

ONO SOKKI

# FX-1100 Series

MASS BURETTE FLOW DETECTOR

INSTRUCTION MANUAL

ONO SOKKI CO., LTD.

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## Warranty

1. This product is covered by a warranty for a period of one year from the date of purchase.
  2. This warranty covers free-of-charge repair for defects judged to be the responsibility of the manufacturer, i.e., defects occurred while the product is used under normal operating conditions according to descriptions in this manual and notices on the unit label.
  3. For free-of-charge repair, contact either your sales representative or our sales office nearby.
  4. The following failures will be handled on a fee basis even during the warranty period.
    - (a) Failures occurring through misuse, mis-operation, or modification
    - (b) Failures occurring through mishandling (dropping) or transportation
    - (c) Failures occurring through natural calamities (fires, earthquakes, flooding, and lightning), environmental disruption, or abnormal voltage.
- \* For repairs after the warranty period expired, contact your sales representative or our sales office nearby.

# FOR YOUR SAFETY

Please read this manual and the precautions listed in this section to ensure safe and proper use of the FX-1100 Mass Burette Flow Detector.

Ono Sokki, Ltd. bears no responsibility for nor makes any warranty regarding damages or injury resulting from failure to follow directions given within this document during operation.

## Meaning of Symbols

- In this section precautions are classified into two categories:

### WARNING and CAUTION

This depends on the degree of danger or damage possible if the precaution is ignored and the product is used incorrectly.

|   |   |
|---|---|
| <br><b>WARNING</b> | This symbol is used to indicate precautions where there is a risk of death or serious personal injury to the operator if the product is handled incorrectly.                            |
| <br><b>CAUTION</b> | This symbol is used to indicate precautions where there is a risk of some personal injury to the operator or only material damage to the product if the product is handled incorrectly. |



**WARNING**

### **Before Using**

- Only take measurements under the direction of someone in charge of handling dangerous materials.  
Only take measurements under the direction of someone in charge of handling dangerous materials as measurements involving fluids such as gasoline or kerosene can be extremely dangerous.
- Beware of possible ignition.  
Pay close attention to possible ignition as measurements involving fluids such as gasoline or kerosene can be extremely dangerous.
- Only use this product in the specified temperature range (0 to +40, C).  
Avoid using in locations of extremely high temperature as there may be a risk of fire. Also avoid using this product in locations where condensation may form as operation with condensation present may result in an electric short inside the product leading to fire from the heat generated or injury from electric shock.
- Only use this product within the specified pressure range.  
This device is designed to withstand 196 kPa of pressure. Be sure to use this product at or below this pressure when used in a pressurized system. Also, the maximum differential pressure before and after using the built-in electromagnetic valve for charging is 98 kPa. Be sure the following conditions are met when using this valve.  
 $P_1$  - Device pressure     $P_2$  - Inlet fluid pressure     $0 \text{ kPa} < P_2 - P_1 < 98 \text{ kPa}$
- Never allow fluid other than type allowed by specifications to flow through this product.  
The FX-1100 Series has been designed to measure only the following types of fluids. Flowing types of fluids other than those allowed may result in damage or corrosion to parts inside the device or put the operator and people nearby in risk of bodily harm.  
For details, contact the retail outlet where you purchased the product or your nearest Ono Sokki business office.
  - Standard specification..... Gasoline (leaded/unleaded), light oil, kerosene, standard petroleum-based hydraulic fluid, A weight oil, and engine oil
  - Alcohol-compatible specification..... Methanol, ethanol, and alcohol and gasoline mixtures
- Do not subject the product to vibration or shock.  
The FX-1100 is a precision instrument. Avoid storing or using it in locations subject to vibration. Also do not subject this product to strong shocks due to dropping or rough handling. Always let out fluid being measured before moving this product as this may result in damage or malfunction of the product leading to risk of bodily harm.



**WARNING**

### **About Installation**

- Always use the supplied bracket to mount the device.  
If the device is tilted, this may result in damage or malfunction due to vibration and lead to risk of bodily harm. To install, mount the device using screws and the mounting holes in the bottom of the device.

