

**ELECTROMAGNETIC FLOWMETER DETECTOR**

---

**MODEL LF470**

---

**INSTRUCTION MANUAL**

---

**TOSHIBA CORPORATION****NOTES**

Before using the equipment, please read this manual carefully and understand the contents, and then use the equipment correctly.

- **NEVER attempt to operate the equipment in any ways that are not described in this instruction manual.**
- **After reading this manual, store it with care in a place where it can be referred to whenever needed.**
- **Please be sure that this manual is delivered to the personnel who will use this product.**

## NOTICE

We thank you very much for your purchase of our LF470 series electromagnetic flowmeter detector.  
**Separate type detector LF470**

This instruction manual describes the notes on using an electromagnetic flowmeter detector, installation, configuration and maintenance. It is intended for the personnel in charge of installation, operation and maintenance.

To use this product properly and safely, read this manual (6F8A0914) carefully before using this product. After reading this manual, store it in a place where it can be referred to whenever needed.

Toshiba LF470 electromagnetic flowmeter detectors can be used in combination with various types of electromagnetic flowmeter converters (LF602, LF612 and LF232).

For the notes on usage, connecting, wiring, installation, configuration and maintenance of the combined converter, check the model number of the combined converter and read the instruction manual of the relevant converter.

### About **Safety Precautions**

Read the **Safety Precautions** described at the front carefully and understand the contents before using this product.

The “**Safely symbols**” used in the “**Safety Precautions**” are shown in a location such as in the margin to the left of the corresponding commentary in the main text.

## 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.



# 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**.

 <b>WARNING</b>	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	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 <b>DON'T</b> 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. <b>DO</b> 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

 <b>WARNING</b>	
<p>■ Do not use the LF470 in an <b>explosive atmosphere</b>.</p>	
 <b>DON'T</b>	<p>Using this product in an explosive atmosphere can cause <b>explosion</b>.</p>

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

# SAFETY PRECAUTIONS (continued)

## Safety Precautions for Installation and Wiring

 <b>CAUTION</b>	
<p>■ Do not touch the LF470 main body when <b>high temperature fluid</b> is being measured.</p> <p> The fluid raises the main body temperature and can cause <b>burns</b> when touched.</p> <p><b>DON'T</b></p>	<p>■ Do not conduct wiring work when <b>power is applied</b>.</p> <p> Wiring while power is applied can cause <b>electric shock</b>.</p> <p><b>DON'T</b></p>
<p>■ Do not conduct wiring work <b>with wet hands</b>.</p> <p> Wet hands may result in <b>electric shock</b>.</p> <p><b>DON'T</b></p>	<p>The label shown left is placed near the terminal board for power input. (A black border and symbol on yellow triangle)</p> <p></p> <p>Be alert to <b>electric shock</b>.</p>
<p>■ Do not use a <b>fuse other than the one specified</b>.</p> <p> Using a fuse other than the one specified can cause <b>system failure, damage or malfunction</b>.</p> <p><b>DON'T</b></p>	<p>Use a rated fuse as follows:</p> <p><b>Fuse rating:</b></p> <ul style="list-style-type: none"> <li>• 1A/250V for 100 to 240Vac or 110Vdc</li> <li>• 2A/250V for 24 V dc</li> </ul> <p><b>Dimensions:</b> Diameter 5.2 mm × 20 mm</p> <p><b>Melting time characteristic:</b> Normal blow</p>

### Usage limitation

This product is **not manufactured for applying to a system requiring safety directly involved human life as follows**. Please contact your nearest Toshiba representative if there is a possibility of using this product for such use.

- **Main control systems of nuclear power plants, safety protection systems in nuclear facilities or other important systems requiring safety**
- **Medical control systems relating to life support**

### Warranty and Limitation of Liability

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 there is snow and ice
  - 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.**
- (2) The cable connection is tightened securely at the time of shipment. Do not remove the connection.
- (3) Make sure the fluid to be measured will not freeze in the detector pipe. This can cause damage to the detector pipe.
- (4) Select appropriate wetted materials suited for the process fluid to be measured. Otherwise, fluid leakage due to corrosion can be caused.
- (5) 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.
- (6) 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.
- (7) 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

<b>SAFETY PRECAUTIONS</b> .....	2
<b>Handling Precautions</b> .....	5
<b>1. Product Inspection and Storage</b> .....	7
1.1 Product Inspection .....	7
1.2 Storage .....	7
<b>2. Overview</b> .....	8
<b>3. Names of Parts</b> .....	9
<b>4. Installation</b> .....	10
4.1 Location .....	11
4.2 Mounting Procedure .....	12
4.3 Piping Connections .....	13
<b>5. Wiring</b> .....	17
5.1 Cables .....	18
5.2 External Device Connections and Grounding .....	19
5.3 Wiring Procedure .....	21
<b>6. Operation</b> .....	24
6.1 Preparatory Check .....	24
<b>7. Maintenance and Troubleshooting</b> .....	25
7.1 Maintenance .....	25
7.2 Troubleshooting .....	27
<b>8. Principle of Operation</b> .....	30
<b>9. Specifications</b> .....	31
9.1 Flowmeter Specifications .....	31
9.2 Type Specification Code .....	33
<b>10. Outline Dimensions</b> .....	34

# 1. Product Inspection and Storage

## 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
(3) cable connection (Note1) .....	2

**Note1:** In case of that the 7th column at specification code of the LF470 is D or E, and the 13th column at that is A, C or D; assembled converter is LF602, LF612 or LF230, and diameter of the cable is 7mm, the cable connections are included.

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

### CAUTION

- (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) If it leaves the cover of converter open while being stored, gradual deterioration of circuit isolation can be caused. And then **don't open the cover** until it is connected with wires.
- (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.

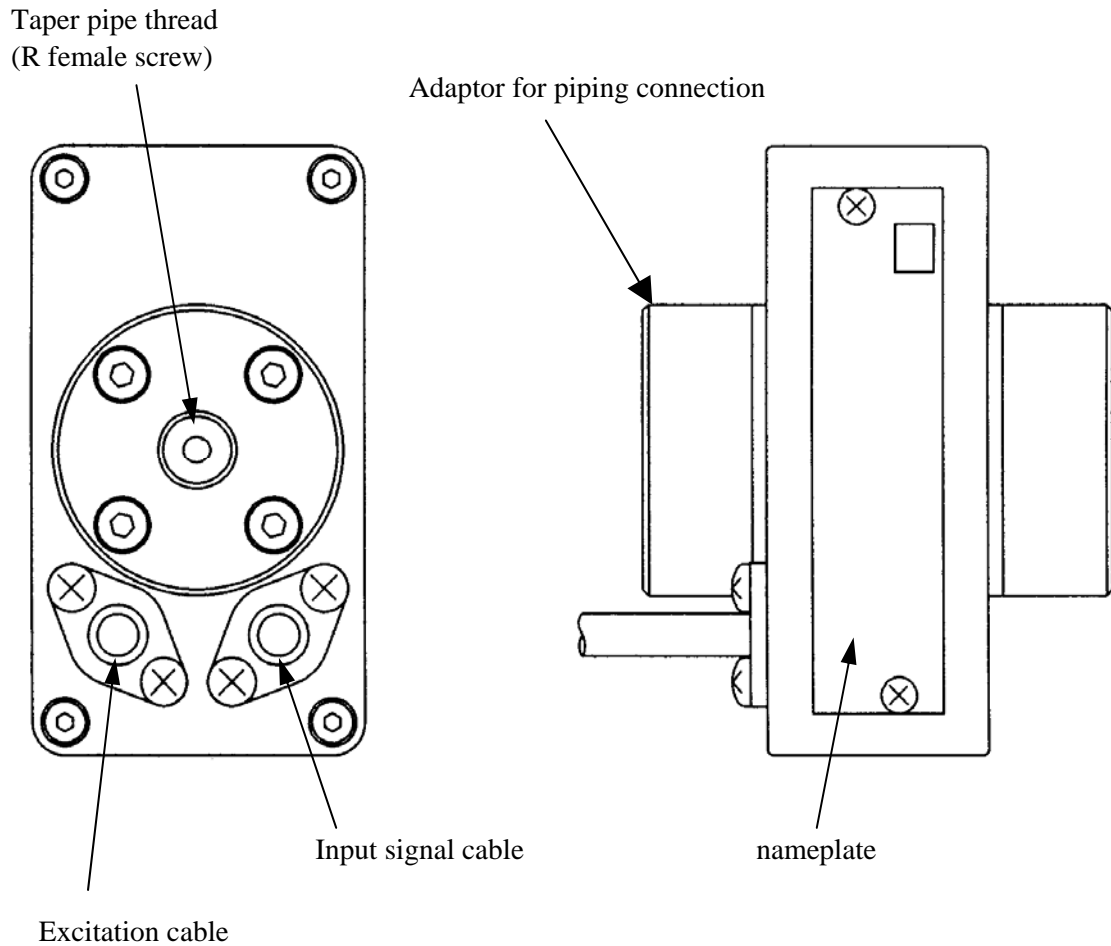
The LF470 electromagnetic flowmeter detector has the following additional features:

