TOSHIBA

6F8A0943

ELECTROMAGNETIC FLOWMETER DETECTOR

MODEL LF664

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 LF664 series electromagnetic flowmeter detector.

Integral type **LF664/LF620F**
Separate type detector **LF664**

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 (6F8A0943) carefully before using this product. After reading this manual, store it in a place where it can be referred to whenever needed.

This manual uses the following markers to identify the integral type or separate type when it describes items specific to the integrated type or separate type. Items without this marker are common items to the integral type and separate type.

Integral type LF664/LF620F:

LF620F

Separate type detector LF664:

LF622F

Toshiba LF664 electromagnetic flowmeter detectors can be used in combination with various types of electromagnetic flowmeter converters (LF620F, LF622F).

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 "**Safety 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.**

3rd Edition January, 2011
First Edition September , 2010

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

⚠ CAUTION	
■ **Turn off mains power** before working on pipes.  DO Working on pipes while power is applied can cause **electric shock**.	■ Use an **appropriate device** to carry and install the LF664.  DO 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 LF664 from mains power.  DO Power supply from mains power can cause **electric shock** or **circuit break-down**.	■ **Do not modify or disassemble** the LF664 unnecessarily.  DON'T Modifying or disassem-bling this product can cause **electric shock**, **malfunction of or damage to this product**.
■ **Turn off mains power** before conducting wiring work.  DO Wiring while power is applied can cause **electric shock**.	■ **Ground** the LF664 **independently from power equipment.**  DO Operating this product without grounding can cause **electric shock** or **malfunction**.
■ Do not conduct wiring work **with bare hands**.  DON'T **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.  DO Loose connections can cause **electric shock**, **fire from excessive current or system 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. Be alert to **electric shock**.

SAFETY PRECAUTIONS (continued)

Safety Precautions for Maintenance and Inspection

⚠ CAUTION	
■ Do not touch the LF664 main body when **high temperature fluid** is being measured. DON'T The fluid raises the main body temperature and can cause **burns** when touched.	■ Do not conduct wiring work when **power is applied**. DON'T Wiring while power is applied can cause **electric shock**.
■ Do not conduct wiring work **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. Be alert to **electric shock**.
■ 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**.	

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.

Safety and Handling Precautions

■ For safety reasons, observe the following precautions.

(1) Do no work on piping or wiring while power is applied. Otherwise, it may result in electric shock. Even if the power is turned off, remaining electric charge may still cause electric shock. Therefore, wear nonconductive gloves whenever you work on piping or wiring.

(2) Do not use the LF664 detector in a way other than those specified in this manual. It may cause malfunction or damage to this product.

(3) When high temperature fluid is being measured, the fluid raises the detector pipe temperature. Do not touch the elevated temperature detector pipe. It may cause injury to personnel when touched.

(4) As this detector is heavy, observe the following precautions:

- ✧ Wear protective gloves.
- ✧ Do not work on piping or wiring when the detector is wet and slippery.
- ✧ A crane is needed to carry and install the detector.
- ✧ To put the detector temporarily on the floor, place it with an appropriate support to prevent it from falling down.

■ To obtain the optimum performance of the LF664 detector for years of continuous operation, observe the following precautions.

(1) Do not store or install the detector in a place such as:

- • where there is direct sunlight. If this is unavoidable, use an appropriate sunshade.
- • where excessive vibration or mechanical shock occurs.
- • under high temperature or high humidity condition.
- • under corrosive atmospheres.

(2) Ground the detector and converter with less than 100 ohm ground resistance. Avoid a common ground used with other equipment where earth current may flow. An independent ground is preferable.

(3) The retaining screws for the terminal housing cover and the cable connections are tightened securely at the time of shipment to keep the terminal housing airtight. Do not remove these screws or connections unless it is necessary to wire new cables or replace old ones. Otherwise, it may cause gradual deterioration of circuit isolation or cause damage to this product.

(4) Make sure the fluid to be measured will not freeze in the detector pipe. It may cause damage to the detector pipe.

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 install the product shortly afterward, store the product and other related items in a place as described in 1.2 below.

1.1 Product Inspection

The LF664 electromagnetic flowmeter detector is shipped in a container filled with shock-absorbing materials. Open the package carefully and check as follows:

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

For the separate type (when a converter and detector are separated)

LF620F

Electromagnetic flowmeter converter---------- 1 unit
Electromagnetic flowmeter detector ---------- 1 unit
Instruction manual----------Once each for the converter and detector

For the separate type (when a converter and detector are separated)

LF622F

Electromagnetic flowmeter converter---------- 1 unit
Electromagnetic flowmeter detector ---------- 1 unit
Instruction manuals----------each for the converter and detector
Ground cable ----------2 pieces

■ Inspect the detector for indications of damage that may have occurred during shipment.
■ Make sure the type and specifications of the detector (meter size, wetted materials, protective coating, etc.) are in accordance with the ordered specifications.

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

1.2 Storage

To store the LF664 detector after opening the package but you will install it at a later date, select a storing place as follows and keep it under the conditions as described:

(1) Avoid the place where there is direct sunlight, rain or wind.
(2) Store the product in a well-ventilated place. Avoid the place where it is extremely high in humidity, extremely high or low in temperature. The following environment is recommended.
  • **Humidity range: 10 to 90% RH (no condensation)**
  • **Storage temperature range: –15 to +65 °C**
(3) Avoid the place where vibrations or mechanical shock occurs.
(4) Do not open the terminal housing cover of the detector. Open it only when you actually wire cables. Leaving the cover open may cause gradual deterioration of circuit isolation. Note that the detector whose cables are wired already at the time of shipment is not needed to open the detector housing cover.

2. Overview

The LF664/LF620F and LF664 electromagnetic flowmeter can be use in the following hazardous (classified) locations.

Class Ⅰ, Ⅱ, Ⅲ, Division 2, Groups A-G

The electromagnetic flowmeter measures the volumetric flow rates of electrically conductive materials based on Faraday's Law of electromagnetic induction.
The device consists of two units: detector, through which the fluid to be measured flows, and converter, which receives the electromotive force signals from the detector, then converts and outputs the signals as the industry-standard output signals.
The detector and converter can be mounted separately as independent units.

Features

The LF664 flange-type electromagnetic flowmeter has the following features:

- There is no pressure loss even if a flowmeter detector is installed in the pipeline.
- It is possible to measure the flow of the fluid containing solid materials such as sludge or slurries.
- Even fluids containing solid abrasives or process slurry noise can be measured with excellent performance.
- No moving parts means a quick indication of flow and even a small amount of flow can be measured with high accuracy.
- Its size and weight was reduced further compared to the conventional type.
- A submersible type is available as optional specification.

3. Names of Parts

3.1 Appearance

3.1.1 Appearance of LF664/LF620F

(1) Meter size 20”(500mm), 24”(600mm)

LF620F

For the detail of the converter, check the converter LF620F instruction manual.

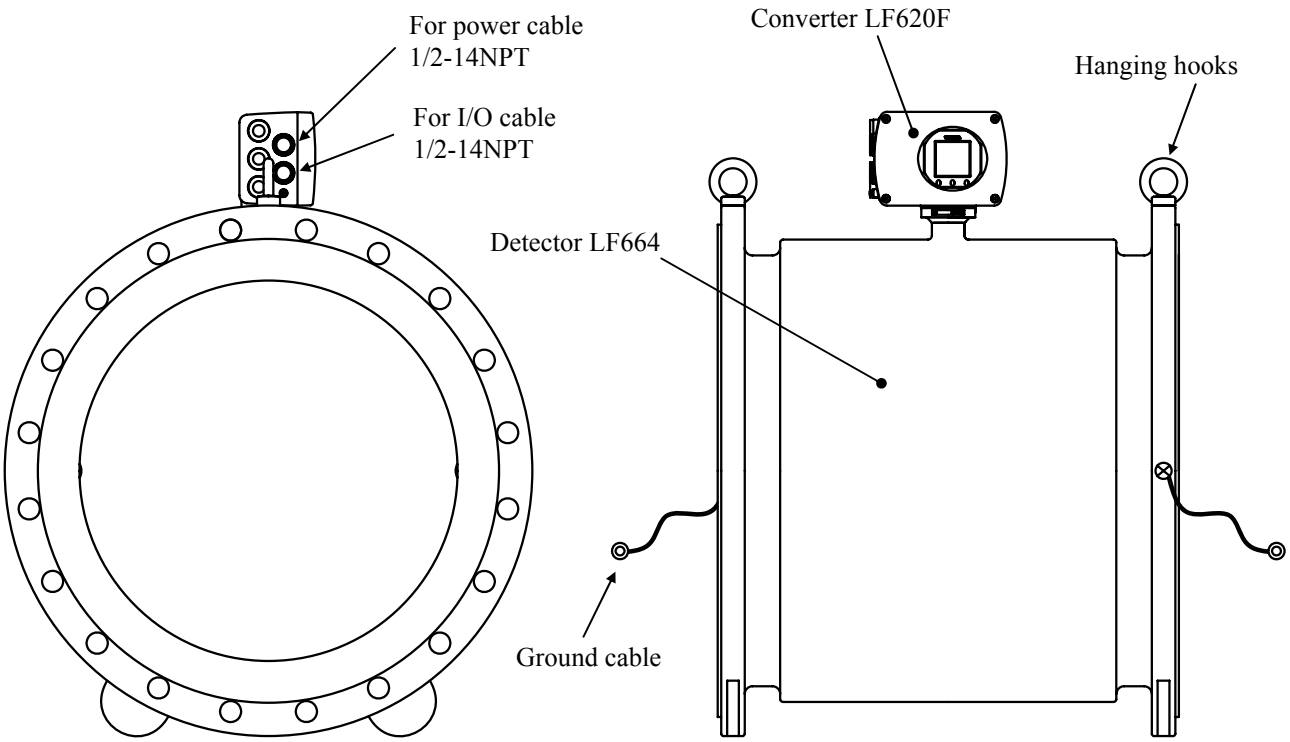


Figure 3.1.1 Appearance of the LF664/LF620F
Meter size 20”(500mm), 24”(600mm)

(2) Meter size 28”(700mm) to 36”(900mm)

LF620F

For the detail of the converter, check the converter LF620F instruction manual.

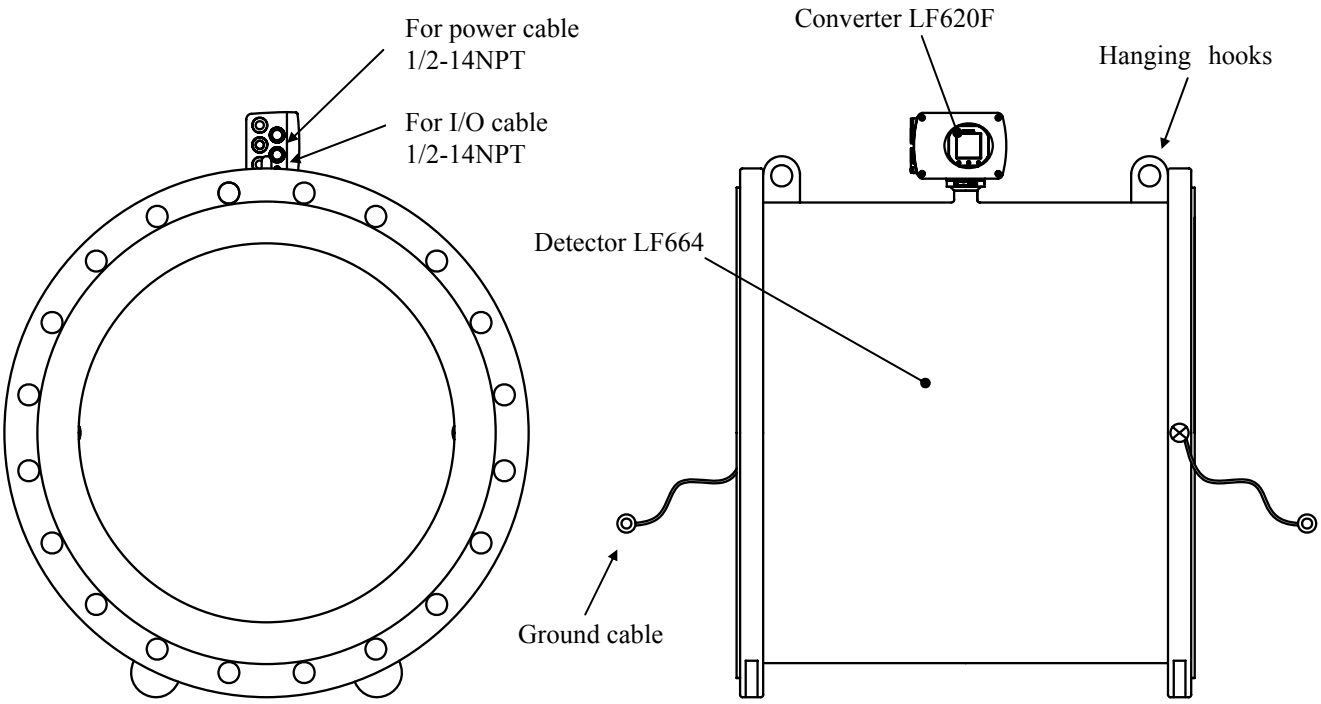


Figure 3.1.2 Appearance of the LF664/LF620F
Meter size 28”(700mm) to 36”(900mm)