### **About Piping**

- Only lay pipes after checking that the power is off.  
Always check that the power of the FX-3400 Mass Burette Flow Detector is off before laying pipes.  
Switch the power of the FX-3400 on and off after connecting the FX-1100 Series and FX-3400 Series with flow signal cable.
- Only remove pipes after closing the outlet valve.  
Always remove pipes after closing the valve as removing pipes with the outlet valve left open will result in fluid spilling from the device.
- Take safety precautions when using the FX-1100 under atmospheric release.  
Take safety precautions such as connecting pipe to the air layer of the fluid tank just in case the electromagnetic valve on the outlet side (air release) happens to overflow. Using an optional FX-003A float switch tank for overflow detection is even safer.
- There is extreme danger from risk of explosion if fluid being measured leaks from pipes and ignites.  
When using rubber hoses as pipes, be sure to use a hose band so that rubber hoses do not come off and be sure that joints are secured firmly.  
Also be sure to periodically inspect rubber hoses. If you see evidence of degradation of hoses, be sure to quickly replace them with new hoses.



**CAUTION**

### **About Installation**

- Install the device in a stable location lower than the fluid tank.  
When obtaining fluid supply pressure to the device from a height difference, be sure to install the device in a location lower than the fluid tank to prevent air from collecting and negative pressure.
- Do not install the device sideways.  
Do not install the device sideways while fluid enters as doing so can cause fluid being measured to enter the reference tube (low-pressure side of the differential pressure detector) and lead to malfunction.
- Always handle this product as a precision instrument.  
Products of the FX-1100 Series are precision instruments. Never install them in locations of extreme high temperature or in places subject to vibration.

### **About Piping**

- Do not mistake inlet and outlet of the device.  
The device has an inlet (IN) where fluid flows in and an outlet (OUT). Be sure to check the inlet and outlet when connecting pipes.
- Pay attention to how you wrap sealing material.  
Note the following things when wrapping Teflon sealing tape around threaded parts such when modifying joints.
  - Secure the threaded part by wrapping the sealing tape one and a half to two times around the threaded end, leaving the last one or two threads uncovered.
  - If you use liquid sealant, be sure that the sealant does not lead inside the pipes.
- Do not bend pipes up then down.  
Bending pipes at up then down may cause air to collect because it is harder for air to escape from the top of the bend in the pipe. Note that accurate measurements cannot be made if air collects inside pipes.
- We recommend that you install a bypass valve.  
We recommend that a bypass valve be installed inside pipes in preparation for maintenance of systems for measuring engines and in case of device malfunctions.

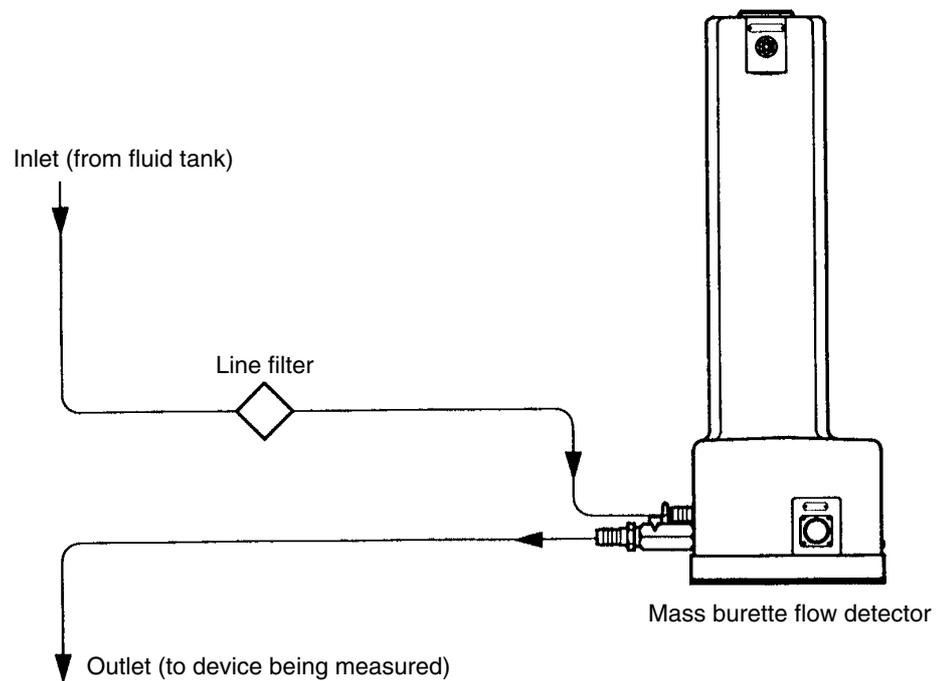


CAUTION

### About Piping

- Use a line filter.

If there is any possibility of dirt in the fluid or inside the pipe, insert a line filter having a filtering performance of 10 to 20  $\mu\text{m}$  in front of the inlet to the FX-1100 Series in order to protect the electromagnetic valve for charging.



