Inch	0.3 m/s	1 m/s	10 m/s
2.5	0.1	0.005301 m^3/h	0.01767 m^3/h	0.1767 m^3/h
		0.08835 l/min	0.2945 l/min	2.945 l/min
4	0.16	0.013570 m^3/h	0.04524 m^3/h	0.4524 m^3/h
		0.2262 l/min	0.7540 l/min	7.540 l/min
6	0.25	0.030540 m^3/h	0.10180 m^3/h	1.0180 m^3/h
		0.5089 l/min	1.6965 l/min	16.965 l/min

9.2 Type Specification Code

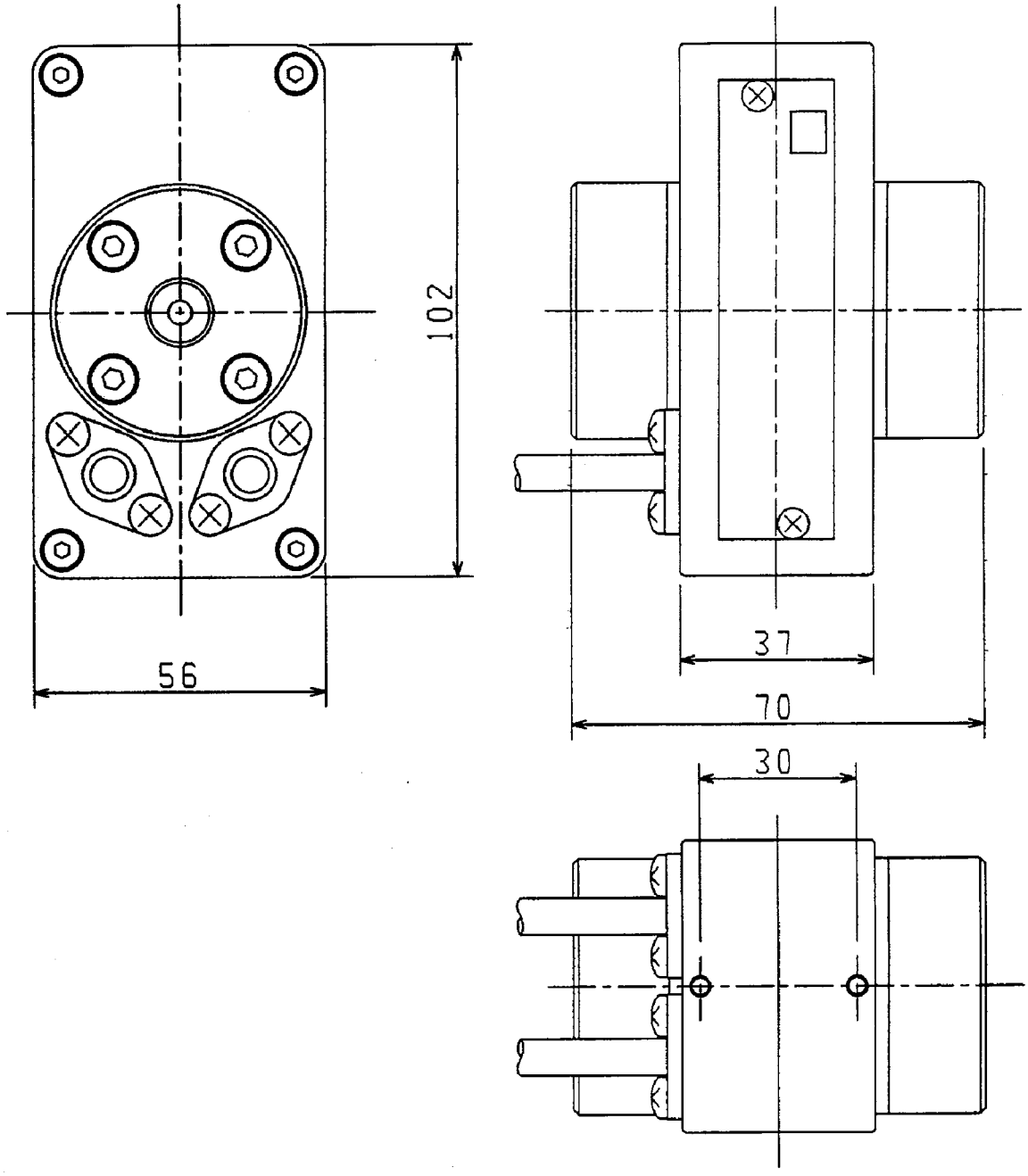
Table 9.3 Type Specification Code (Model LF470 Detector)