3.1.2 Appearance of LF664

(1) Meter size 20”(500mm), 24”(600mm)

LF622F

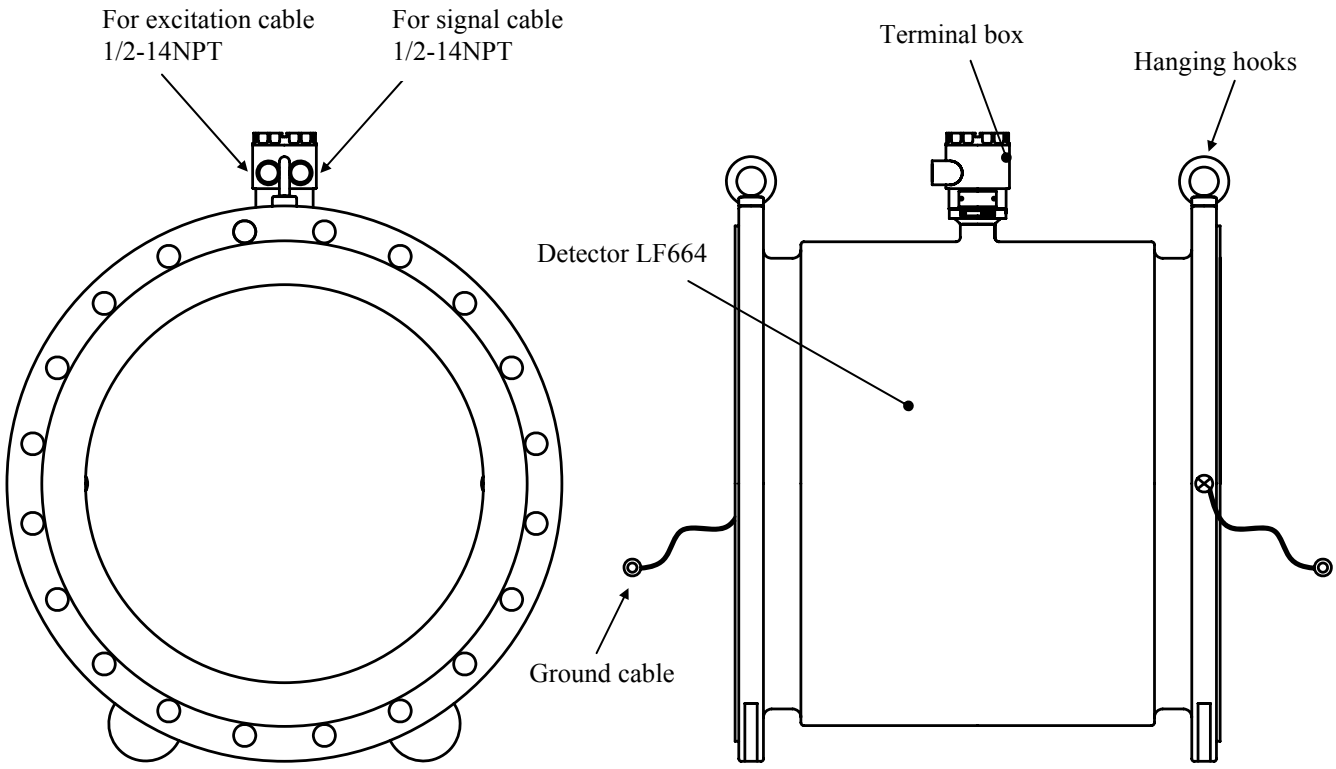


Figure 3.1.3 Appearance of the LF664
Meter size 20”(500mm), 24”(600mm)

(2) Meter size 28”(700mm) to 78”(1950mm)

LF622F

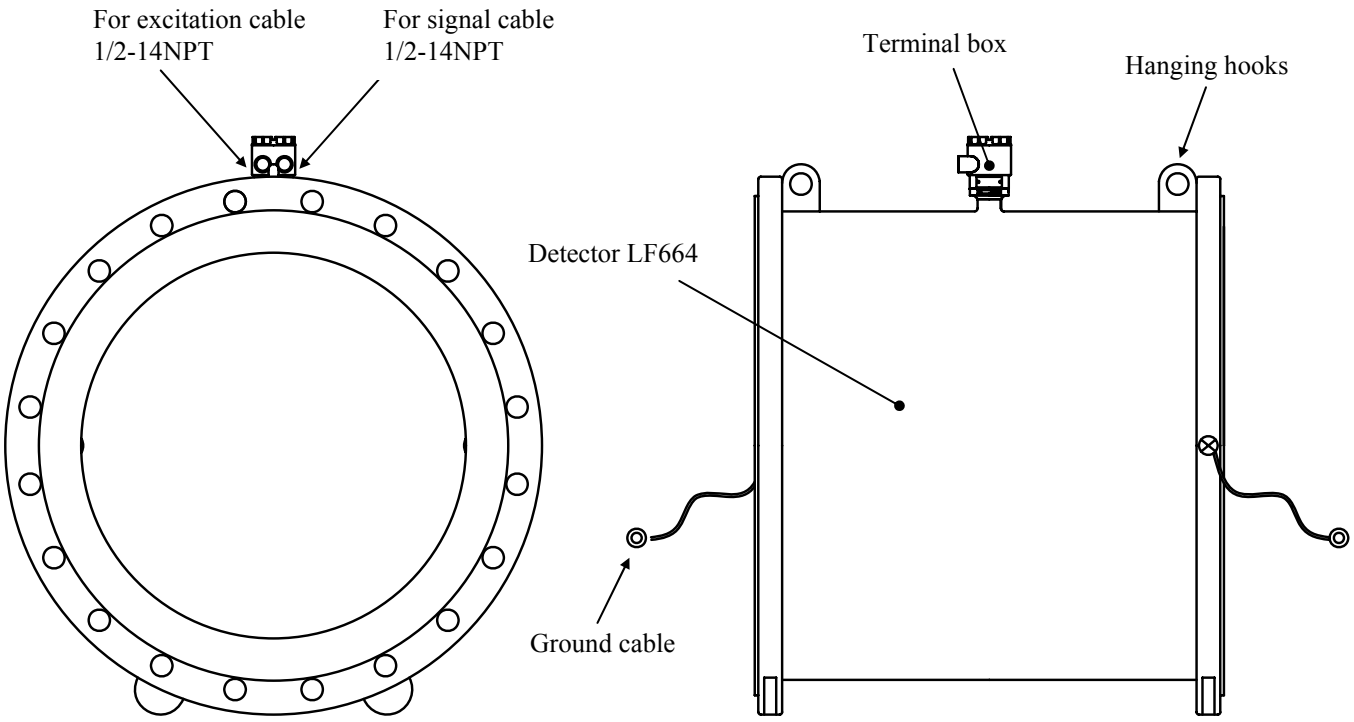


Figure 3.1.4 Appearance of the LF664
Meter size 28”(700mm) to 78”(1950mm)

3.2 Construction of the terminal blocks

3.2.1 Terminal Block Construction of LF664/LF620F Type

LF620F

For the detail of the converter, check the converter LF620F instruction manual.

3.2.2 Terminal Block Construction of LF664 Type

LF622F

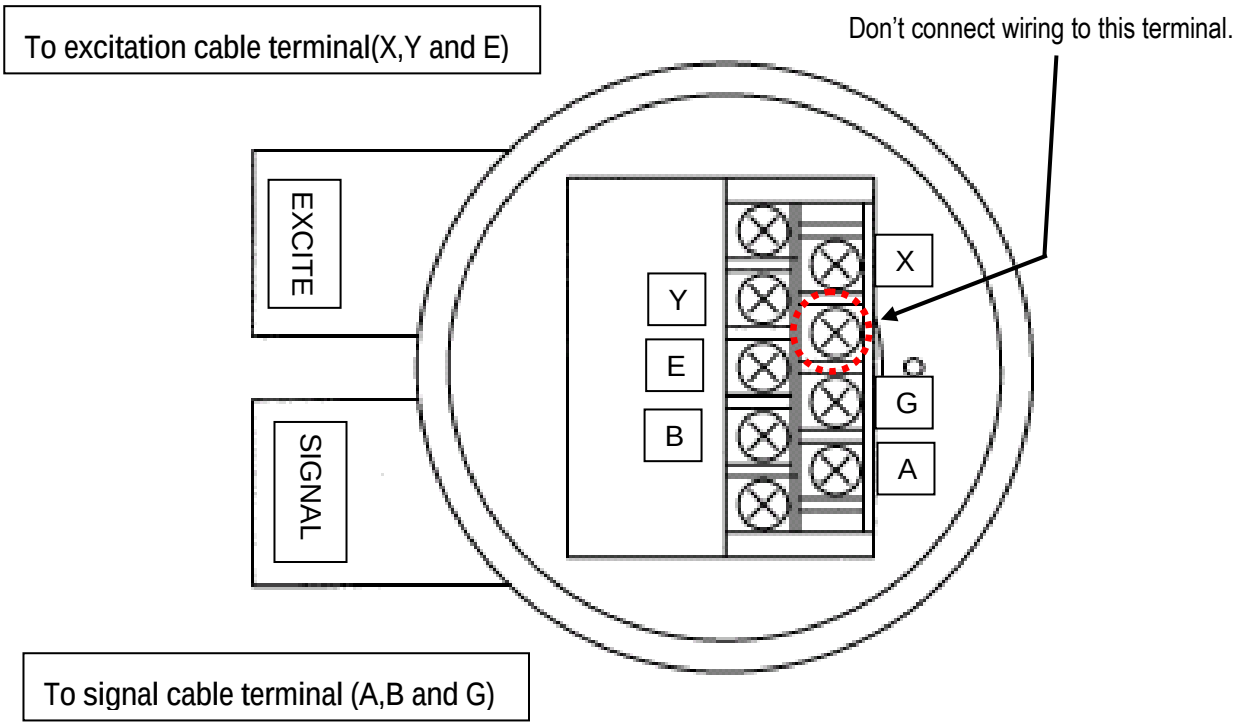


Figure 3.2 Terminal Block of LF664

4. Installation

Safety Precautions for Installation

⚠ WARNING

■ **Do not active live circuits** under environment of explosive atmospheres.

DON'T

Live part of electric circuit or a high temperature department can cause **explosion**.

■ **Do not use parts of other products**.

DON'T

Protective performance degradation for hazardous location can cause **explosion**.

■ **Do not active live circuits** While assembly of all components is not over.

DON'T

Protective performance degradation for hazardous location can cause **explosion**.

■ **Install per the National Electrical Code for the US (NEC, ANSI/NFPA 70) and the Canadian Electrical code for Canada (CEC, CAN/CSA-C22.1) and the drawing Appendix 1.**

DO

Unsuitable conduit connections for hazardous location can cause **explosion**.

⚠ CAUTION

■ **Ground the LF664/LF620F and LF664 independently from power equipment. (100 ohm or less ground resistance)**

DO

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

■ **Use an appropriate device to carry and install the LF664/LF620F and LF664** .

DO

If his 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 LF664/LF620F and LF664 from mains power.

DO

Power supply from mains power can cause **electric shock** or **circuit break-down**.

■ **Do not modify or disassemble the LF664/LF620F and LF664 unnecessarily.**

DON'T

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

■ **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 supply to the converter.

Be alert to **electric shock**

4.1 Notes on Selecting the Installation Location

1. 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**).
2. **Avoid places where excessive pipe vibration occurs**.
3. Avoid places where fluid is pumped in a pulsating manner
4. Avoid places where there is **direct sunlight**. If this is unavoidable, use an appropriate **shade**
5. Avoid places where **corrosive atmospheres** or **high humidity conditions** obtain.
6. Avoid places where **there may be limited access such as pipes installed next to high ceilings or constricted areas** where clearance for installation or maintenance work is not provided.
7. Design piping so that the detector pipe is always filled with fluid, whether the fluid is flowing or not.
8. The detector has no adjustable piping mechanism. Install an adjustable short pipe where needed.
9. Chemical injections should be conducted on the downstream side of the flowmeter.
10. The maximum length of the cable that connects **the detector and converter is 300m**. Select the converter installation location so that the distance between the detector and converter dose not exceed 300m.