- \* Allow enough time for the device to warm up.

The FX-1100 Series is controlled to maintain a constant temperature inside the differential pressure detector. Although it may be used about three minutes after power is turned on, allow it to warm up for about 30 minutes to ensure rated accuracy.

# FOREWORD

Thank you for purchasing the FX1100 Mass Burette Flow Detector.

Please read this manual thoroughly in order to take full advantage of the superior performance of this device.

This device has been rigorously tested at the factory and found to operate normally. If the packaging has come open, check that the product has not been damaged during shipping and read this instruction manual carefully so that you may check its operation.

If the product has somehow become damaged and does not operate as per specifications, contact the retail outlet where you purchased or your nearest Ono Sokki business office.

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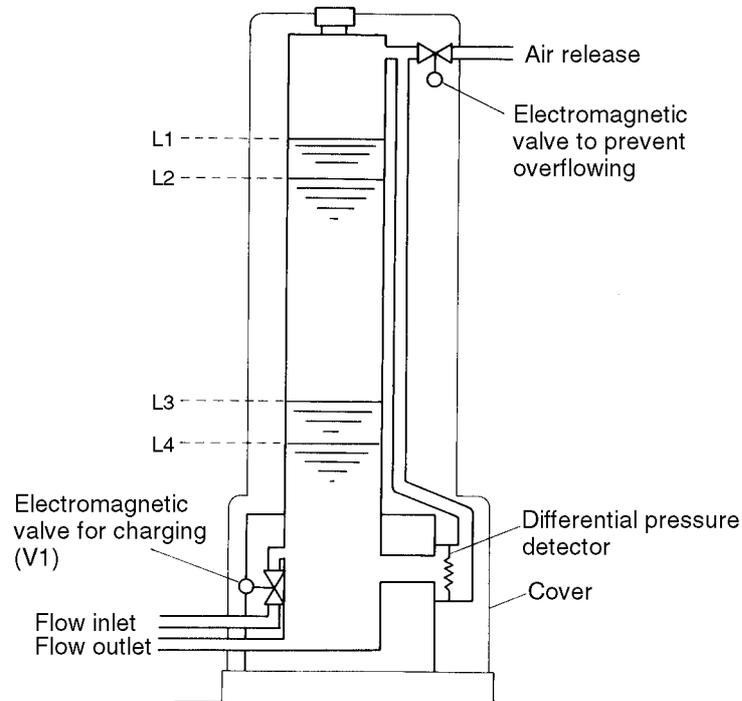
# **1 OVERVIEW**

## **1.1 Overview**

The FX-1100 Series Mass Burette Flow Detector takes the position of the fluid surface inside the burette as the head pressure using the differential pressure detector attached at the bottom and directly measures the flow of fluid as a mass based on changes in this pressure.

- This style of burette is less likely to allow air bubbles to form than a capacity-type burette and also includes an air release function.
- In combination with an FX-3400 Mass Burette Flow Meter, it can measure cumulative mass (g), cumulative time (s), and instantaneous flow (g/s).
- Since a differential pressure detector is used for pressure detection pressurized flow may be used.

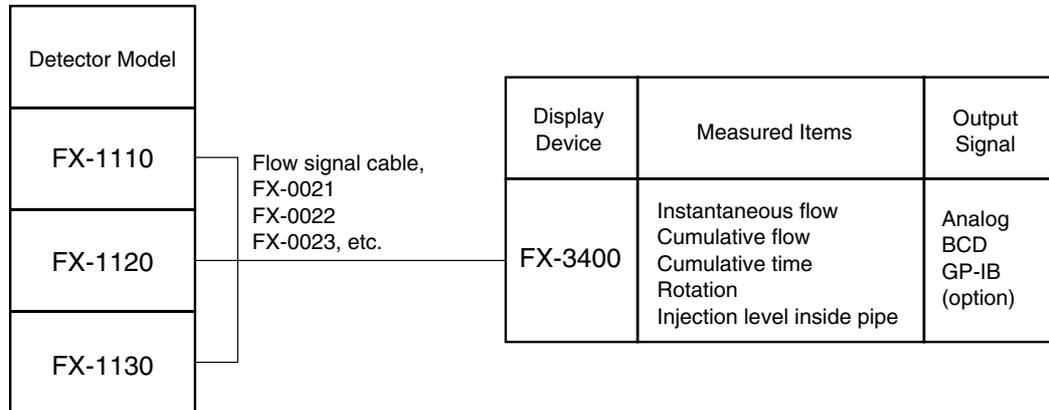
## 1.2 Principle of Detection



When the fluid surface goes below L3, a pressure signal from the differential pressure detector opens an electromagnetic valve (V1) to allow more fluid to enter. V1 closes once the fluid surface reaches L2, and after about two seconds the device begins measuring instantaneous flow. The output of the differential pressure detector varies according to the mass of discharged fluid as the fluid surface goes down from L2 as fluid is discharged from the flow detector. When used in combination with an FX-3400 Mass Burette Flow Meter, the flow can be displayed digitally as a mass reading based on the amount of this variance.