- (1) High accuracy,  **$\pm 0.8\%$  of rate** is possible for 1.0–10 m/s velocity range.  
 **$\pm 0.8\%$  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




 <b>CAUTION</b>	
<p>■ <b>Ground the LF470 independently from power equipment.</b></p> <p> Operating this product without grounding can cause <b>electric shock</b> or <b>malfunction</b>.</p> <p><b>DO</b></p>	<p>■ <b>Use an appropriate device to carry and install the LF470.</b></p> <p> If his product <b>falls to the ground</b>, injury, or malfunction of or damage to the product, can be caused.</p> <p><b>DO</b></p>
<p>■ <b>Install a switch and fuse to isolate the LF470 from main power.</b></p> <p> Power supply from mains power can cause <b>electric shock</b> or <b>circuit break-down</b>.</p> <p><b>DO</b></p>	<p>■ <b>Do not modify or disassemble the LF470 unnecessarily.</b></p> <p> Modifying or disassembling this product can cause <b>electric shock, malfunction</b> or <b>damage to this product</b>.</p> <p><b>DON'T</b></p>
<p>■ <b>Do not work on piping and wiring with wet hands.</b></p> <p> Wet hands may result in <b>electric shock</b></p> <p><b>DON'T</b></p>	<p> The label shown left is placed near the terminal board for power supply to the converter. Be alert to <b>electric shock</b></p>

## 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.

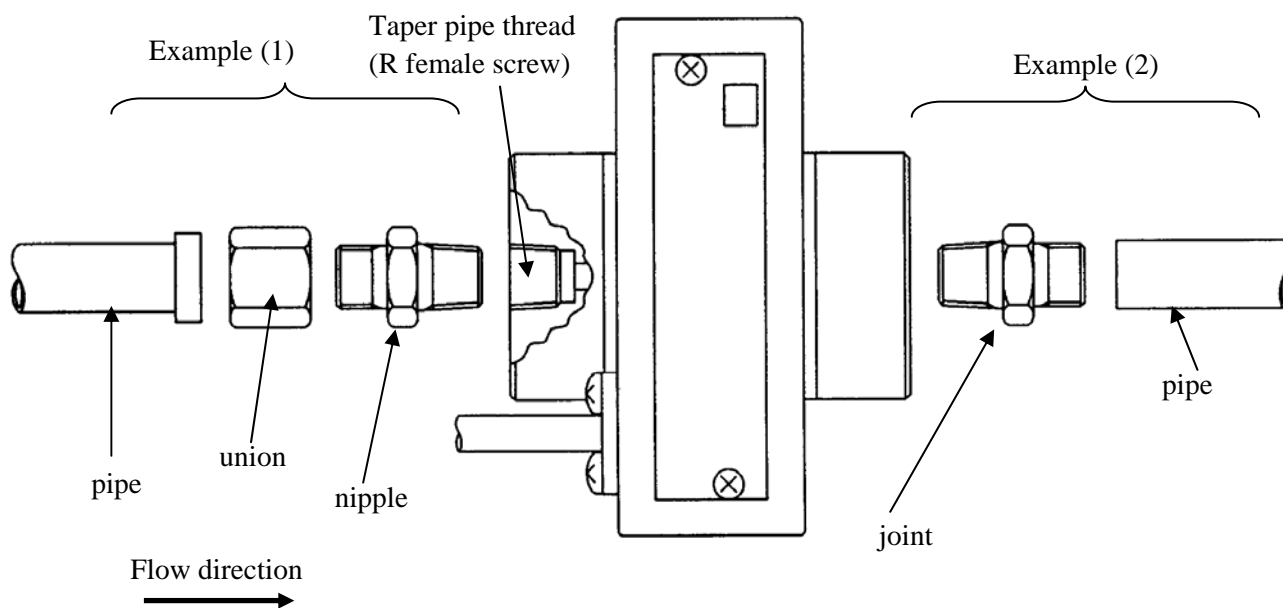
## 4.2 Mounting Procedure

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

### 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 joint
  - (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:**

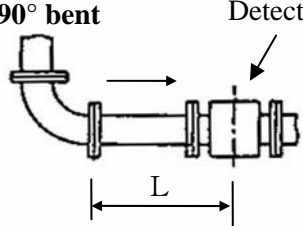
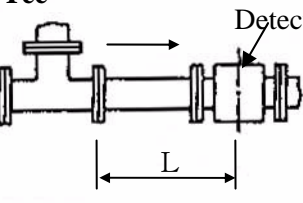
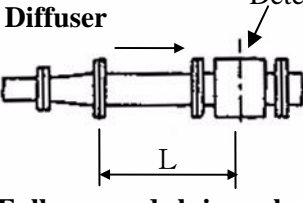
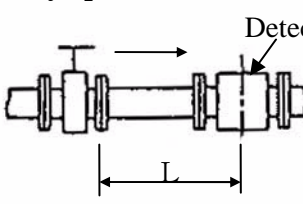
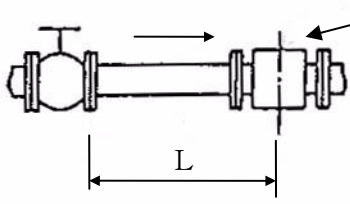
- (1) Preventing from leaking, seal up R male screw with sealant which is appropriate material to the process fluid to be measured.
- (2) Keep that the inner diameters of the nipple, the joint and pipe on the sides of the detector larger than that of LF470. If not, the air bubbles will stagnate in the measuring pipe and they may disturb the normal measurement of flow rate.

### 4.3 Piping Connections

#### (1) Required Upstream Straight 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**

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

**L:** Required straight pipe length—straight pipe length plus half length of the detector.

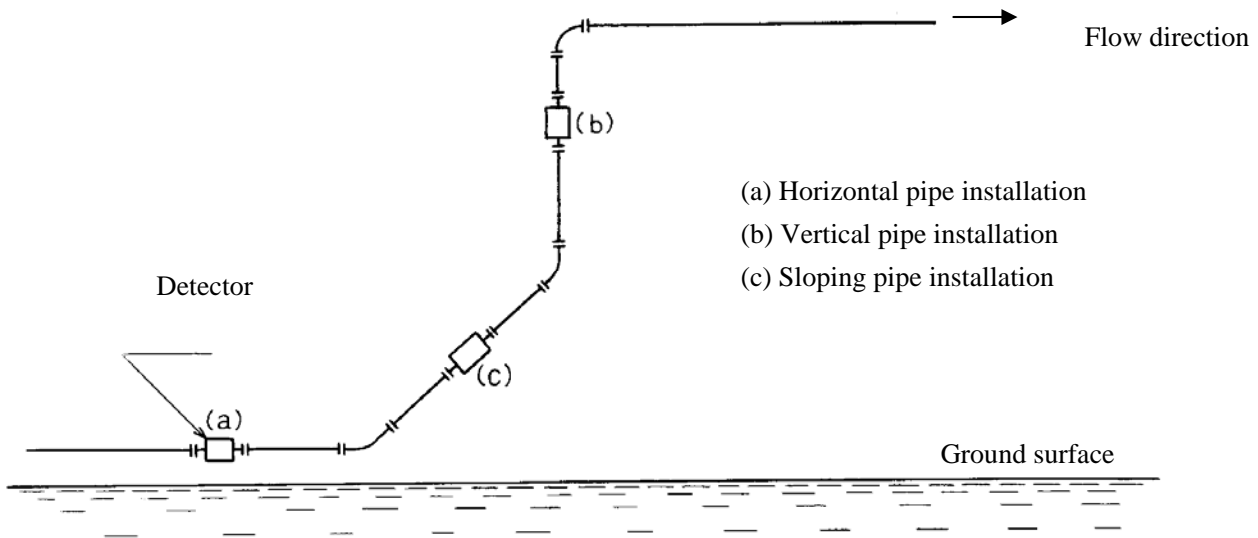
**D:** Nominal bore size (diameter)