LF622F

4.2 Mounting Procedure

⚠ CAUTION	
■ Use an **appropriate device** to carry and install the LF664.  **DO** If this 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 Piping Connections

The LF664 detector has flanges on both ends of detector main body. To mount the LF664, refer to Figure 4.1 and follow the procedure below:

1. Place one of the flange packing next to the upstream (or downstream) pipe flange. Align the holes of the packing with those of the flange so that the holes are not obstructed.
2. Insert the LF664 detector in pipeline in accordance with the flow direction arrow on the detector.

> **IMPORTANT**
> A crane is needed to carry and install the detector.

3. Insert the bolts, one at a time, through the hole in the upstream pipe flange and packing, and then through the hole of the detector flange. Then thread nuts, one at a time, on each end of the bolts, finger-tighten. This will help support the detector on one side.
4. Insert the downstream (or upstream) packing between the detector flange and the downstream pipe flange. Align the holes of the packing with those of the flanges so that the holes are not obstructed.
5. Inert the bolts, one at a time, through the hole in the downstream pipe flange and packing, and then through the hole of the detector flange. Then thread nuts, one at a time, on each end of the bolts, finger-tighten. This will help support the detector.
6. While centering the detector with the longitudinal axis of the pipeline, tighten the bolts with a wrench diagonally across in even increments. Bolt torque should be limited to that shown in Table 4.1

> **IMPORTANT**
> When high-temperature fluid is being measured, radiant heat from the detector pipe surface and adjoining pipes may cause the ambient temperature of the converter to go above 60 °C. If the ambient temperature goes above 60° C, try to lower the temperature by measures such as wrapping heat-insulating materials over the detector pipe and adjoining pipes .

Table 4.1 Number of bolts, size and recommended bolt torque

Meter size [inch (mm)]	Number of bolts	Bolt size [inch]	Bolt torque *1 [N・m]	Flange standard
20” (500)	20	1-1/8	199～249	ANSI 150
24” (600)	20	1-1/4	305～381	
28” (700)	28	1-1/4	268～335	AWWA class D
30” (750)	28	1-1/4	310～387	
32” (800)	28	1-1/2	416～520	
36” (900)	32	1-1/2	450～562	
40” (1000)	36	1-1/2	450～562	
42” (1050)	36	1-1/2	571～713	
48” (1200)	44	1-1/2	570～712	
54” (1350)	44	1-3/4	830～1037	
60” (1500)	52	1-3/4	863～1078	
66” (1650)	52	1-3/4	1058～1323	
72” (1800)	60	1-3/4	1066～1332	
78” (1950)	64	2	1431～1789	

*1: 1[N・m] is 0.7376 [ft・lbf].

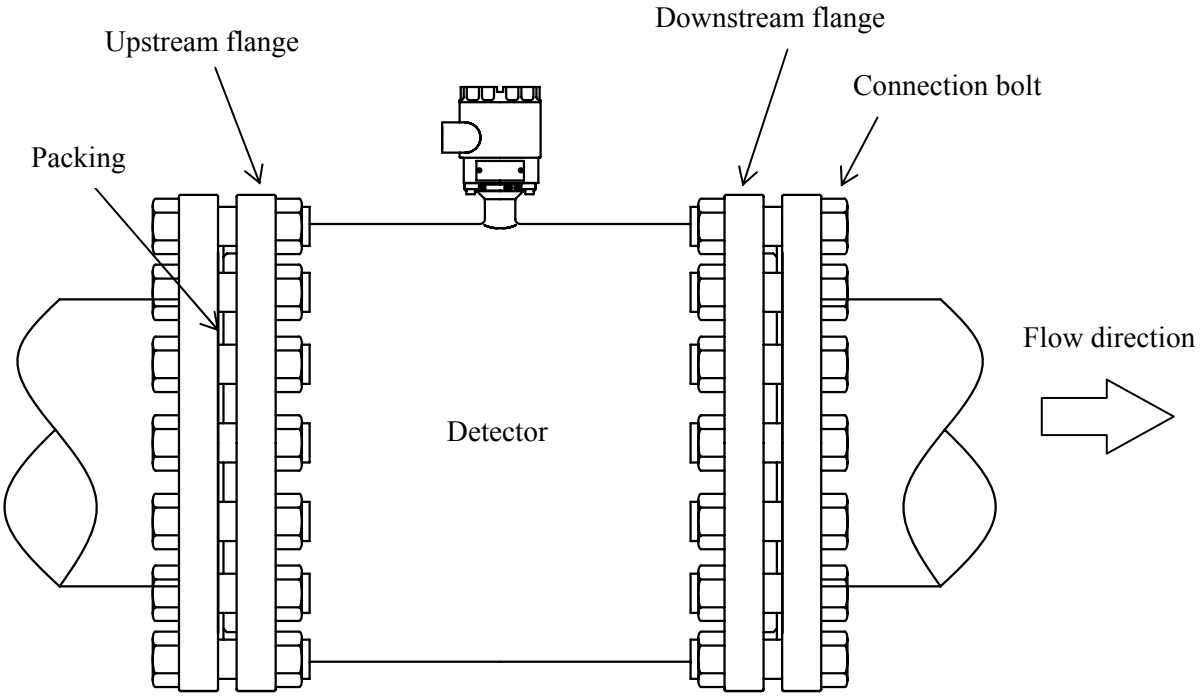


Figure 4.1 The LF664 detector piping connections

4.2.2 Precautions in transportation

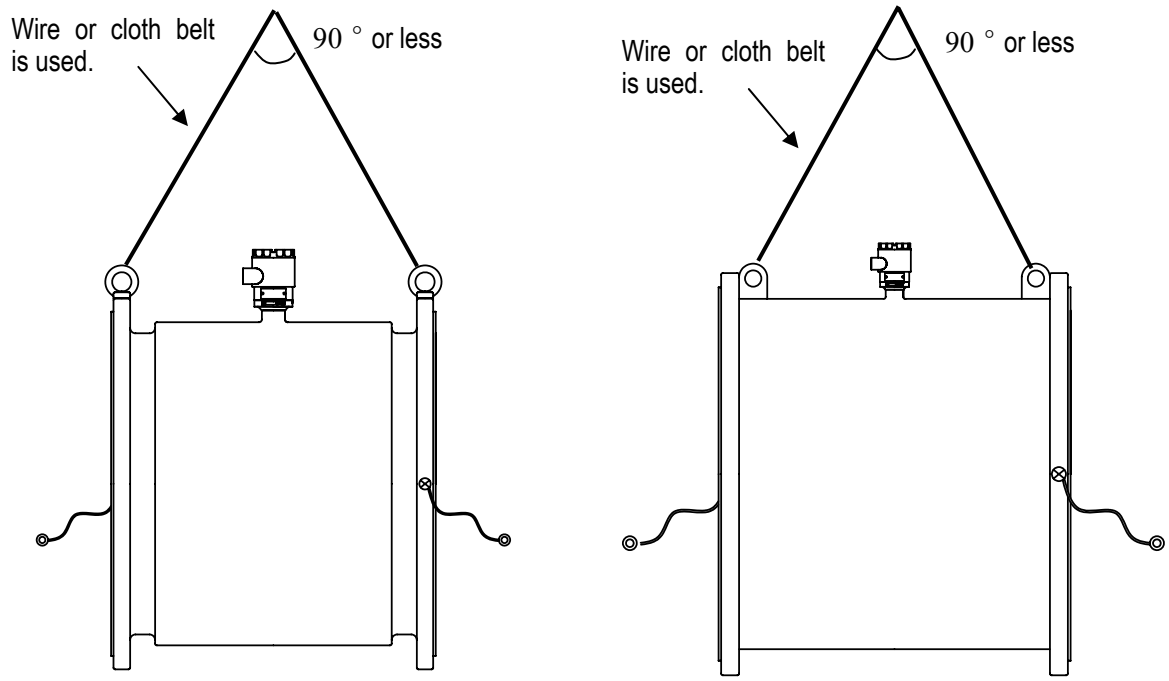
To prevent the device from being damaged during transportation, the original packing should be left untouched until the device arrives near the intended installation site.

The detector is equipped with hanging hooks. Lift it as shown in Figure 4.5. For information on the actual mass of each diameter, refer to "10. Outline Dimensions"

IMPORTANT

Never lift the detector by inserting a bar into its measurement pipe, because this will damage the linings, thus making it impossible to take stable measurements.

* The lifting work should be executed by those qualified for crane work or slinging work



(b) Meter size 20” and 24”(500mm and 600mm) (a) Meter size 28” and over (700mm and over)

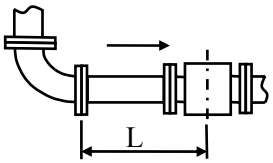
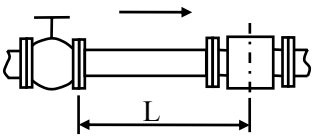
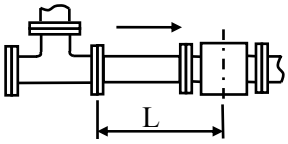
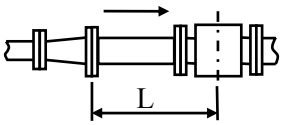
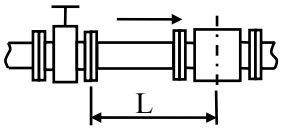
Figure 4.2 Transportation of LF664 flowmeter detector

4.3 Precautions on Piping

(1a) Ideal Upstream Straight Pipe Length Installation Requirements

If various joints are used upstream of the detector outlet, the straight pipe length as shown in Table 4.1 is required.

Table 4.1 Ideal 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

The length of a reducer, if connected, can be counted as a part of the straight pipe length. 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.

(1b) Optional "Mount Anywhere" Installation

Mount-Anywhere Technology:

With Toshiba's unique magnetic field distribution technology, the meter is highly immune to upstream flow disturbances. A minimum of 3D (diameter) length of upstream straight pipe from the flange is required to maintain the performance specification.

NOTE

The test results were obtained and demonstrated at Toshiba admitted flow calibration facility.

(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.

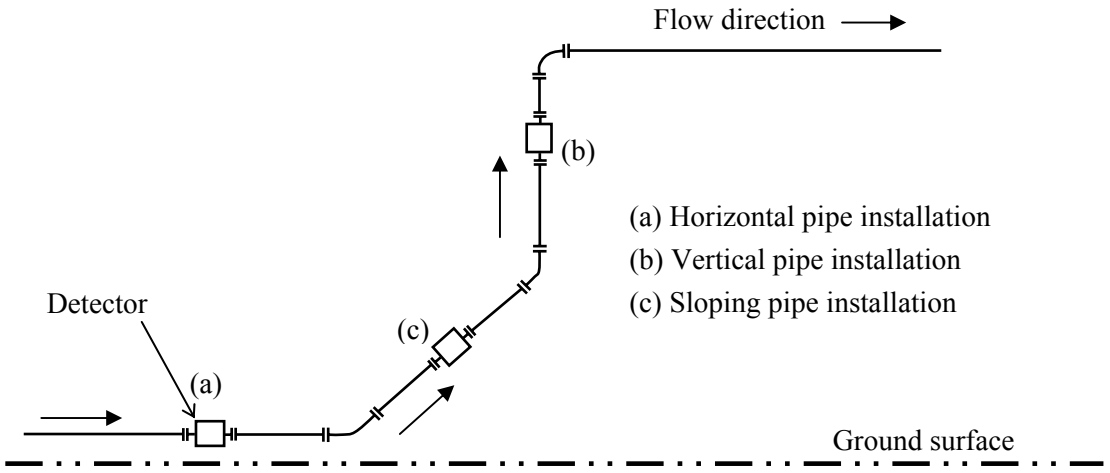


Figure 4.3 Detector Piping Orientation

The electrodes should be positioned horizontally relative to the ground surface in any piping installation. See Figure 4.4.

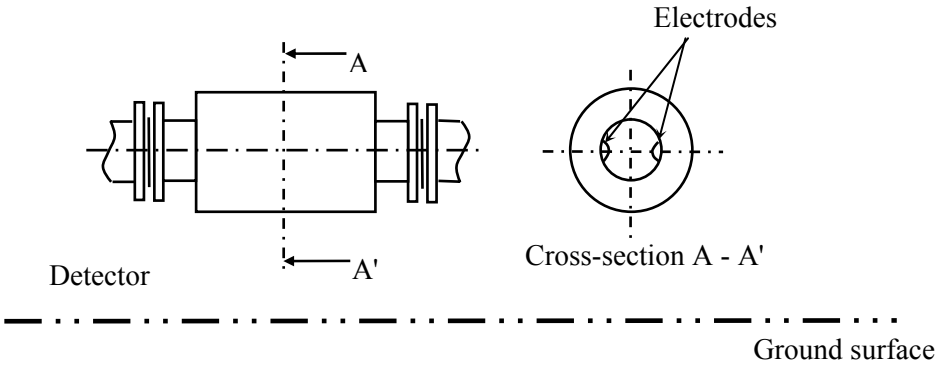


Figure 4.4 Installation position of the detector

(3) Flow Direction

Install the detector in accordance with the flow direction arrow on the detector.