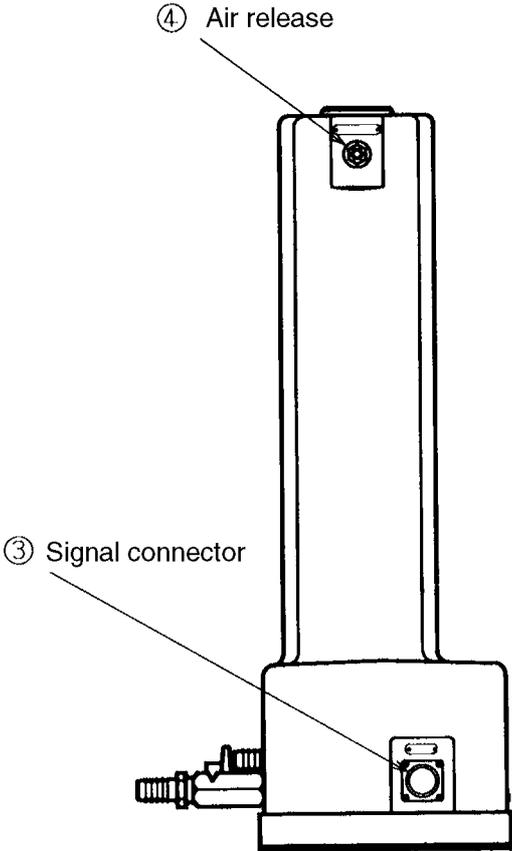
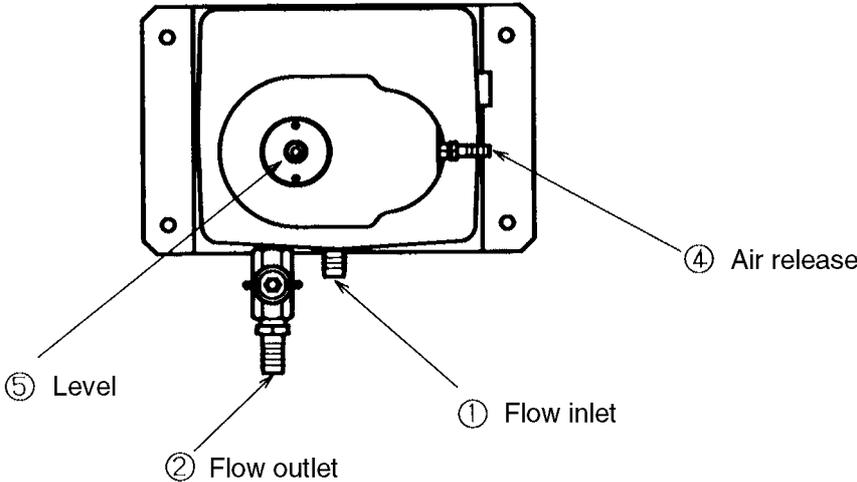
Any one of three modes can be used to measure cumulative flow for: (1) time from manual start to stop, (2) set amount of flow from start, and (3) set time from start. A display device is used to issue an alarm when the fluid level reaches L1, the overflow detection level, or L4, the out-of-fluid detection level. (Each of the fluid surface levels L1 through L4 are detected based on the output level from the differential pressure detector.)

## 1.3 System Configuration



- Notes • Some items which can be measured require sensors other than the FX-1100.
- The detector and display device have been adjusted and set for use together at time of shipment from the factory.  
If you are going to use the display device in combination with a different type of detector, it will be necessary to bring back the display device for re-adjustment.  
Please consult your nearest Ono Sokki business office at this time.

## 2. NAMES OF PARTS



## 2. Names of Parts

(1) Flow inlet (IN)

This is the inlet port to the FX-1100 Series. Connect the pipe from a supply tank here.

Supply pressure should be as follows.