Model	Specification Code									Description
1 2 3 4 5	6	7	8	9	10	11	12	13	14	
L F 4 7 0										LF470 Detector
	2									Meter size 2.5mm (1/10") 4mm (1/6") 6mm (1/4")
		D								Assembled converter LF420 LF230
			A							Pipe connection port (adapter) Rc(PT)1/4 female screw (standard) Rc(PT)1/8 female screw Rc(PT)3/8 female screw Rc(PT)1/2 female screw NPT1/4 female screw other
				A						Pipe connection material 316 stainless steel (standard) Ti (titanium) Polyvinyl chloride(shock-resistant) + Ta (tantalum for) grounding ring plate Polyvinyl chloride + Pt-Ir grounding ring plate Other
					C					Gasket material Fluoric rubber for acid-resistant (Standard) **(Note1)** Fluoric rubber for alkali-resistant **(Note1)** other
						A				Mounting board Not provided (standard) Provided (SUS304)
							A			Flow and calibration velocity range 0.3 to 10 m/s (Standard range calibration) 0.3 to 10 m/s (Specified range calibration) other
								A		Dedicate Preformed Cable length 5m (standard) **(Note2)** 5m or more (extension cable dia. 12mm, + Scotch cast connection) 5m or more (extension cable dia. 7mm, + Scotch cast connection) **(Note2)** 5m or more (extension cable dia. 7mm, with no connector termination) **(Note2)**
									A	Coating phthalic acid resin coating, pearl-gray colored (standard) other

Note1: Consult Toshiba before ordering when choose materials at the wetting parts.
Note2: A set of cable ground sized 7mm diameter for converter is packed when the code "A", "C" or "D" are chosen.

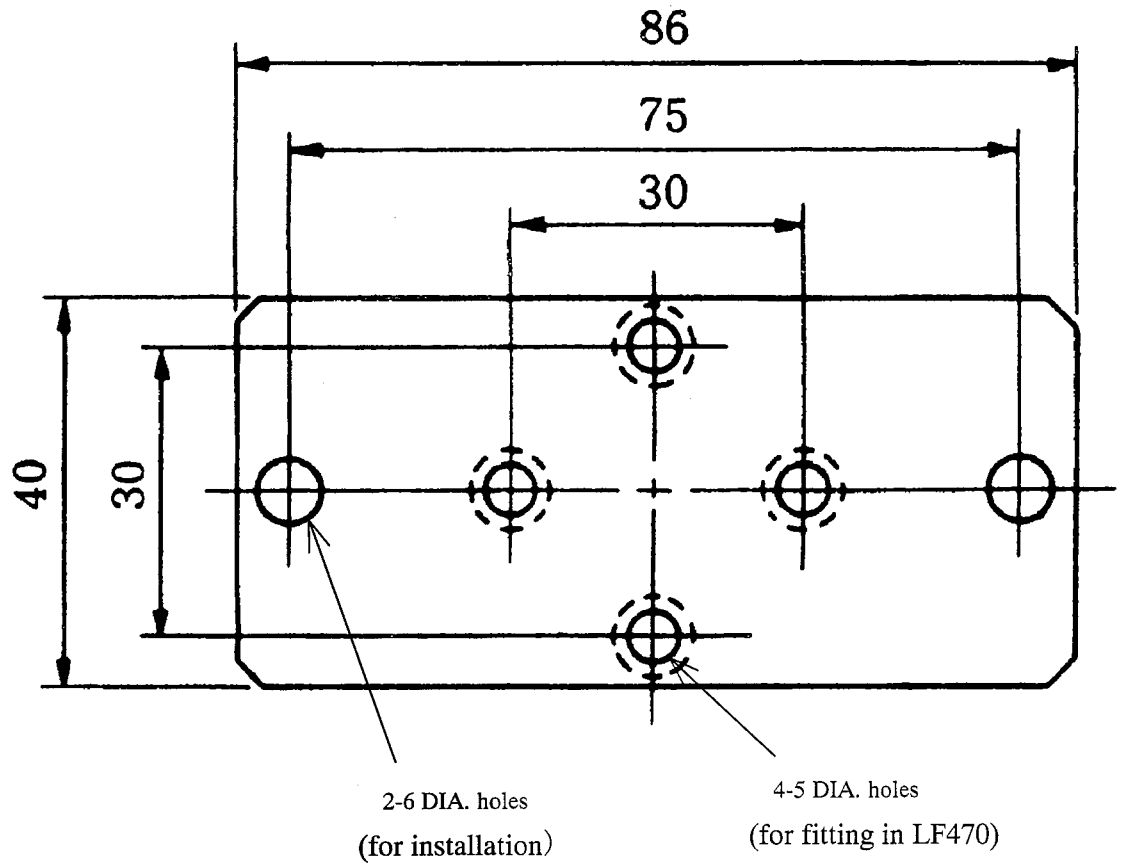
10. Outline Dimensions

Weight: approv. 1.0kg



unit: mm

Figure 10.1 LF470 Outline Dimension



unit: mm

Figure 10.2 Mounting plate (option)

USER'S FORM

NOTES

Unit purchased from	
Name	
Title	
Company	
Address	
City/State or Province	
Country	
Tel	
Fax	
Model/Specification Code	**LF470**
Serial No.	

Industrial Equipment Department
1-1,Shibaura 1-chome, Minato-ku, Tokyo, 105, Japan
Tel.: (03)3457-4900 Fax.: (03)5444-9268

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