(4) Full Pipe Condition

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

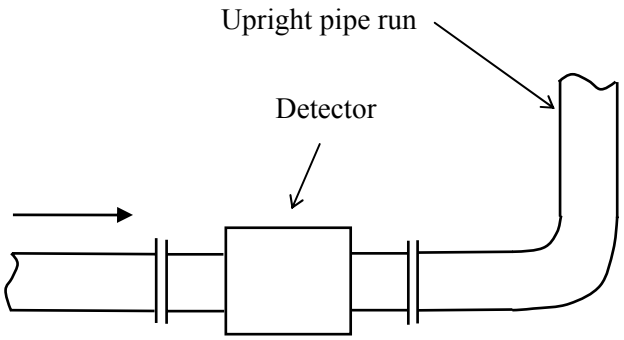


Figure 4.5 Detector with an upright pipe run at the downstream outlet

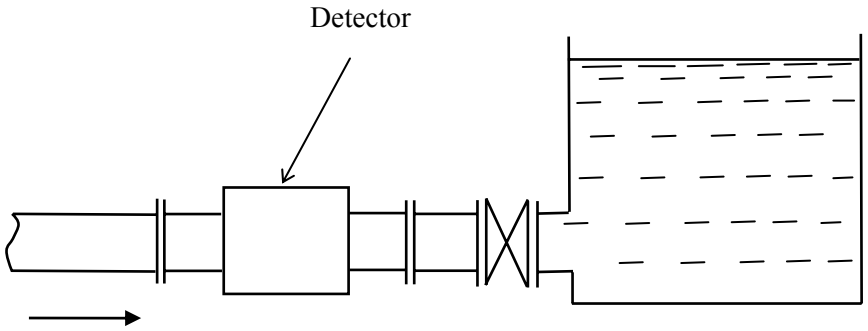


Figure 4.6 Detector with enough water head at the downstream outlet

4.4 Grounding

⚠ CAUTION	
■ Do not wire cables and replace parts when power is supplied. DON'T Wiring work and replacing parts in the power-on state may cause electric shock.	■ Do not work on piping and wiring **with wet hands**. DON'T Wet hands may result in **electric shock**.

(1) Grounding of the LF664/LF620F type

LF620F

Ground as shown in Figure 4.11. Make the grounding wire as short as possible. **Use grounding wire material of IV wire 5.5mm^2 or more. Do not share a grounding wire with other instruments where grounding current may flow. (An independent grounding is preferable.)**

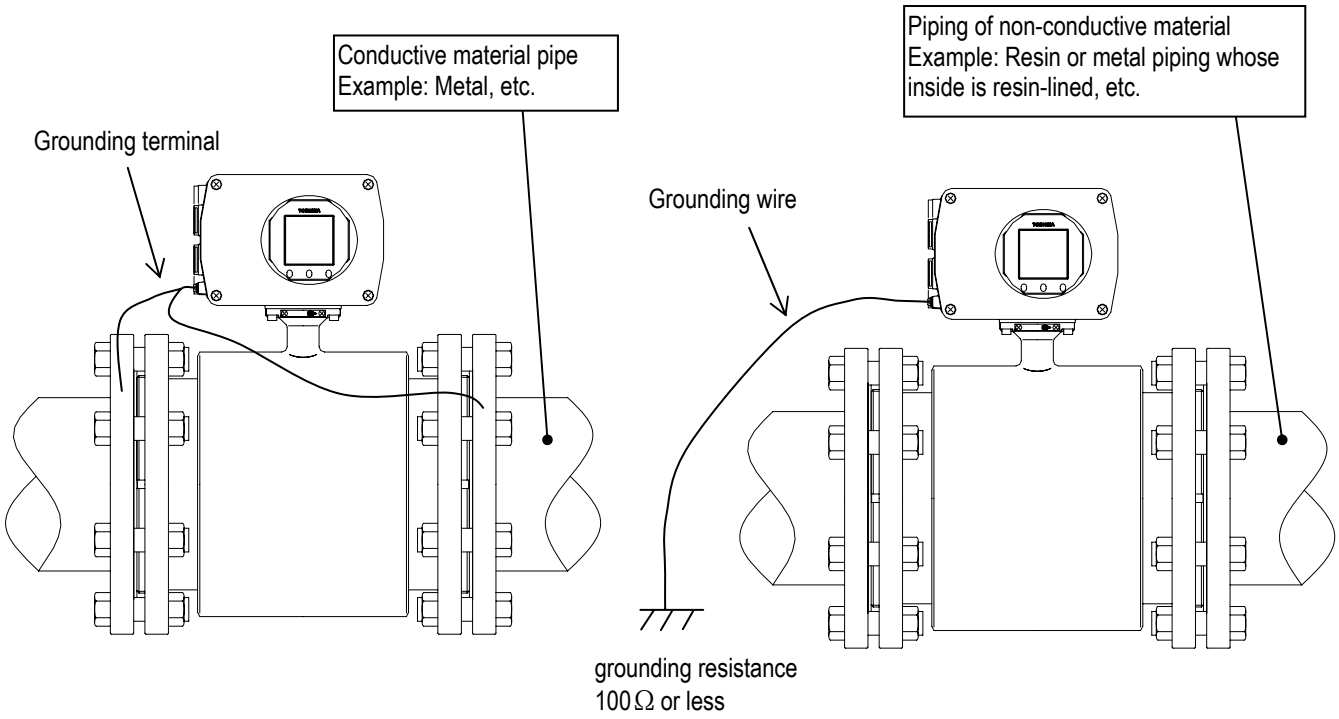
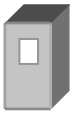


Figure 4.7 Grounding the LF664/LF620F Type



LF622F

(2) Grounding of the LF664 type

Ground the external grounding terminal of the detector and the FG terminal of the converter (or external grounding terminal of the converter) securely (**grounding resistance 100Ω or lower)**. Use grounding wire material of **IV wire 5.5mm^2 or more. Do not share a grounding wire with other instruments where grounding current may flow. (An independent grounding is preferable.)**

If it is difficult to perform grounding work at the detector side because of a pit installation or other reasons, use a 3-core cable for the excitation cable and connect the E terminal of the detector to the E terminal of the converter. (The E terminal of the converter is internally connected with the FG terminal and the converter case.)

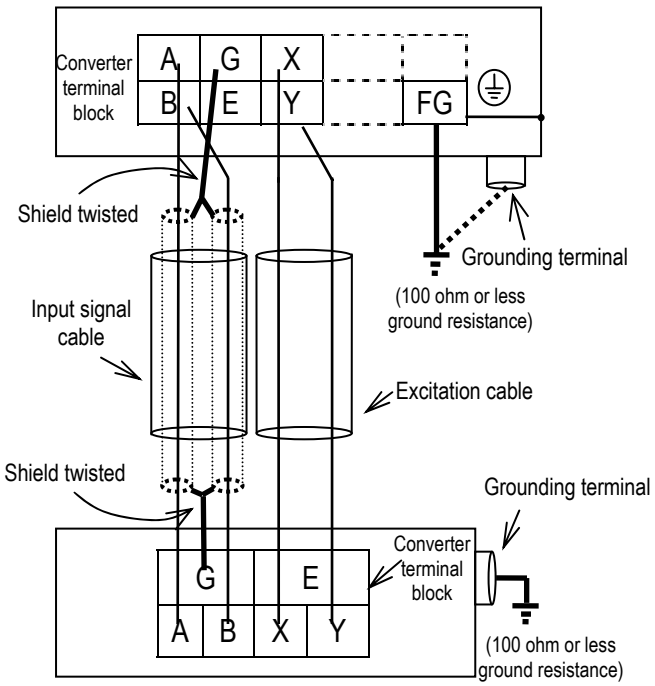


Figure 4.12 (a)
Wiring between Detector and Converter (For grounding the detector, see Figure 4.13 below.)

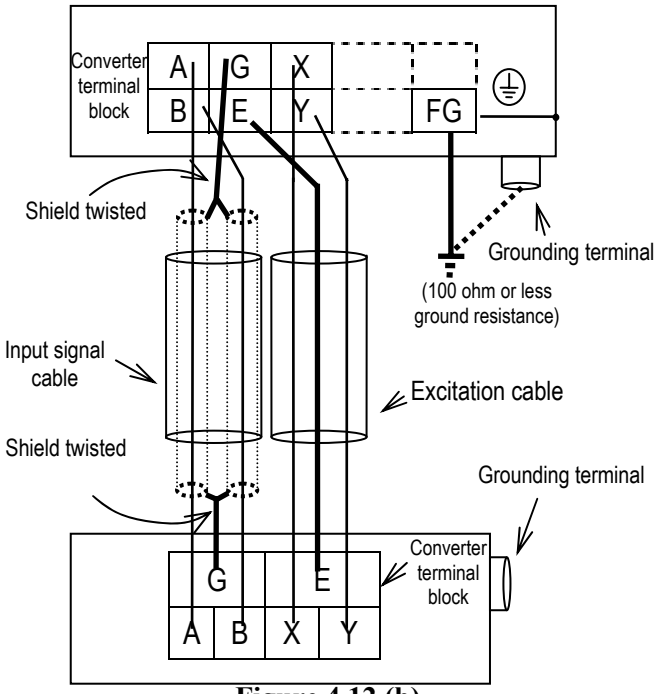
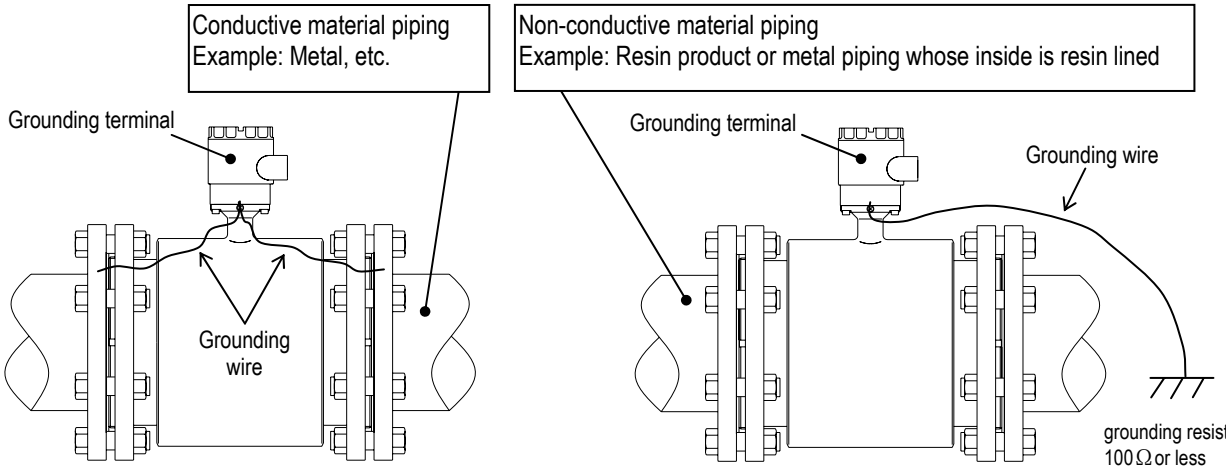


Figure 4.12 (b)
Wiring between Detector and Converter (when grounidng of the detector is difficut)



- If the piping material is conductive, connect the grounding wires to the both ends of the piping flange.
- If the piping material is non-conductive, perform grounding resistance 100Ω or less.

Figure 4.8 Grounding the LF664 Type Detector

5. Wiring

Safety Precautions for Wiring

⚠ WARNING
■ **DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS LOCATION IS KNOWN TO BE NONHAZARDOUS.**  DON'T Live part of electric circuit or a high temperature department can cause **explosion**.
■ **Do not active live circuits** While assembly of all components is not over.  DON'T Protective performance degradation for hazardous location can cause **explosion**.
■ **Install per the National Electrical Code for the US (NEC, ANSI/NFPA 70) and the Canadian Electrical code for Canada (CEC, CAN/CSA-C22.1) and the drawing Appendix 1.**  DO Unsuitable conduit connections for hazardous location can cause **explosion**.