**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.

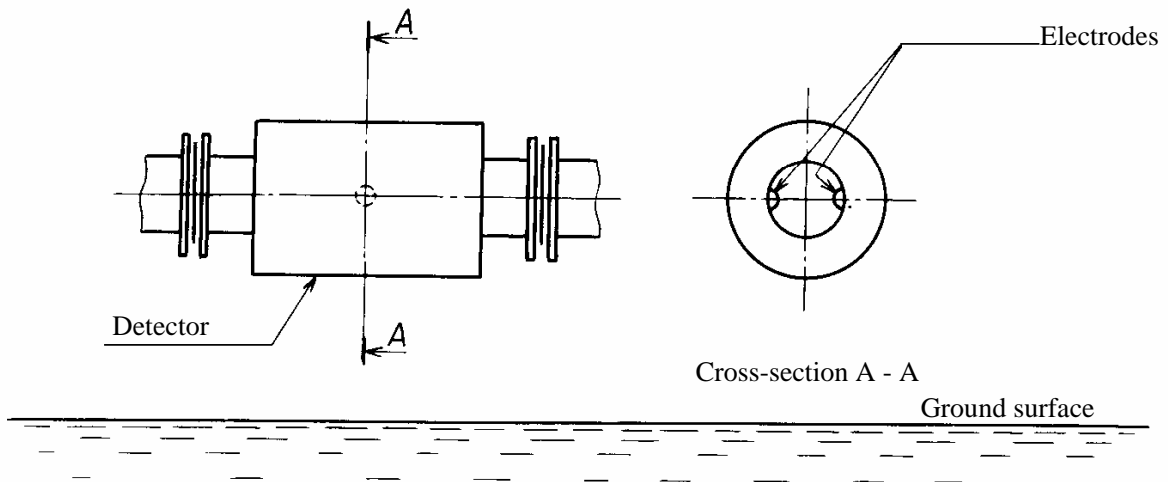
**(2) Pipe Orientation**

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. If no air bubble, Vertical down flow application are acceptable under pressured piping conditions. See Figure 4.3.



**Figure 4.2 Detector Piping Orientation**

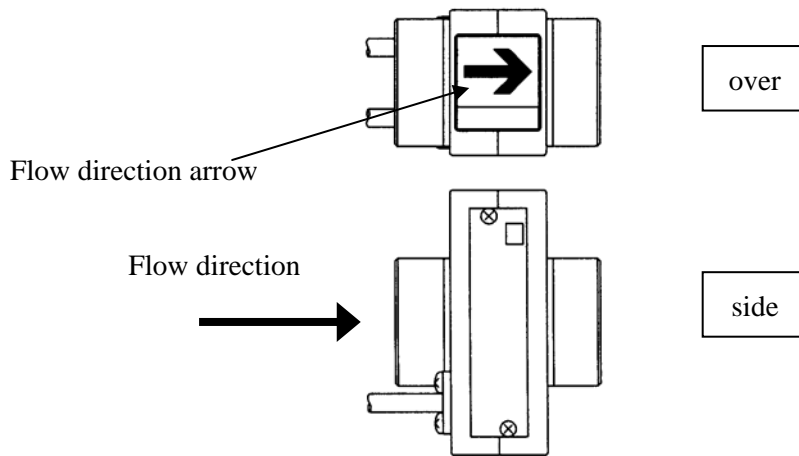
The electrodes should be positioned horizontally relative to the ground surface in any piping installation. See Figure 4.3.



**Figure 4.3 Installation position of the detector**

**(3) Flow Direction**

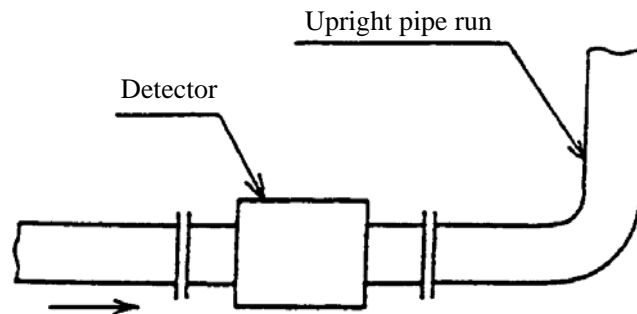
Install the detector in accordance with the flow direction arrow on the detector. See Figure 4.4.



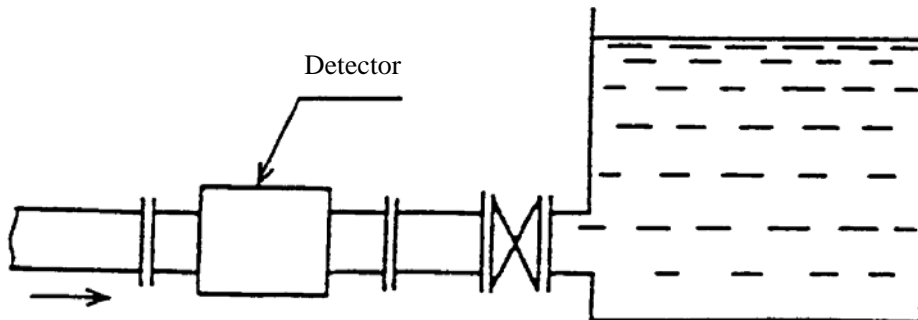
**Figure 4.4 Flow direction arrow on the detector**