$P_o < P_s < P_o + 98 \text{ kPa (1 kg/cm}^2\text{)}$ , where  $P_o$  is flow feed pressure

When using the flow detector at atmospheric pressure, be sure to supply fluid at  $P_s < 98 \text{ kPa (1 kg/cm}^2\text{)}$ .

(2) Flow outlet (OUT)

This is the flow outlet port from the FX-1100. Connect the pipe to the device being measured here.

(3) Signal connector

This is the connector for I/O signals. Connect the prescribed flow signal cable (FX-0021, FX-0022 or FX-0023) to the DETECTOR connector of the FX-3400 or POWER BOX.

(4) Air release

This port is so that air may flow in and out of the detector as fluid flows in and out.

Normally, a pipe is connected to the air layer of the fluid supply tank. It is also possible to use pressure to feed flow to the device being measured using this port.

(5) Level

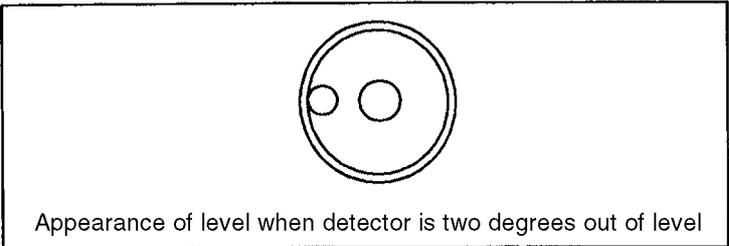
This is used to check that the FX-1100 is level during installation. Install the FX-1100 so that the air bubble in the level is inside the center of the circle. For details on using the level, see Section 3.1, "Installation".

3. Installation and Arranging Pipes

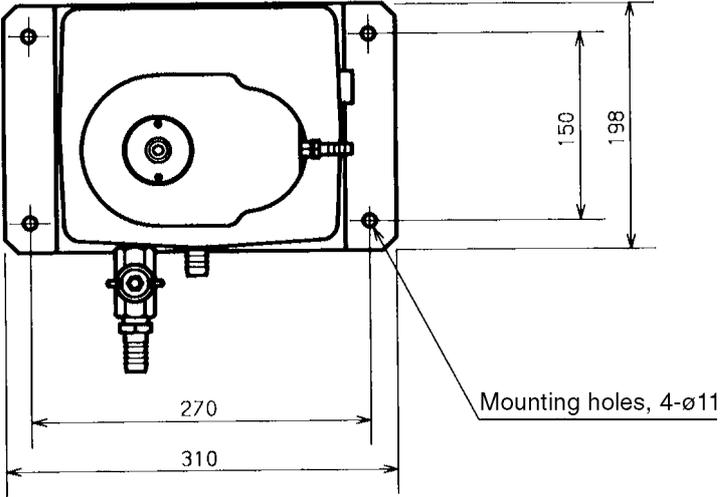
### 3. INSTALLATION AND ARRANGING PIPES

#### 3.1 Installation

Although the FX-1100 Series Mass Burette Flow Detector is designed as much as possible for use under adverse conditions, it is a precision instrument and should not be installed in locations subject to much vibration or in locations of high temperature (the allowable ambient temperature range is 0 to 40°C). If the detector is not level, the FX-1100 Series is susceptible to slight errors (about 0.06% per two degrees out of level). The level on the top of the detector will appear as shown below if the detector is about two degrees out of level.