⚠ CAUTION

■ **Install a switch and fuse** to isolate the LF664/LF620F and LF664 from mains power.  DO Power supply from mains power can cause **electric shock** or **circuit break-down**.	■ **Turn off mains power** before conducting wiring work.  DO 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**	■ **Ground the LF620F independently from power equipment. (100 ohm or less ground resistance)**  DO Operating this product without grounding can cause **electric shock** or **malfunction**.
■ Do not conduct wiring work **with bare hands**.  DON'T **Remaining electric charge** even if power is turned off can still cause **electric shock.**	■ For the power supply wiring and grounding wiring, use crimping terminals with insulated sleeve.  DO There is a **risk of electric shock** due to drop-off or loosing, and a **risk of fire** and **equipment trouble** due to heat generation.
Do not modify or disassemble the LF664/LF620F and LF664 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 power supply terminal on the converter. Be alert to **electric shock**.

Flowmeter accuracy may be affected **by the way wiring is executed. Proceed with correct wiring taking the precautions in following pages**.

Notes on wiring

⚠ CAUTION

(1) The apparatus does not be provided with the cable connections. Please prepare yourself for the cable connections which could be used in Division2 hazardous locations.

The cable lead –in section must be tightened securely to keep air tightness.

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

(3) 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

(4) The converter has an arrestor installed inside. Therefore, **do not conduct a withstand voltage test for the converter**. To check the insulation of the converter, use a voltage of **250Vdc or less**.

(5) After wiring, be sure to install the terminal block protection cover.

LF622F

(6) Because the excitation cable and flow rate signal cable transmit very delicate signals, pass each of them separately through a thick steel conduit tube, keep them away from the large current wiring as far as possible, and do not install them in parallel.

5.1 Cables

Use the kind of cables shown in Table 5.1 to wire the converter.

Table 5.1 Installation Cables

Name	Cable name	Nominal cross-sectional area	Finished outer diameter	Description
Power cable	3-core vinyl sheathed cable or 2-core vinyl sheathed cable	2 mm²	11~13mm	CVV JIS C 3401 or equivalent
Output signal cable	The number of conductors the cable contains differs depending on the specification of the output signal cable. Use a shielded cable of finished outer diameter 11 to 13mm and nominal cross-sectional area 1.25mm^2.			CVV-S JIS -258-C or equivalent
Flow rate signal cable	2-core shielded chloroprene cabtyre cable (Rubber covered cable)	0.75 mm^2	11~13mm	2PNCT-S JIS C 3327 or equivalent
Excitation cable	3-core chloroprene cabtyre cable (Rubber covered cable)	2 mm^2 1.25 m^2	11~13mm	2PNCT JIS C 3327 or equivalent

LF622F

LF622F

5.2 External Device Connections and Grounding

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

5.3 Notes on Wiring

5.3.1 Notes on Instrumentation-Converter Wiring

To avoid 2-point grounding, **ground the shield of output cable basically at the receiving side.**
Use a grounding wire of IV wire 5.5mm^2 or more. The size of the external grounding terminal screws is M4. Do not share **a grounding wire with other instruments where grounding current may flow. (An independent grounding is preferable.)**
Power cable
When a 3-core cable is used: **Ground with the FG terminal.**
When a 2-core cable is used: Use an external grounding terminal and make the cable as short as possible.

LF622F

5.3.2 Notes on Wiring of the Separate type (LF664)

The detector is shipped with a flow rate signal cable and excitation cable. Be sure to use those cables coming with the detector.

Note: When the cable length exceeds 300m, cables may not be supplied. Check whether the cable is supplied with the specs.

The allowable cable length between the detector and converter varies depending on the conductivity of the operating fluid. **Refer to the instruction manual of the combined detector.**
When connecting with the detector, wire the cables in the order of the excitation cable and flow rate signal cable.
Because the input cables transmit very delicate signals, pass the excitation cable and input signal cable **separately through a thick steel conduit tube , keep them away from the large current wiring as far as possible, and do not install them in parallel.**
When replacing the flow rate signal cable and excitation cable, also refer to the instruction manual of the relevant detector. Order the detector terminal box cover packing from Toshiba or a Toshiba distributor.

5.4 Wiring

5.4.1 Terminal Treatment of Cables

Follow the procedures below to treat the terminals (at the converter side) of various cables and install the cables to the terminal block. Use appropriate cables based on the description in Section **5.1** "Cables." Crimp a **round type insulated crimp-type terminal** to the end of the cables.

(1) Power cable, current output cable, digital I/O cables

The necessary cables should be ordered from the person responsible for the installation. Strip the sheath of each conductor as shown in Figure 5.1 and attach a crimping terminal with insulated sleeve to it. The size of the crimping terminal is as follows:

Integral type **LF620F**: **M3.5**

Separate type **LF622F**: **M3.5**

- Connect the power cable to terminal blocks L1 and L2.
- Connect the current output cable to terminal blocks + and -.
- Connect the digital I/O cable to terminal blocks D1, D01, D02 and COM, as required.

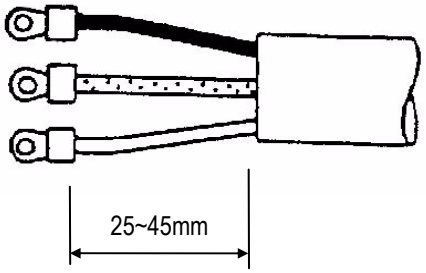


Figure 5.1 Terminal Treatment of Power Cable, Current Output Cable and Digital I/O cable

(2) Excitation cable

LF622F

Strip the sheath from the end of each conductor as shown in Figure 5.2, attach an M3.5 crimping terminal with insulated sleeve, and connect it to the terminal blocks X and Y. Connect the red conductor to terminal block E.

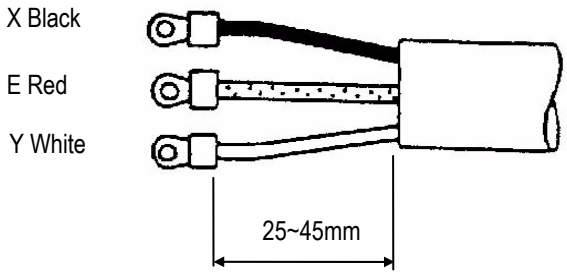


Figure 5.2 Terminal Treatment of Excitation Cable

(3) Connecting the input signal cable

Strip the sheath from the end of each conductor of a 2-core individually shielded cable as shown in Figure 5.4. Twist those shields and cover them with a thermal contraction tube or vinyl tube not to make contact with the case or core wires. Then attach an M3.5 crimping terminal with insulated sleeve as shown in Figure 5.3. Connect a crimping terminal to the A and B terminals on the terminal block and connect to each G terminal of the detector and converter.

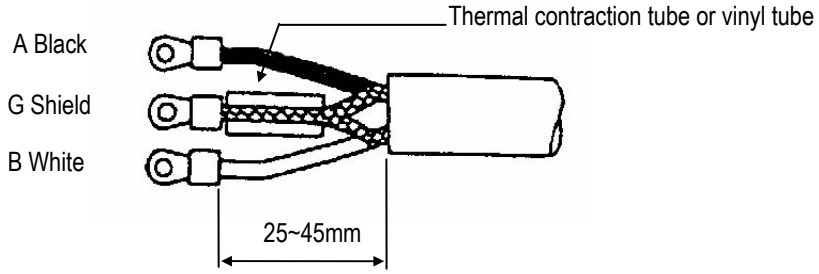
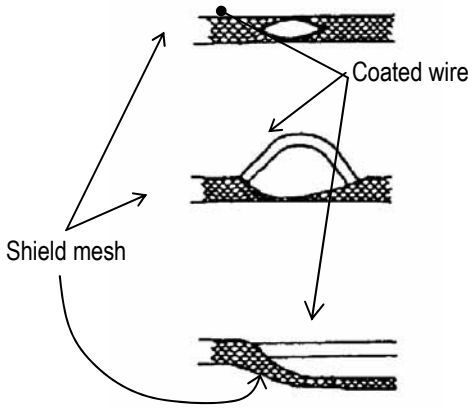


Figure 5.3 Terminal Treatment of Flow Rate Signal Cable

● 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 5.9.



a. Open the shield mesh with a pair of tweezers or the like.

b. Pull out the internal coated wires from the hole of the shielded mesh.

c. Pull out all internal coated wires and extend the shield mesh wire.

Figure 5.4 Treating the Signal Cable Shield Mesh

5.4.2 Cable Connection

LF622F **Connect and install the terminal-treated cables to the terminal block.**

*Connect the cables to the terminal block securely. A loose connection may cause incorrect measurement. After connecting a cable, try to pull it to check whether it has been connected securely.

(1)Referring to **combined converter's manuals of "Connections and Grounding"**, connect each cable to the terminal block. **Tighten the screws of the terminal block tightly to ensure the secure connection**. A loose connection may cause incorrect measurement. **After connecting a cable, try to pull it to see whether it has been connected securely.**

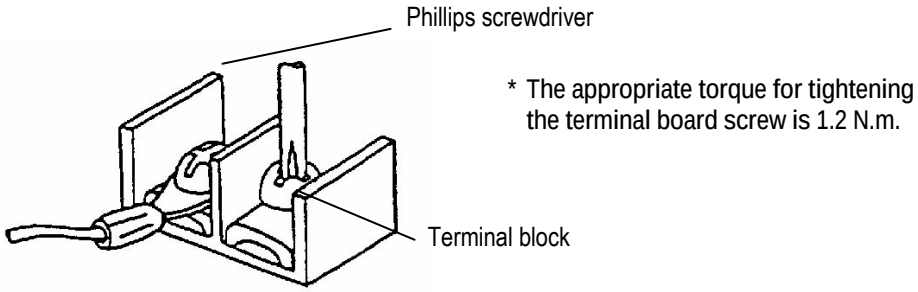


Figure 5.6 Connecting a Cable to Terminal Block

(2) Attach the terminal box cover . To keep the seal, tighten securely the cover.

6. Operation

⚠ CAUTION	
■ Do not touch the terminal board when power is supplied. DON'T Touching the terminal board when power is supplied can cause electric shock.	■ Do not touch the main body when high temperature fluid is being measured. DON'T The fluid raises the main body temperature and can cause burns.

Preparatory check

Follow the procedure described below to prepare before starting the flow measurement (described with regard to the entire flowmeter).

System Check Check the items listed below

- Check **the wiring between the converter and related instruments**.
- 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 **housing covers** are securely tightened.

Placing System On-Stream

- **Let the fluid go through** the detector pipe. (Note 1)
- 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 combined converter's manual.**

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 **combined converter's manual.**

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.

Note 1: If the detector pipe is not filled with the fluid to be measured, the flow rate will be indefinite and unable to be measured. Before using the flowmeter , be sure to fill the detector pipe the fluid to be measured.

7. Maintenance and Troubleshooting

Safety precaution for Maintenance and Troubleshooting

⚠ WARNING

■ **Do not disconnect while circuit is live** unless location is known to be nonhazardous.


DON'T

Live part of electric circuit or a high temperature department can cause **explosion**.

■ **Do not modify or disassemble** the enclosure.


DON'T

Strength degradation and defects of enclosure can cause **explosion**.

■ **Do not use parts of other products**.


DON'T

Protective performance degradation for hazardous location can cause **explosion**.

■ **Do not live circuits** While assembly of all components is not over.


DON'T

Protective performance degradation for hazardous location can cause **explosion**.

■ **Install per the National Electrical Code for the US (NEC, ANSI/NFPA 70) and the Canadian Electrical code for Canada (CEC, CAN/CSA-C22.1) and the drawing Appendix 1.**


DO

Unsuitable conduit connections for hazardous location can cause **explosion**.

⚠ 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 LF664/LF620F and LF664 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

■ Cleaning

Adhesion might be created in the detector over a long period of time when used on certain materials.

Try to confirm whether to cause the adhesion in the detector pipe when the phenomenon is seen, and an abnormality (ex. decreasing indication, etc.) is confirmed.

Please clean with a soft brush etc. and remove any unnecessary build up inside the meter. When using it in the line to which such a phenomenon occurs easily, it is recommended that the detector pipe be cleaned regularly.

Use new gaskets when reinstalling the flowmeter detector in the pipeline.

■ Mag-Prover Built-In Calibrator

The converter LF620F and LF622F has a built-in reference signal calibration and verification circuit that allows you to re-verify the original magmeter flow lab calibration without the need for external devices. **This reference signal can be used to check the zero and span of the converter for the purpose of instrumentation maintenance or periodical inspection. Refer to combined converter's manual.**

■ Operative life

The design operative life of this flowmeter is 10 years from the date of shipment at a standard use condition .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.

■ Product disposal

The electromagnetic flowmeter must be disposed of, according to the rules and regulations of your local government.