**(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**

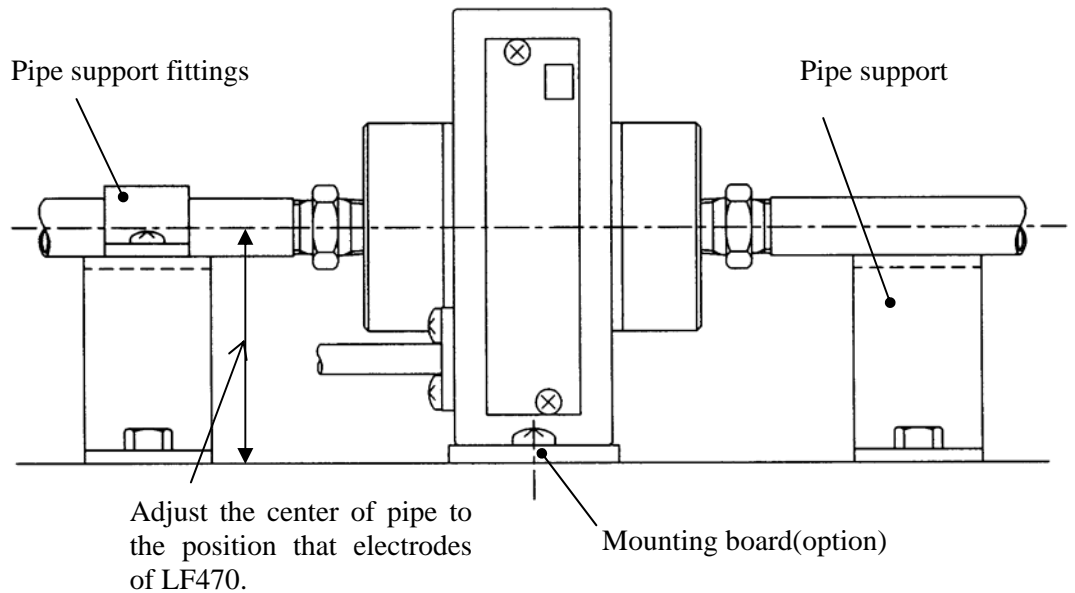


**Figure 4.6 Detector with sufficient head pressure at downstream outlet**

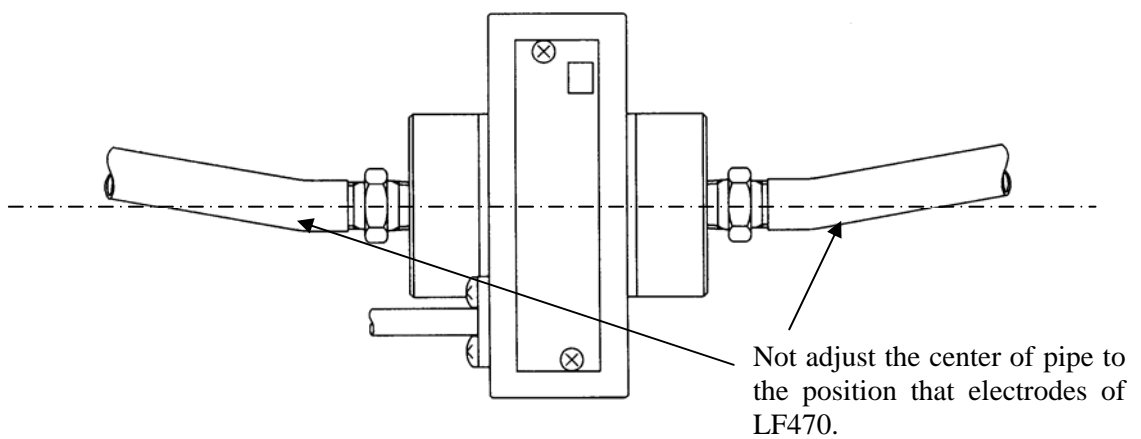


**(5) Supporting Pipe**

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

 <b>CAUTION</b>	
<p>■ <b>Do not work on piping and wiring with wet hands.</b></p> <p>Wet hands can cause <b>system failure.</b></p> <p style="text-align: center;">   <b>DON'T</b> </p>	<p>■ <b>Ground the LF470 properly.</b></p> <p>Operating this product without a grounding can cause <b>system malfunction.</b></p> <p style="text-align: center;">   <b>DO</b> </p>
<p>■ <b>Do not modify or disassemble the LF470 unnecessarily.</b></p> <p>Modifying or disassembling this product can cause <b>electric shock, malfunction of or damage to this product.</b></p> <p style="text-align: center;">   <b>DON'T</b> </p>	<p>The label shown left is placed near the terminal board for power input. Be alert to <b>electric shock.</b></p> <p style="text-align: center;">  </p>

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 locate 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
<b>Excitation cable</b>	Three-core chloroprene cabtyre cable ( Rubber coverd cable )	5m	0.5 mm <sup>2</sup>	6 to 8 mm
<b>Input signal cable</b>	Two-core sheathed chloroprene cabtyre cable ( Rubber coverd cable )	5m	0.3 mm <sup>2</sup>	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
<b>Excitation cable</b>	Three-core chloroprene cabtyre cable ( Rubber coverd cable )	2 mm <sup>2</sup>	11 to 13 mm
<b>Input signal cable</b>	Two-core sheathed chloroprene cabtyre cable ( Rubber coverd cable )	0.75 mm <sup>2</sup>	11 to 13 mm

**Note:** Total cable length must be within 30m .

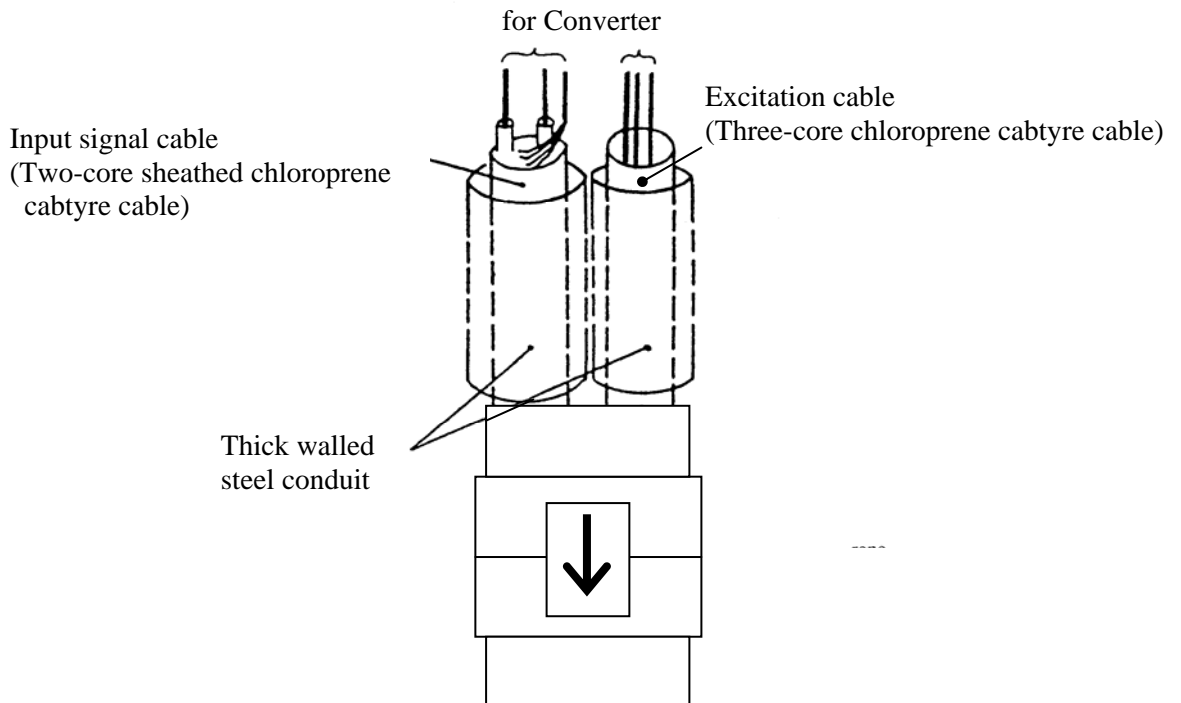
## 5.2 External Device Connections and Grounding

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

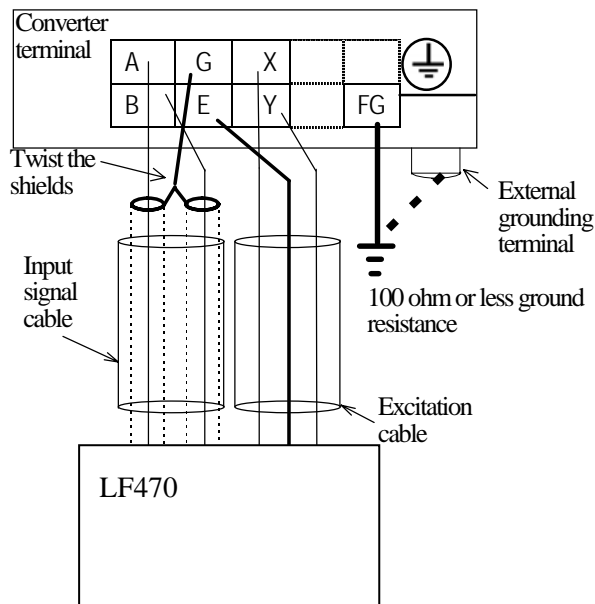
- (1) The input signal cable and excitation cable are attached to the detector. Be sure to use the attached cable, check the specification of the detector.
- (2) The converter side ends of the attached cables are covered with caps to prevent exposure to humidity. Do not remove the caps from the cable 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<sup>2</sup> 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

 <b>CAUTION</b>	
<p>■ Do not conduct wiring work when <b>power is applied.</b></p> <div style="display: flex; align-items: center;">  <p style="margin: 0;">Wiring while power is applied can cause <b>electric shock.</b></p> </div> <p><b>DON'T</b></p>	<p>■ Do not work on piping and wiring <b>with wet hands.</b></p> <div style="display: flex; align-items: center;">  <p style="margin: 0;">Wet hands may result in <b>electric shock.</b></p> </div> <p><b>DON'T</b></p>

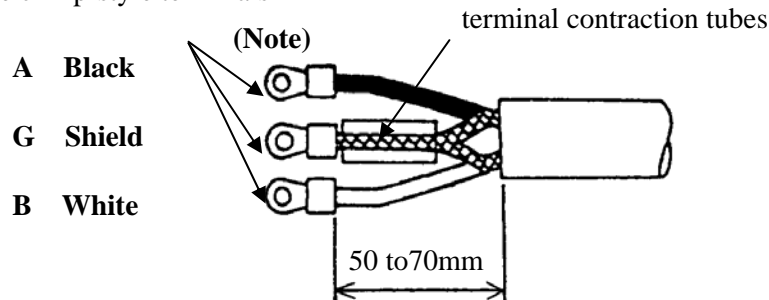
#### ■ Input signal Cable

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
LF602, LF612	M3.5
LF232	M4

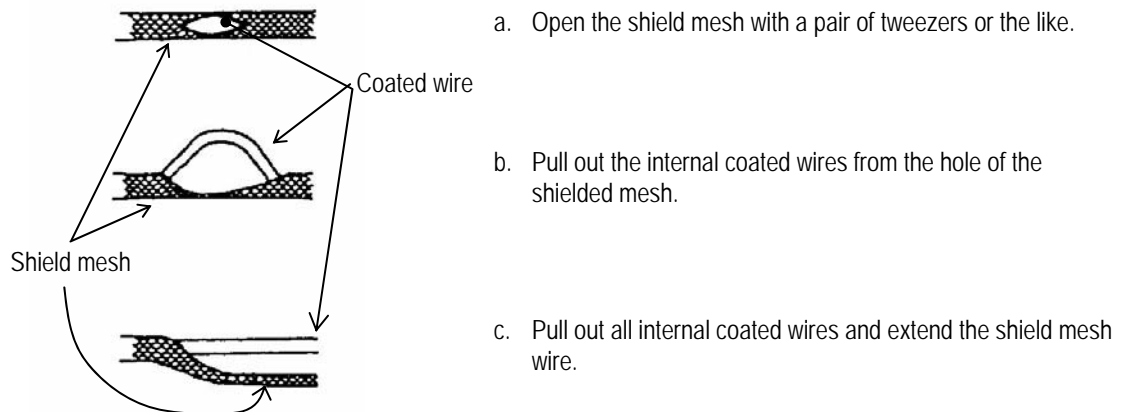
Insulating sleeve crimp-style terminals



**Figure 5.3 Input signal cable end processing**

## ● Notes on signal cable shield processing work

When stripping an external sheath, intermediate and insulated sheath, be careful not to scratch or cut the internal conductors and shield mesh. Do not disjoint the shield mesh but treat it as shown in Figure 5.4.



**Figure 5.4 Untying shields from cables**

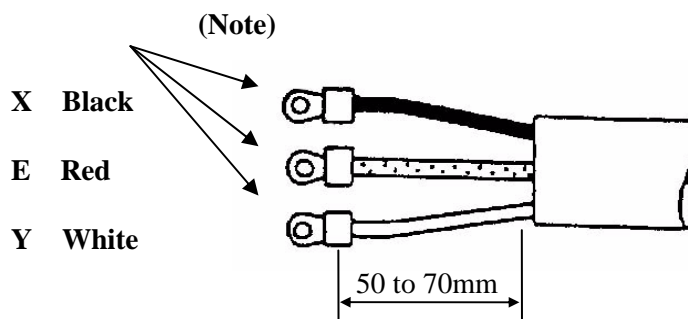
■ Excitation Cable

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
LF602,LF612	M3.5
LF232	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.

**Notice**

See the 7th and 13th column at specification code of the LF470, if the 7th code is D or E and 13th code is A, C or D; assembled converter is LF602, LF612 or LF230, and diameter of the cable is 7mm, the cable connections that suitable for 7mm diameter of cable are included in package with the flowmeter and the manual. Change the cable connections for suitable cable connections.



Use the suitable cable connections when connecting the cable. Unsuitable diameter of them may not keep vapor tight of converter, which may be damaged according to the moisture coming into.

**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.

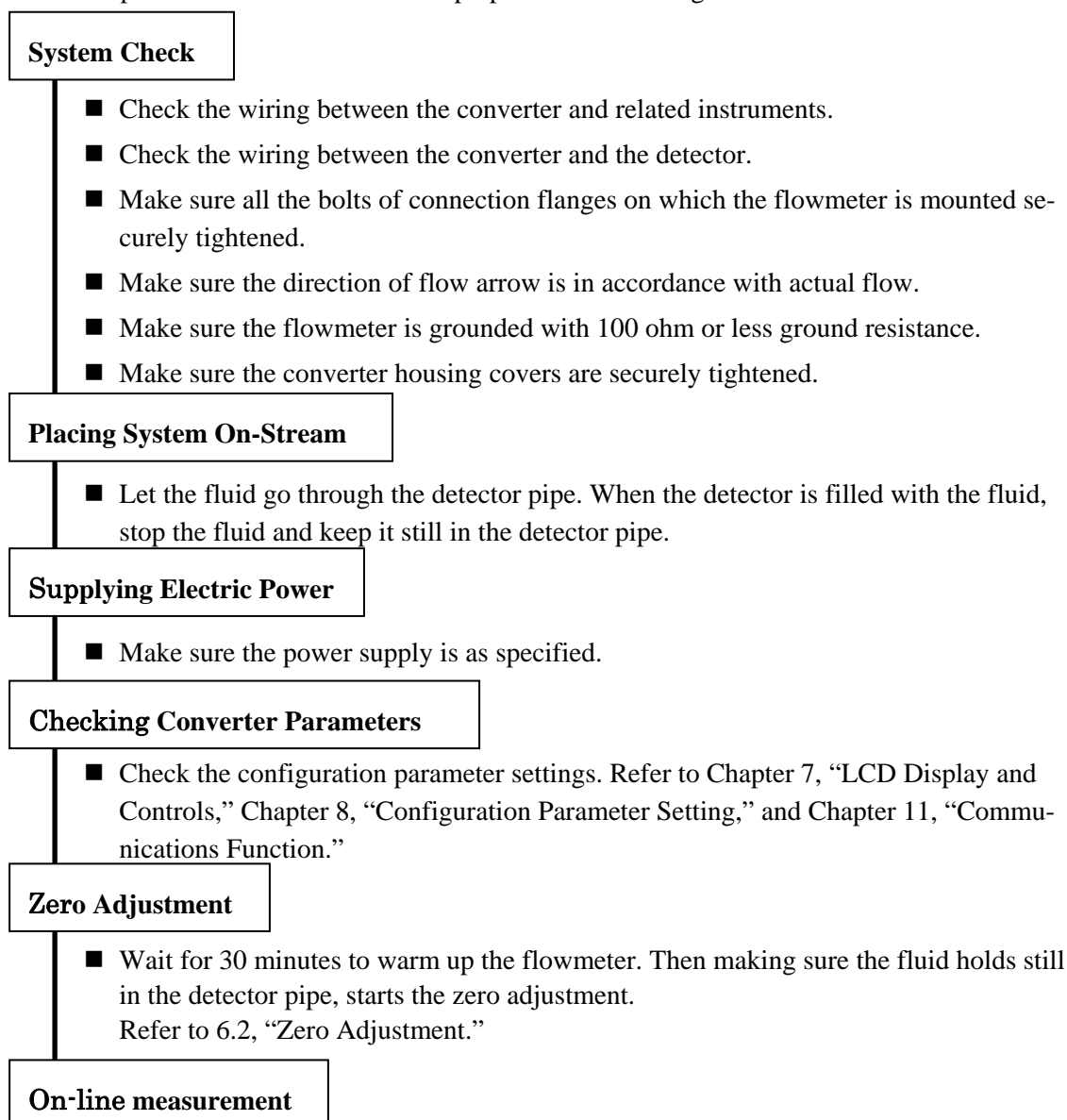


## 6. Operation

 <b>CAUTION</b>	
<ul style="list-style-type: none"> <li>■ <b>Do not touch the LF470 main body when high temperature fluid is being measured.</b></li> </ul>	
 <b>DON'T</b>	<p>The fluid raises the main body temperature and can cause <b>burns</b> when touched.</p>




### 6.1 Preparatory check

Follow the procedure described below to prepare before starting the flow 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

 <b>CAUTION</b>	
<p>■ <b>Do not conduct wiring work when power is applied.</b></p> <p style="text-align: center;">   <b>DON'T</b> </p> <p>Wiring while power is applied can cause electric shock.</p>	<p>■ <b>Do not touch the LF470 main body when high temperature fluid is being measured.</b></p> <p style="text-align: center;">   <b>DON'T</b> </p> <p>The fluid raises the main body temperature and can cause burns.</p>