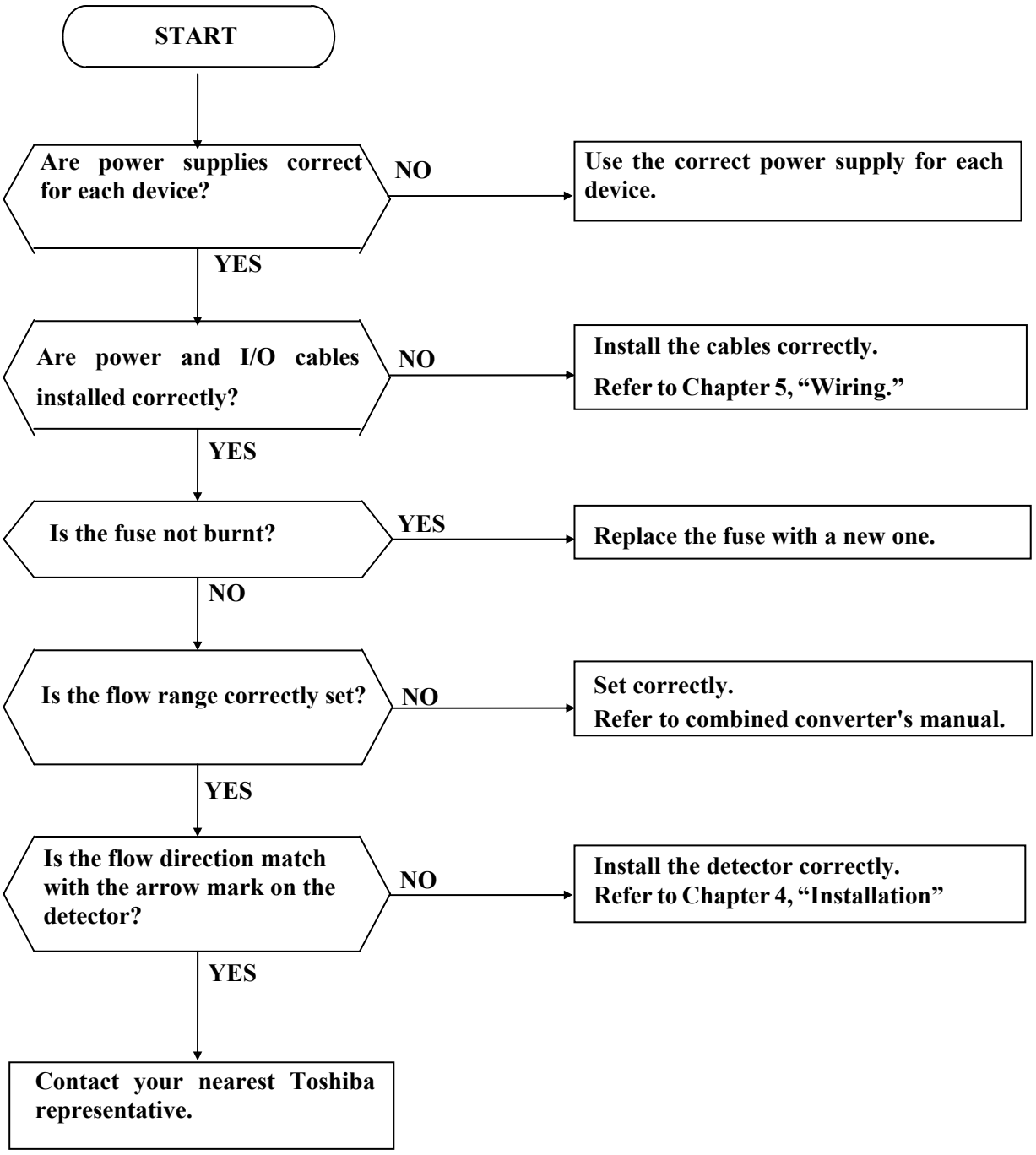
Especially if you dispose of electrolytic capacitors to replace parts, have it done by an agency which is licensed to handle industry waste materials.

7.2 Troubleshooting

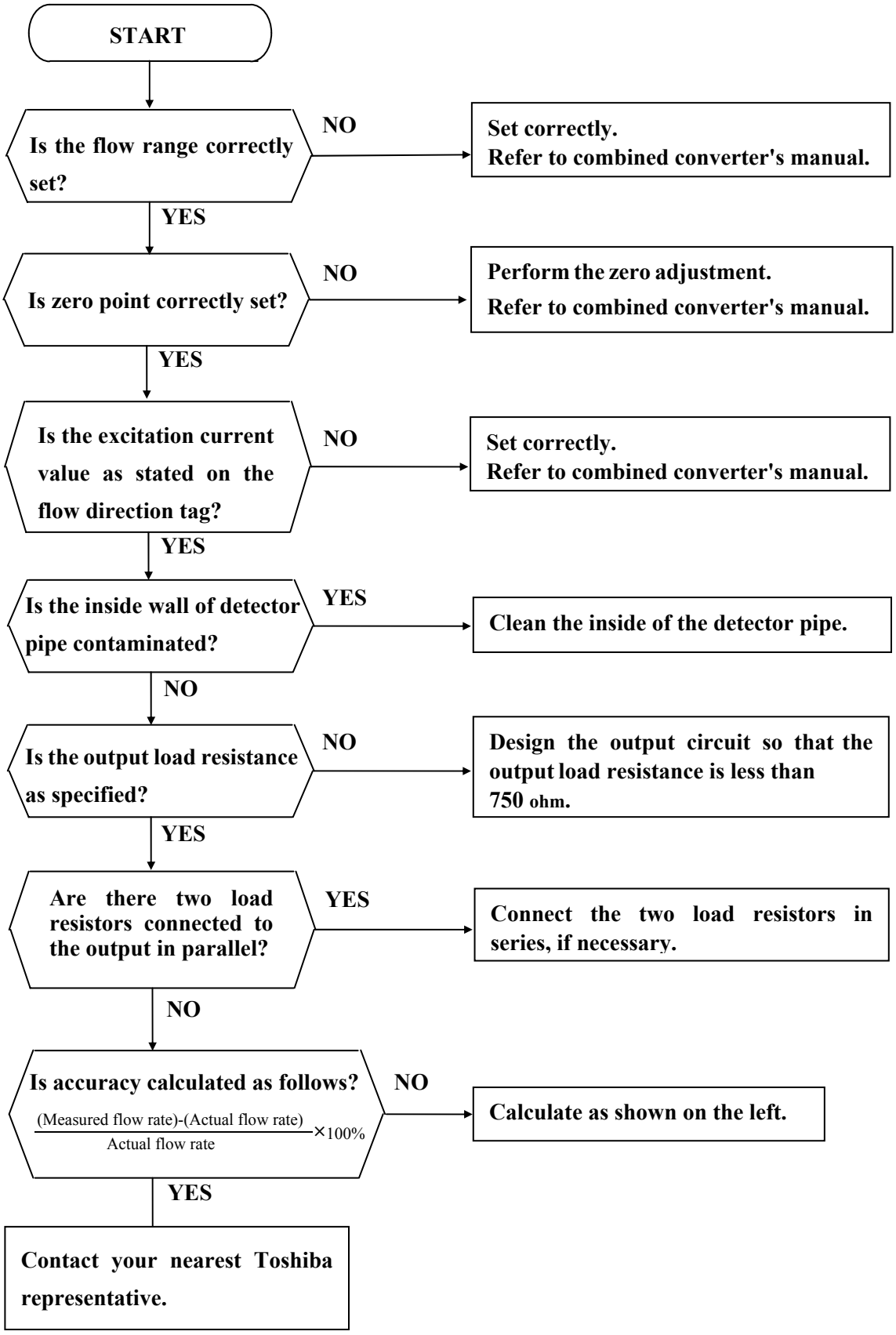
If a problem occurs while using the LF664/LF620F, LF664/LF622F follow the flowcharts described below.

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.

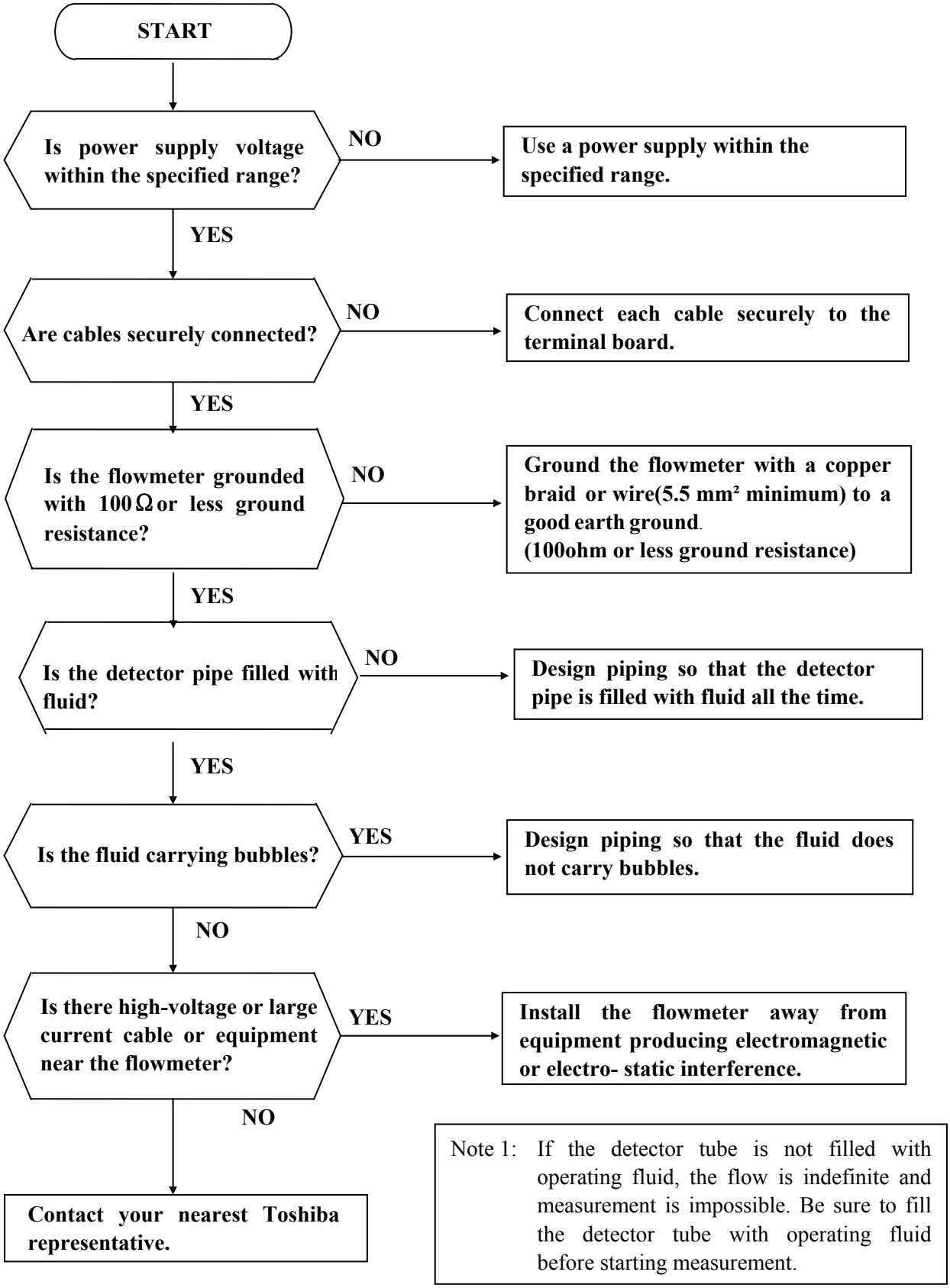
7.2.1 Flow rate is not indicated



7.2.2 Flow rate indicated is not correct



7.2.3 Flow rate indication is not stable



Note 1: If the detector tube is not filled with operating fluid, the flow is indefinite and measurement is impossible. Be sure to fill the detector tube with operating fluid before starting measurement.