### 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

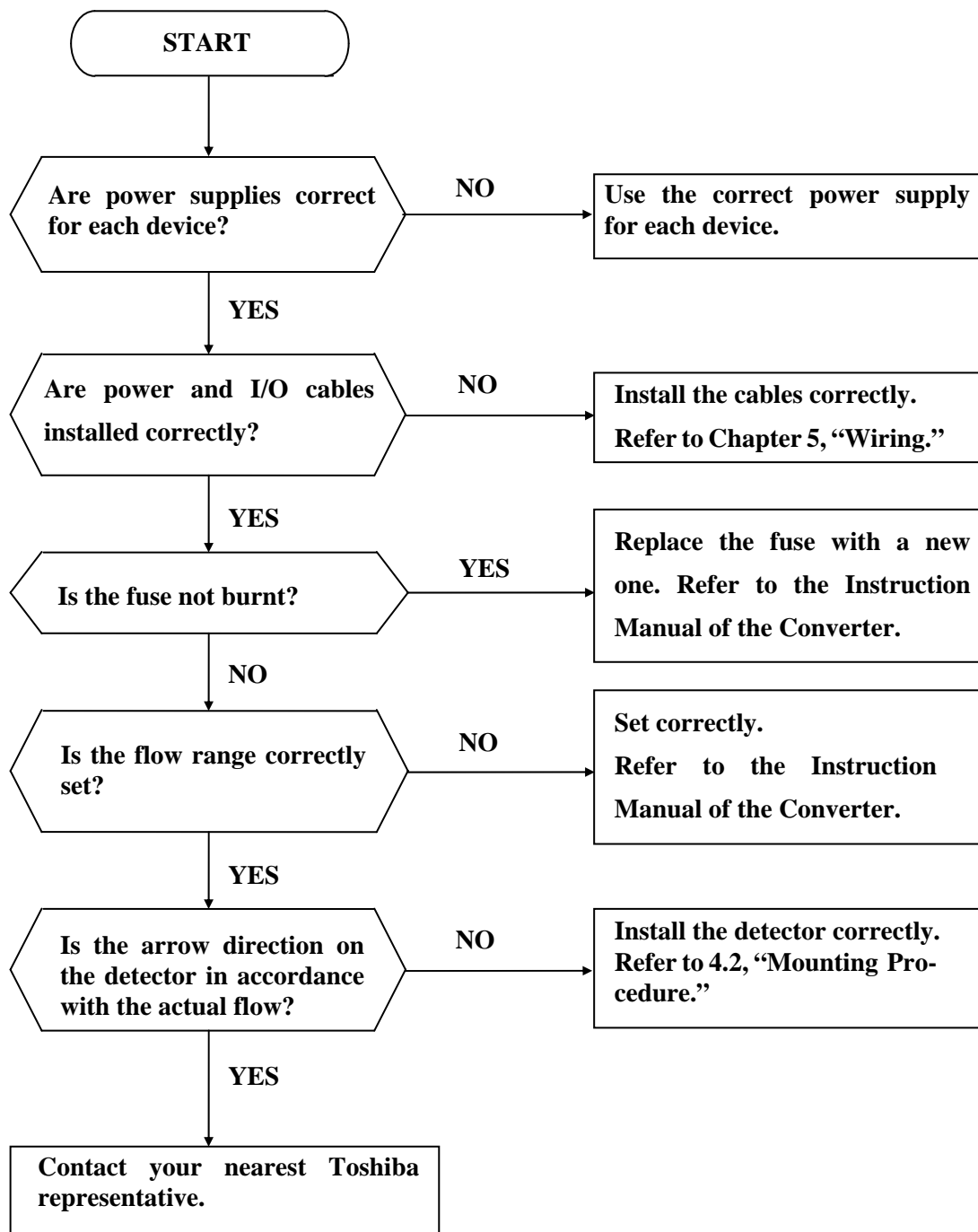
**■ Operative life**

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.

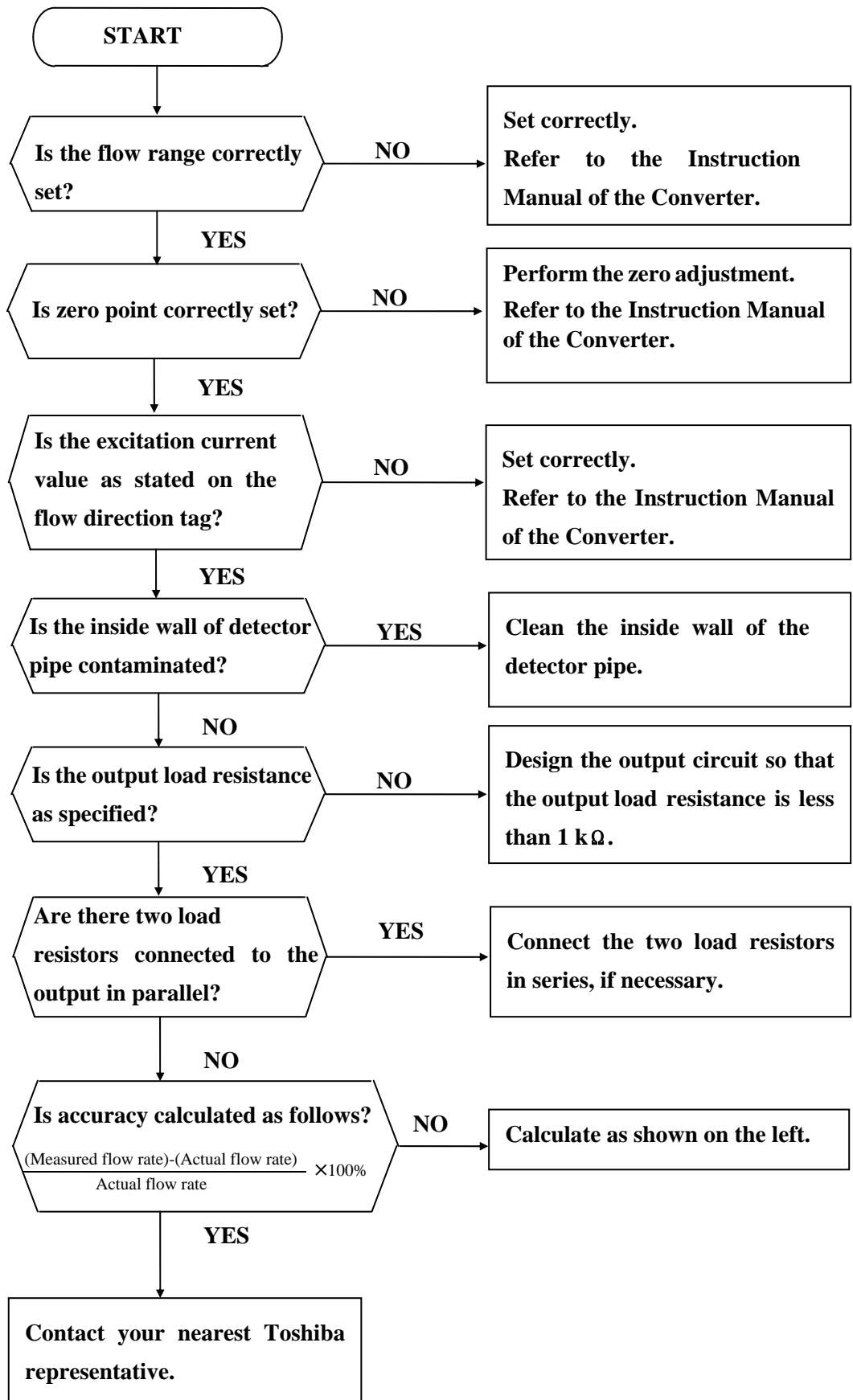
## 7.2 Troubleshooting

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.

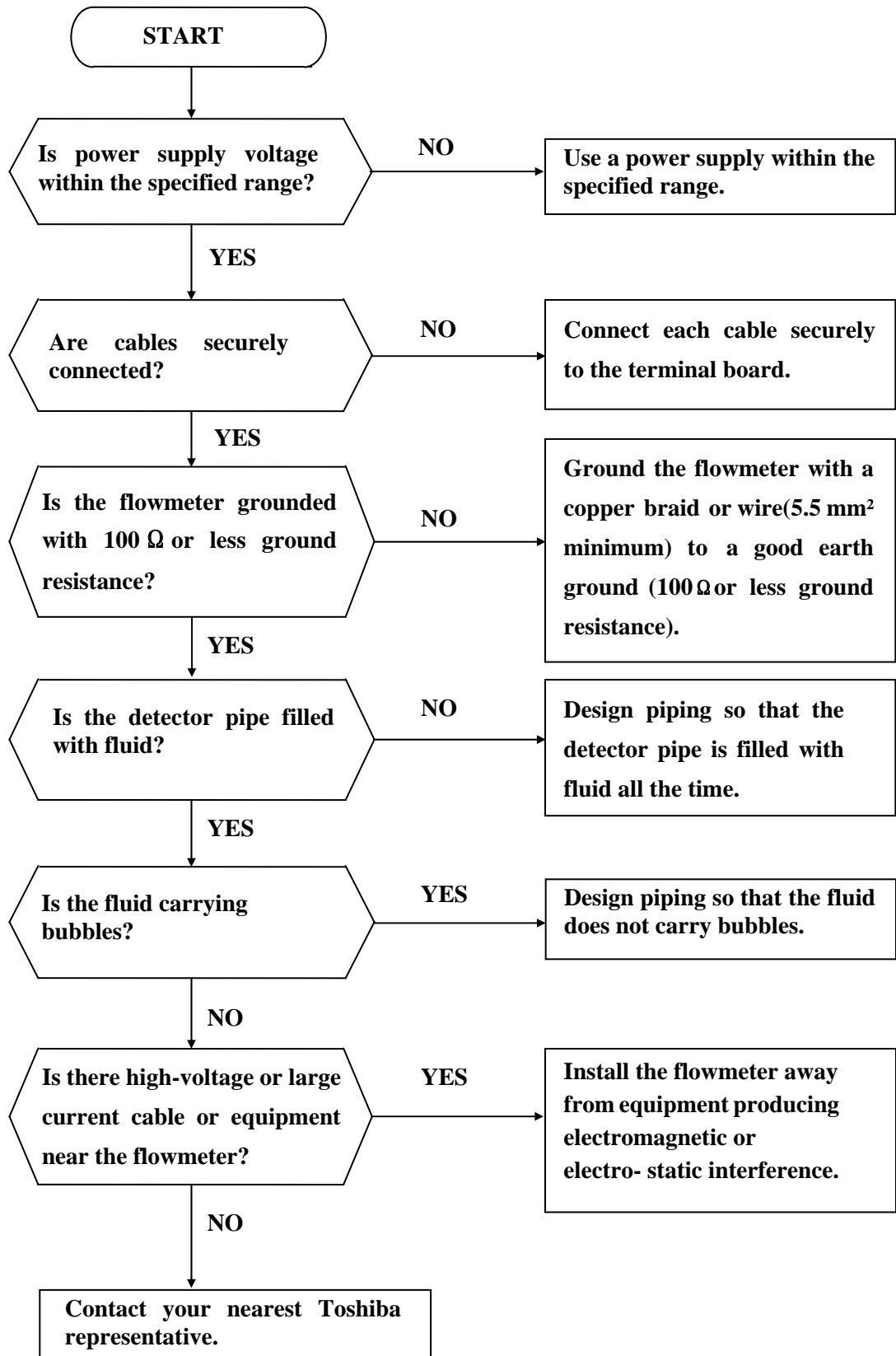
### (1) Flow rate is not indicated.



**(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.

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

$E$  = 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<sup>3</sup>/s] is:

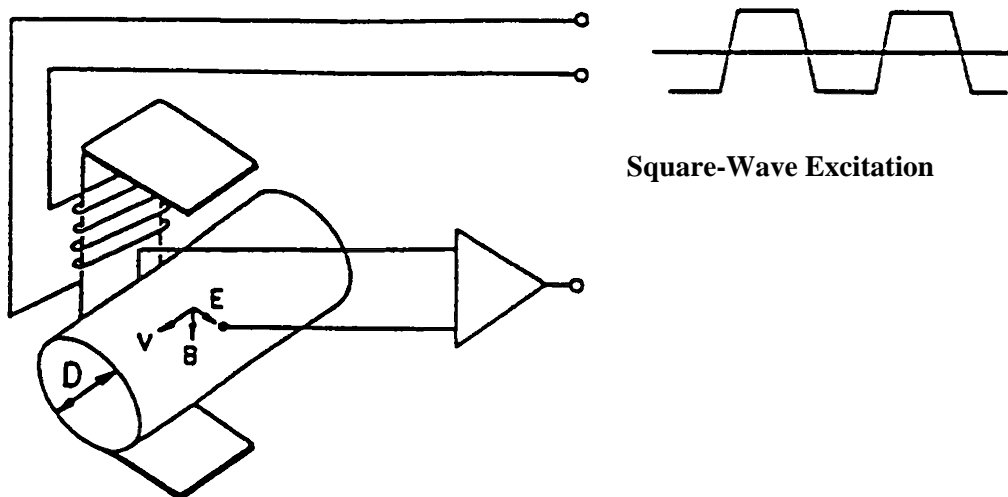
$$Q = \frac{\pi \times D^2}{4} \times V \text{ .....(Eq. 8.2)}$$

Using the Equation 8.1 and 8.2

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

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

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



**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:** 1/10"(2.5mm), 1/6"(4mm), 1/4"(6mm)

**Measurement range in terms of flow velocity:**

0–1.0 ft/s to 0–32.8 ft/s (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	
	1.0–3.3 ft/s (0.3 – 1.0 m/s)	3.3–32.8 ft/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)	14 to 248 °F (–10 to +120 °C)
Polyvinyl chloride (shock-resistant) (Option)	14 to 140 °F (–10 to +60 °C)

**Ambient temperature:** 14 to 140 °F (–10 to +60 °C)

**Structure:** IP67

**Power consumption:**

Converter type	Power supply
LF602, LF612	Approx.17W(27VA)
LF232	Approx.14W(25VA)

**Fluid pressure:** –15 to 150 psi , or –1.0 to 10 bar (–0.1 to 1.0 MPa)

**Pipe joints:**

- Rc(PT)1/4 female thread (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)
- NPT 3/8 female screw (Option)
- NPT 1/8 female screw (Option)



**Principal materials:**

**Measurement tube** — Alumina ceramics

**Electrodes** — Platinum

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

Pipe connection port:

Standard — 316 stainless steel

Option — Ti (titanium),

Polyvinyl chloride (shock-resistant)+ Ta (Tantalum) for grounding plate,

Polyvinyl chloride (shock-resistant)+ Pt-Ir grounding plate,

Hastelloy C (Equivalent)

**Coating:** Phthalic acid resin coating pearl-gray colored

**Weight:** Approx. 2.2 lb (1.0kg) (for each size excluding cables)

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

U.S. Unit		Unit:gal/min		
Meter size (inch)	0.98 ft/s	3 ft/s	10 ft/s	32.8 ft/s
1/10"	0.02334	0.07115	0.2372	0.7781
1/6"	0.05975	0.1821	0.6071	1.992
1/4"	0.1344	0.4098	1.3660	4.482

SI Unit		Unit:L/min		
Meter size (mm)	0.3m/s	1m/s	3m/s	10m/s
2.5	0.08835	0.2945	0.884	2.945
4	0.2262	0.7540	2.262	7.540
6	0.5088	1.6967	5.090	16.967