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.

$$E = K \times B \times D \times V \text{ [V]} \quad \text{..... (Eq. 7.1)}$$

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:

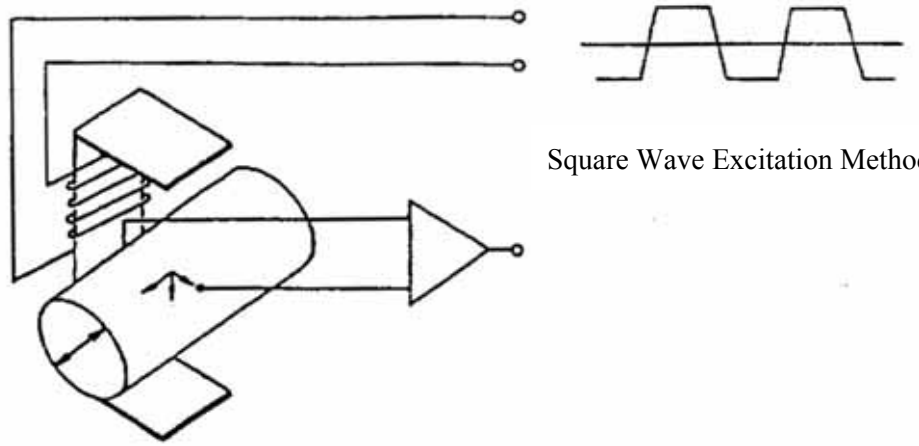
$$Q = \frac{\pi \times D^2}{4} \times V \quad \text{.....(Eq. 7.2)}$$

Using Equation 7.1 and 7.2

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

$$E = \frac{4 \times K \times B}{\pi \times D} \times Q \quad \text{.....(Eq. 7.3)}$$

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



Square Wave Excitation Method

Figure 8.1 Principle of Operation

The LF664 flange-type electromagnetic flowmeter uses square-wave excitation method, which provides a long-term stable operation. With square-wave excitation, the LF664 offers reliable measurement without being affected by electrostatic or electromagnetic interference, or electrochemical polarization between the electrode and the fluid to be measured.

9. Specifications

Overall specifications of the LF664 detector and type specification code tables to specify each item of the detector specifications are described in the following sections.

9.1 Specifications

Meter size: ANSI 150

20", 24" (500, 600mm)

AWWA class D

28", 30", 32", 36", 40", 42", 48", 54", 60", 66", 72", 78"
(700, 800, 900, 1000, 1050, 1200, 1350, 1500, 1600, 1800, 1950mm)

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)

Accuracy:

< 20" to 24" (500mm to 600mm) >

± 0.3% of Rate * (Accuracy when combined with the converter LF620F and LF622F)

* This pulse output error result is established under standard operating conditions at Toshiba admitted flow calibration facility.

* Individual meter's measurement error may vary up to ± 0.5 % of Rate at 3.28 ft/s (1.0 m/s) or more and ± 0.3% of Rate ±0.079 inch/s (2 mm/s) at 3.28 ft/s (1.0m/s) or less.

* Current output: plus ±8 μA(0.05% of span.)

* Refer to individual calibration data for each meter's measurement error.

< 28" and over (700mm and over) >

± 0.5% of Rate * (Accuracy when combined with the converter LF620F and LF622F)

* This pulse output error result is established under standard operating conditions at Toshiba admitted flow calibration facility.

* Individual meter's measurement error may vary up to ± 0.8 % of Rate at 3.28 ft/s (1.0 m/s) or more and ± 0.4% of Rate ±0.157 inch/s (4 mm/s) at 3.28 ft/s (1.0m/s) or less.

* Current output: plus ±8 μA(0.05% of span.)

* Refer to individual calibration data for each meter's measurement error.

Fluid conductivity: 5 μS/cm minimum

Fluid temperature: 20" to 40" (500 to 1000mm) ; 14 to 140 °F (–10 to +60 °C)

42" (1050mm) and over ; 14 to 104 °F (–10 to +40 °C)

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

Fluid pressure: -0.1MPa to 1.0 MPa

Structure: IP 67 and NEMA 4X Watertight

Option 1: IP68 and NEMA 6P Temporary submersible type

The coating for this type is polyurethane coating.

Option 2: IP68 and NEMA 6P Continuous submersible type

The coating for this type is tar epoxy resin coating. This type of flowmeter is sub-mersible to 5 m in water.

Connection flange standard: ANSI 150, AWWA class D

Principal materials:

Case • • • • carbon steel

Lining • • • Natural rubber

Electrodes • • • AISI316L (std.), Titanium (opt.), Hastelloy C equivalent (opt.)

Grounding rings • • • None (std.), AISI304(opt), AISI316(opt), Titanium (opt.), Hastelloy C equivalent (opt.)

Measuring tube • • • AISI304

Coating: Polyurethane coating (std.), pearl-gray colored

Note: If the optional IP68 and NEMA 6P continuous submersible type structure is specified, the coating is tar epoxy resin coating.

Cable connection port: 1/2-14NPT male screw for both signal cable and exciting cable.

Cable length: Allowable cable length between the converter and the detector varies with the electrical conductivity of fluid. See Figure 9.1.

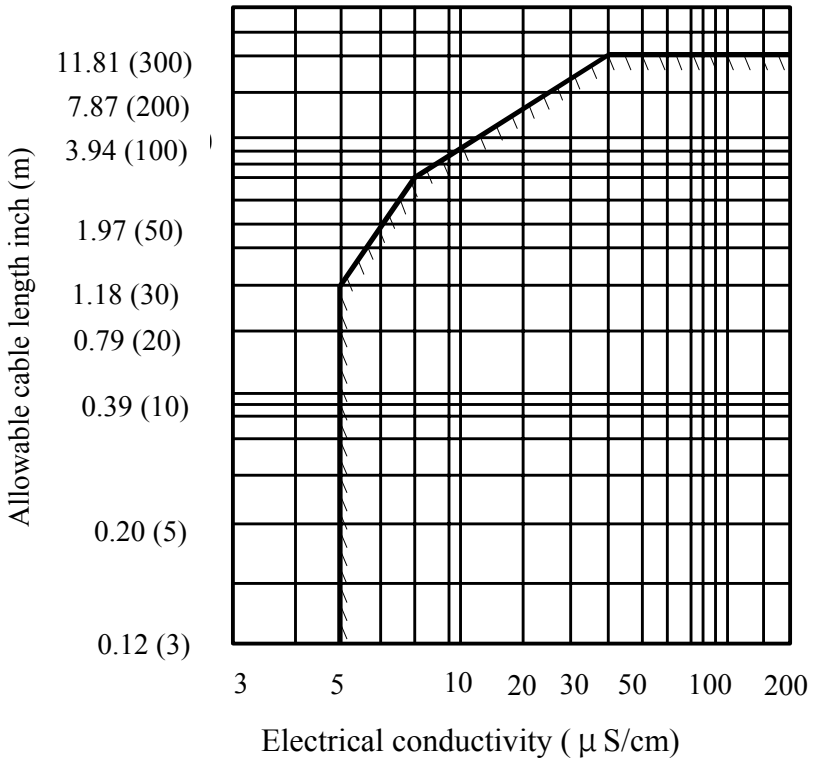


Figure 9.1 Electrical Conductivity vs. Cable Length

Flow and calibration velocity range**:**

It calibration by standard Range shown in the table below when Range is not specified.

It calibration when there is specification by flowing quantity Range in which the customer is specified. Is this specification Range flowing quantity of Table 9.2. Please confirm becoming in the upper bound value from the flow velocity chart.

Table 9.2 Standard flow range

Meter size Inch (mm)	Standard Flow range	
	Flow rate (m^3/h)	Flow velocity (m/s)
20” (500)	3,000	4.244
24” (600)	4,000	3.930
28”(700)	5,000	3.609
30”(750)	6,000	3.774
32”(800)	7,000	3.868
36”(900)	9,000	3.930
40”(1000)	10,000	3.537
42”(1050)	12,000	3.850
48” (1200)	16,000	3.930
54” (1350)	16,000	2.211
60” (1500)	16,000	2.515
66” (1650)	16,000	2.076
72” (1800)	16,000	1.747
78” (1950)	16,000	1.488

To select the meter size:

See Table 9.3 and find meter sizes within the velocity of 0.3 to 10 m/s for a specified full-scale (measuring range high limit) flow. Select one that has its full-scale velocity between 1 and 3 m/s.

Make sure the full-scale flow rate used for the final planning stage stays within 10 m/s in terms of flow velocity.

Table 9.3 Flow rate and Flow velocity

Unit : gal/min

Meter size	Flow velocity			
inch	0.98ft/s	3ft/s	10ft/s	32.8ft/s
20”	933.7	2,846	9,486	31,120
24”	1,344	4,098	13,660	44,820
28”	1,830	5,578	18,590	61,000
30”	2,101	6,403	21,340	70,020
32”	2,390	7,285	24,280	79,670
36”	3,025	9,221	30,740	100,800
40”	3,735	11,433	38,109	124,997
42”	4,117	12,551	41,833	137,239
48”	5,378	16,392	54,640	179,280
54”	6,806	20,747	69,143	226,883
60”	8,403	25,611	85,359	280,090
66”	10,168	31,125	103,751	340,303
72”	12,100	36,884	122,939	403,315
78”	14,201	43,285	144,284	473,411

Unit : m3/h

Meter size	Flow velocity			
mm	0.3m/s	1m/s	3m/s	10m/s
500	212.2	706.9	2,121	7,069
600	305.4	1,018	3,054	10,179
700	415.6	1,385	4,156	13,854
750	477.1	1,590	4,771	15,904
800	542.9	1,810	5,429	18,096
900	687.1	2,290	6,871	22,902
1000	848.2	2,827	8,482	28,274
1050	935.2	3,117	9,352	31,172
1200	1,221	4,072	12,215	40,715
1350	1,546	5,153	15,459	51,530
1500	1,909	6,362	19,085	63,617
1650	2,309	7,698	23,093	76,977
1800	2,748	9,161	27,483	91,609
1950	3,225	10,751	32,254	107,513

9.2 Type Specification Code

Table 9.3 Type Specification Code (Model LF664 Detector)

Model number					Specification code									Contents	
1	2	3	4	5	6	7	8	9	10	11	12	13	14		
L	F	6	6	4										Electromagnetic flowmeter detector Hazardous location certification type	●
														Meter size	
					5	0								20” (500mm)	●
					6	0								24” (600mm)	●
					7	0								28” (700mm)	●
					7	5								30” (750mm)	●
					8	0								32” (800mm)	●
					9	0								36” (900mm)	●
					A	0								40” (1000mm)	●
					A	1								42” (1050mm)	●
					A	2								48” (1200mm)	●
					A	3								54” (1350mm)	●
					A	5								60” (1500mm)	●
					A	7								66” (1650mm)	●
					A	8								72” (1800mm)	●
					A	9								78” (1950mm)	●
														Mounting style	
							A							Detector/Converter combined type	●
							B							Detector/Converter separate type	●
														Connection flange standard	
								C						ANSI 150, AWWA class D *1	●
														Electrode material	
									K					AISI316L	●
									C					Titanium	○
									F					Hastelloy C equivalent	○
														Lining material	
										N				Natural rubber	●
														Grounding ring material	
											A			Not provided	●
											B			AISI304	○
											C			AISI316	○
											H			Hastelloy C equivalent	○
											E			Titanium	○
														Dedicated preformed cable	
												A		Not provided	●
												B		30m cable, provided	○
												C		Other length, provided	○
														Coating	
													F	Polyurethane	●
													G	Polyurethane + IP68	○
													E	tar epoxy resin (for submersible type)	○

Table 9.4 Type Specification Code (Exciting Cable and Signal Cable)

Model	Specification Code					Description
1 2 3	4	5	6	7	8	
A C C						Dedicated preformed cable
						Nominal cross-sectional area of Exciting cable **(Note 1)**
	A					1.25 mm²
	B					2 mm²
						Nominal cross-sectional area of Signal cable **(Note 2)**
		A				0.75 mm²
						Cable length
			0	0	1	1 m
			0	0	2	2 m
			0	0	3	3 m
			0	0	4	4 m
			0	0	5	5 m
			0	0	6	6 m
			0	0	7	7 m
			0	0	8	8 m
			0	0	9	9 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	6	0	60 m
			3	0	0	300 m

From 1 to 10 meters (3.3 to 32.8 feet), Cable can be ordered in 1 meter increments.

From 10 to 50 meters (32.8 to 164 feet), cable can be ordered in 5 meters increments.

From 50 to 300 meters (164 to 984 feet), cable can be ordered in 10 meters increments.