## 9.2 Type Specification Code

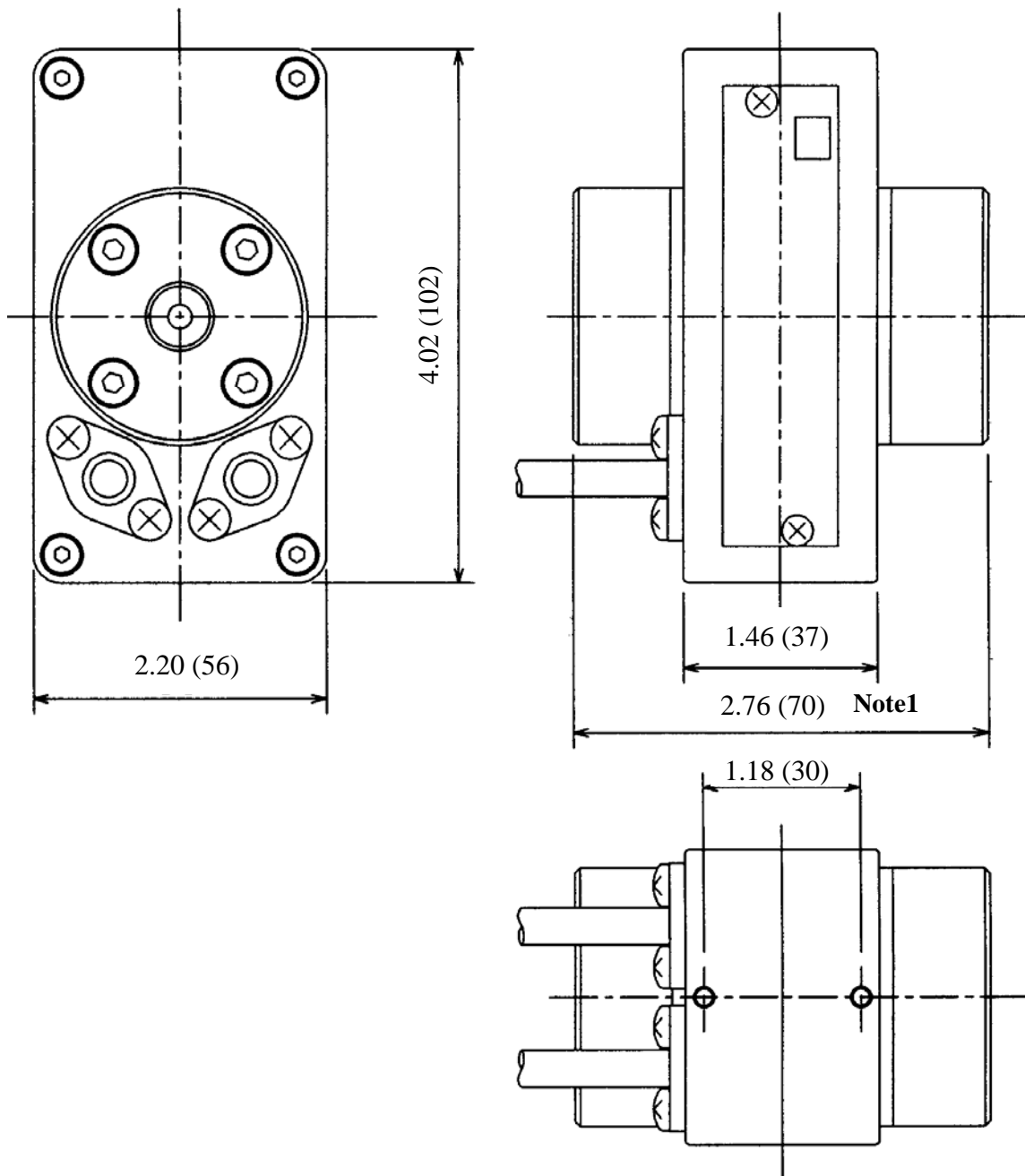
Table 9.3 Type Specification Code (Model LF470 Detector)

Model					Specification Code										Description
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
L	F	4	7	0											LF470 Flowmeter
					2										Meter size 1/10" (2.5 mm)
					4										1/6" (4 mm)
					6										1/4" (6 mm)
						D									Converter ( Separate type ) combined LF602, LF612
						E									LF232
							A								Pipe connection port (adapter) Rc (PT) 1/4 female screw (standard)
							B								Rc (PT) 1/8 female screw
							C								Rc (PT) 3/8 female screw
							D								Rc (PT) 1/2 female screw
							E								NPT1/4 female screw
							F								NPT3/8 female screw
							G								NPT1/8 female screw
								A							Pipe connection material (Note1) 316 stainless steel (standard)
								D							Ti (titanium)
								E							Polyvinyl chloride (shock-resistance)+ Ta (Tantalum) for grounding plate
								F							Polyvinyl chloride (shock-resistance)+ Pt-Ir for grounding plate
								H							Hastelloy C (Equivalent)
									C						Packing used between main body and pipe connection adapter
									D						Acid-resistant ceramic
									G						Alkali-resistant ceramic Ammonia-resistance
										A					Mounting Not provided
										B					Provided, 304 stainless steel
											A				Flow and calibration velocity range 1.0 to 32.8 ft/s (0.3 to 10 m/s) (standard range calibration)
											B				1.0 to 32.8 ft/s (0.3 to 10 m/s) (specified range calibration)
												A			Cable length (Note2) 5m (cable dia.7mm)
												1			10m (cable dia.7mm)
												2			15m (cable dia.7mm)
												3			20m (cable dia.7mm)
												4			25m (cable dia.7mm)
												5			30m (cable dia.7mm)
												B			5m or more (extension dia. 12mm+Scotch cast connection)
													A		Coating Phthalic acid resin coating pearl-gray colored (standard)
													Z		Other

**Note1:** Consult Toshiba before ordering when choose materials at the wetting parts.

**Note2:** Total cable length must be within 30m.

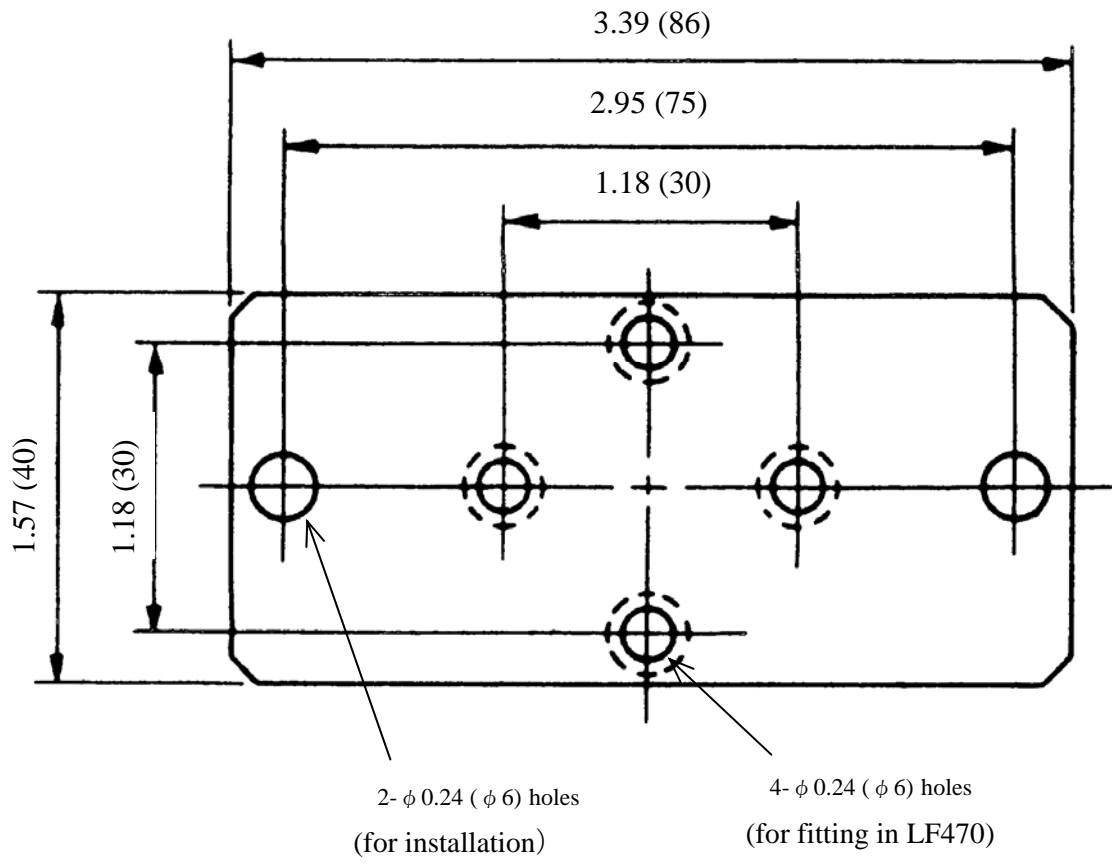
# 10. Outline Dimensions



**Note1:** In case of that the 8th column at specification code of the LF470 is D; pipe connection port is Rc(PT)1/2, this dimension is 3.07" (78mm).

**unit: inch (mm)**

**Figure 10.1 LF470 Outline Dimension**



unit: inch (mm)

Figure 10.2 Mounting plate (option)

Write down the address and phone number of the distributor from which you purchased this product, the product code, SER.NO. and so on.

Distributor Address _____
Name _____
Phone number (     ) —
Product code <u>LF</u> _____
SER.NO. _____

**TOSHIBA CORPORATION**

---