Notes:

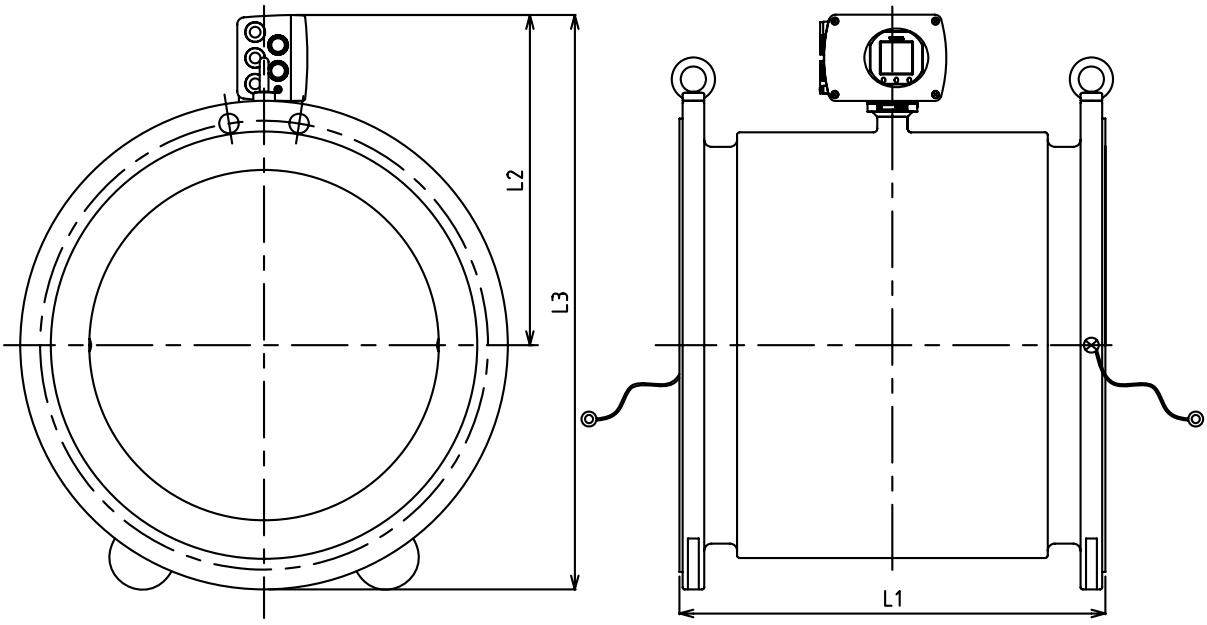
1. Exciting cable is a 3-wire chloroprene sheathed cable. For a nominal cross-sectional area of 1.25 mm², the overall diameter will be 12 mm (15/32 inch): for 2 mm², 13 mm(1/2 inch).
2. Signal cable is a 2-wire shielded chloroprene sheathed cable with a nominal cross-sectional area of 0.75 mm² and an overall diameter of 12 mm (15/32 inch).
3. Relation between exciting cable length and its nominal cross-sectional area and overall diameter is as follows.

Exciting cable length	Nominal cross-sectional area	Overall diameter
1 to 200 m	1.25 mm²	12 mm
210 to 300 m	2 mm²	13 mm

10. Outline Dimensions

10.1 Outline dimensions of LF664/LF620F

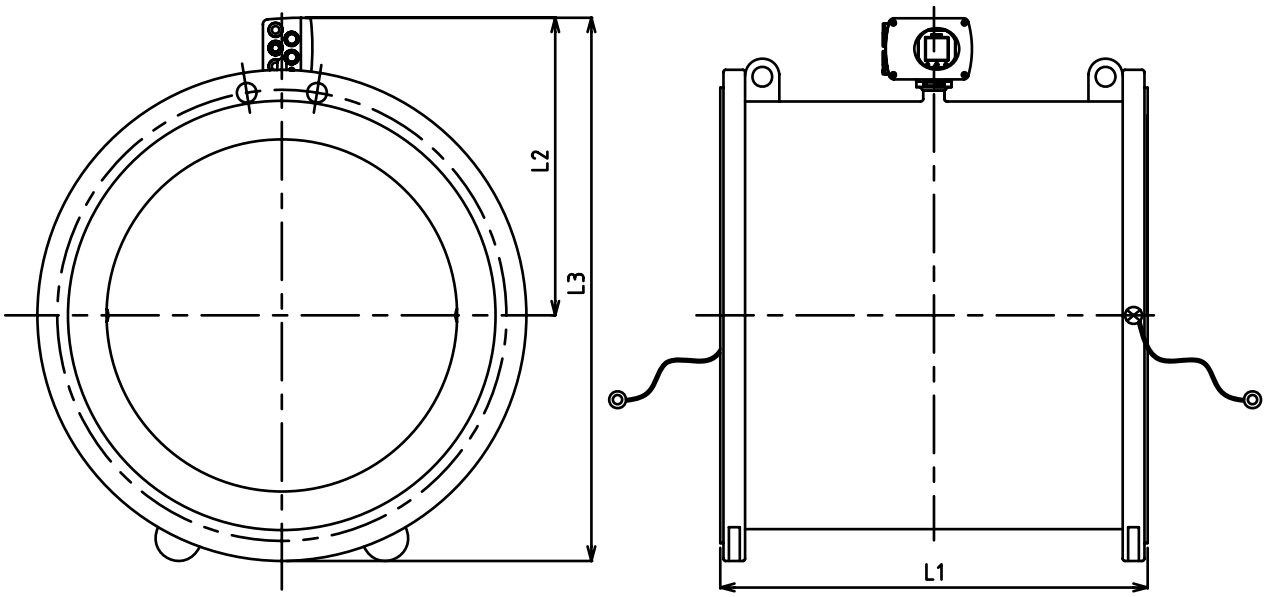
■ **Meter size 20”(500mm), 24” (600mm)**



ANSI class 150 dimensions:

Meter size inch (mm)	L1 inch (mm)	L2 inch (mm)	L3 inch (mm)	Weight lb(kg)
20” (500)	23.62 (600)	17.54 (445.5)	31.29 (794.8)	530 (240)
24” (600)	23.62 (600)	19.61 (498.0)	35.61 (904.4)	710 (320)

■ Meter size 28”(700mm) to 36” (900mm)

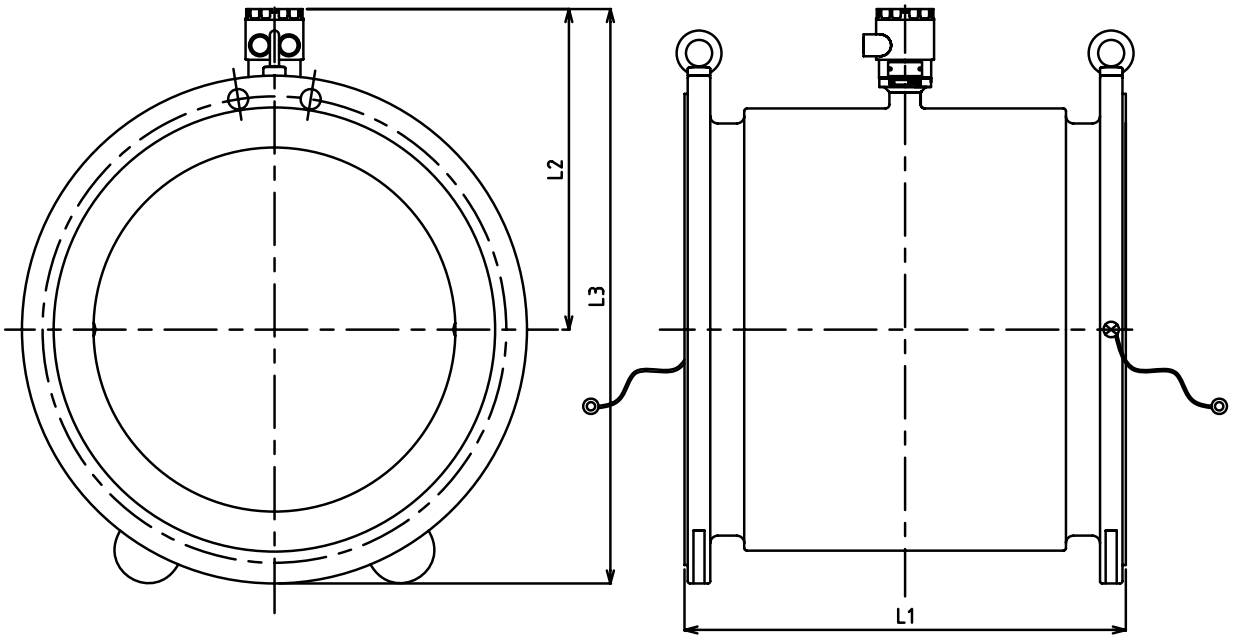


AWWA class D dimensions:

Meter size inch (mm)	L1 inch (mm)	L2 inch (mm)	L3 inch (mm)	Weight lb(kg)
28” (700)	27.56 (700)	21.79 (553.5)	40.04 (1017.1)	640 (290)
30” (750)	29.53 (750)	22.80 (579.0)	42.17 (1137.8)	710 (320)
32” (800)	31.50 (800)	23.92 (607.5)	44.79 (1137.8)	840 (380)
36” (900)	35.43 (900)	25.93 (658.5)	48.93 (1242.8)	1100 (490)

10.2 Outline dimensions of LF664

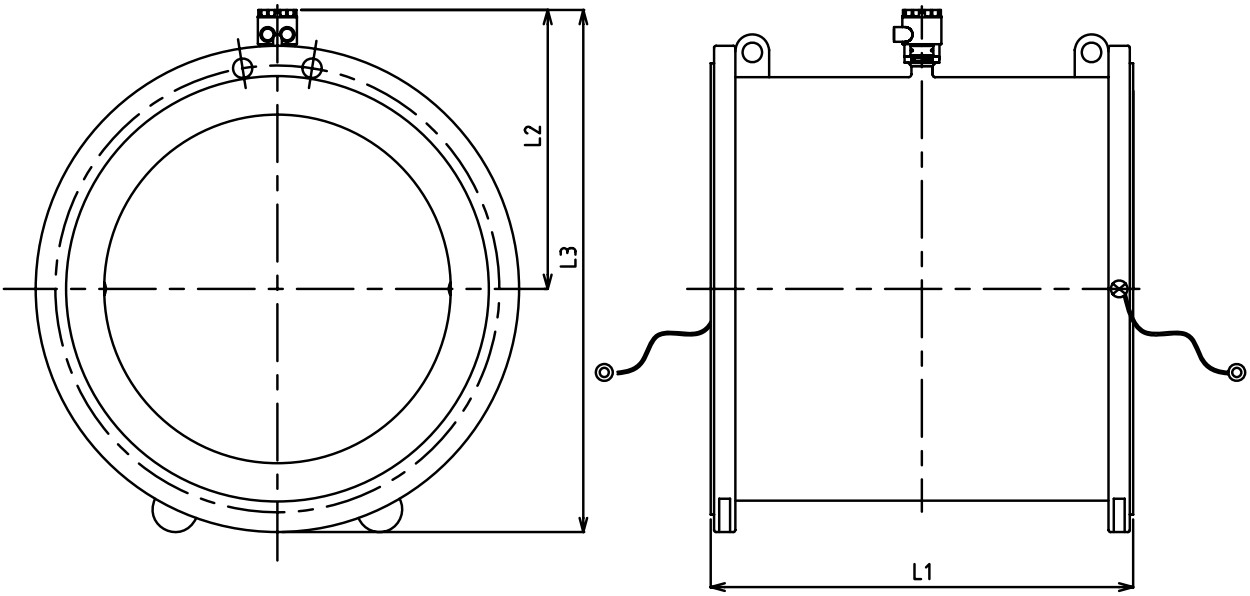
■ Meter size 20”(500mm), 24” (600mm)



ANSI class 150 dimensions:

Meter size inch (mm)	L1 inch (mm)	L2 inch (mm)	L3 inch (mm)	Weight lb(kg)
20” (500)	23.62 (600)	16.24 (413)	29.99 (762)	530 (240)
24” (600)	23.62 (600)	18.31 (465)	34.31 (871)	320 (710)

■ Meter size 28”(700mm) to 78” (1950mm)



ANSI class 150 dimensions:

Meter size inch (mm)	L1 inch (mm)	L2 inch (mm)	L3 inch (mm)	Weight lb(kg)
28” (700)	27.56 (700)	20.49 (521)	38.74 (984)	640 (290)
30”(750)	29.53 (750)	22.62 (575)	41.99 (1067)	710 (320)
32”(800)	31.50 (800)	22.62 (575)	43.49 (1105)	840 (380)
36”(900)	35.43 (900)	24.63 (626)	47.63 (1210)	1100 (490)
40”(1000)	39.37 (1000)	26.75 (680)	52.13 (1324)	1300 (590)
42”(1050)	41.34 (1050)	30.75 (781)	57.25 (1454)	1500 (670)
48”(1200)	47.24 (1200)	30.75 (781)	60.50 (1537)	2050 (910)
54”(1350)	55.12 (1400)	33.74 (857)	66.87 (1698)	2600 (1150)
60”(1500)	59.06 (1500)	39.74 (1010)	76.24 (1937)	3450 (1550)
66”(1650)	62.99 (1600)	39.74 (1010)	79.74 (2026)	4400 (2000)
72”(1800)	70.87 (1800)	42.78 (1087)	86.03 (2185)	4950 (2250)
78”(1950)	78.74 (2000)	45.91 (1166)	92.41 (2347)	6400 (2900)

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 LF _____ SER.NO._____

TOSHIBA CORPORATION

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