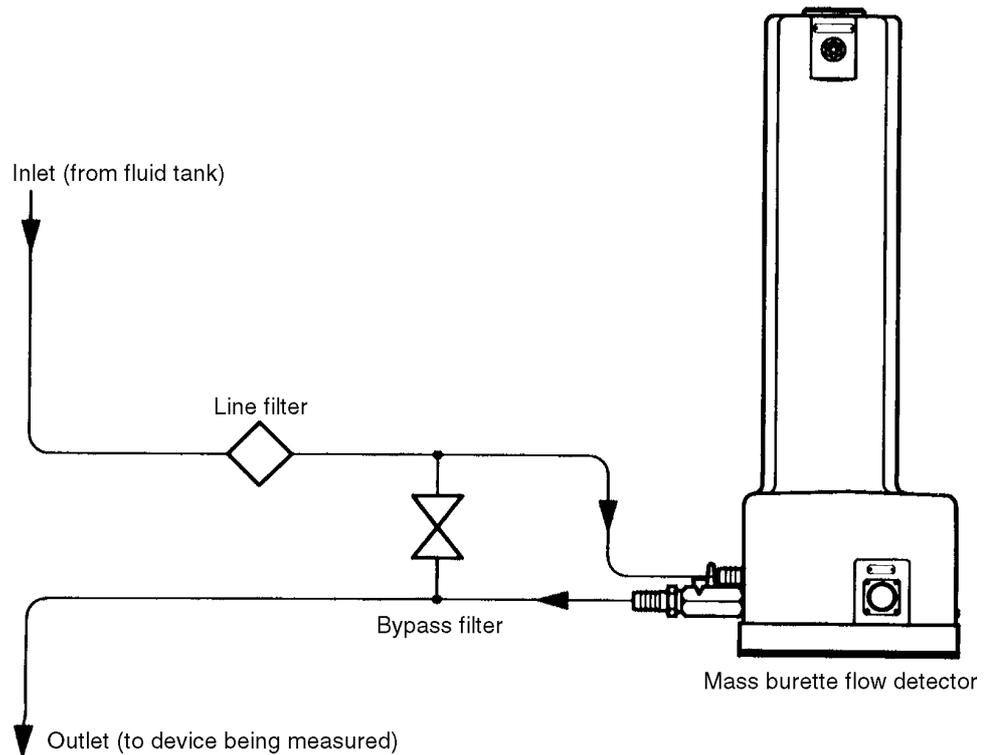


The installation hole pitch and hole radius of the FX-1100 are as follows.



## 3.2 Precautions when Connecting Pipes

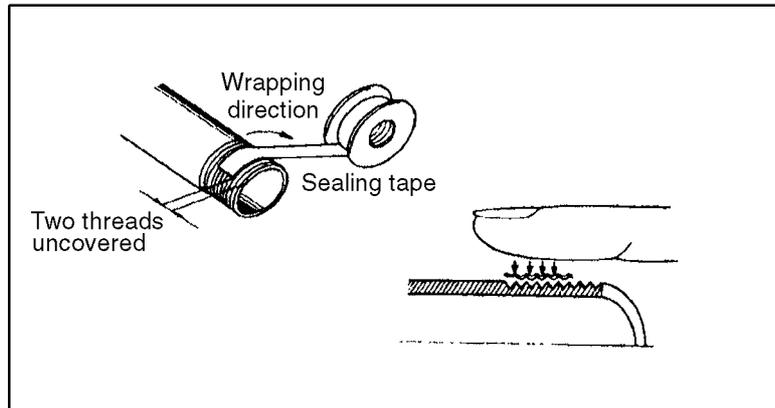
- (1) Always insert a line filter to protect the electromagnetic valve for charging somewhere in the middle of the pipe leading to the inlet of the FX-1100 Series Mass Burette Flow Detector.
- (2) Do not mistake the inlet (IN) and outlet (OUT) of the detector when connecting pipes.
- (3) Insert a bypass valve for bypassing the FX-1100 between the supply and discharge pipes as shown in the figure below to allow for maintenance of the engine or other device being measured, releasing air from pipes, and possible detector malfunction. Be sure this bypass valve is closed during measurements.



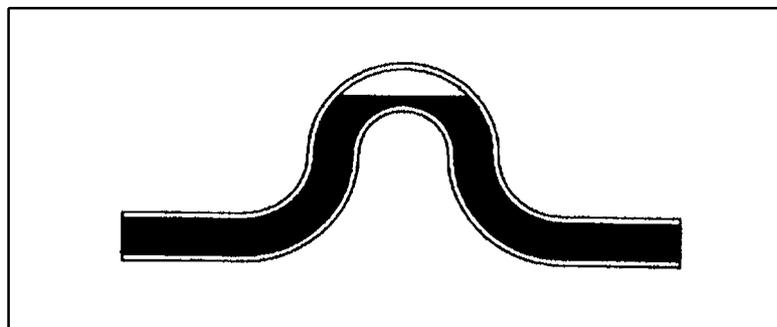
- (4) If using the FX-1100 Series under atmospheric release, connect the outlet (air release) of the electromagnetic valve for protecting against overflow to the air layer of the fluid tank using a pipe as a safety precaution in case of overflow or supply a container to catch any overflow. Using an optional FX-003A float switch tank for overflow detection is even safer.

### 3. Installation and Arranging Pipes

- (5) Pay attention to how you wrap sealing material such as sealing tape. If you use Teflon sealing tape on the threaded part of pipes when modifying a joint, apply the tape to the threads by wrapping it one to two times around the threaded end, leaving the last one or two threads uncovered.



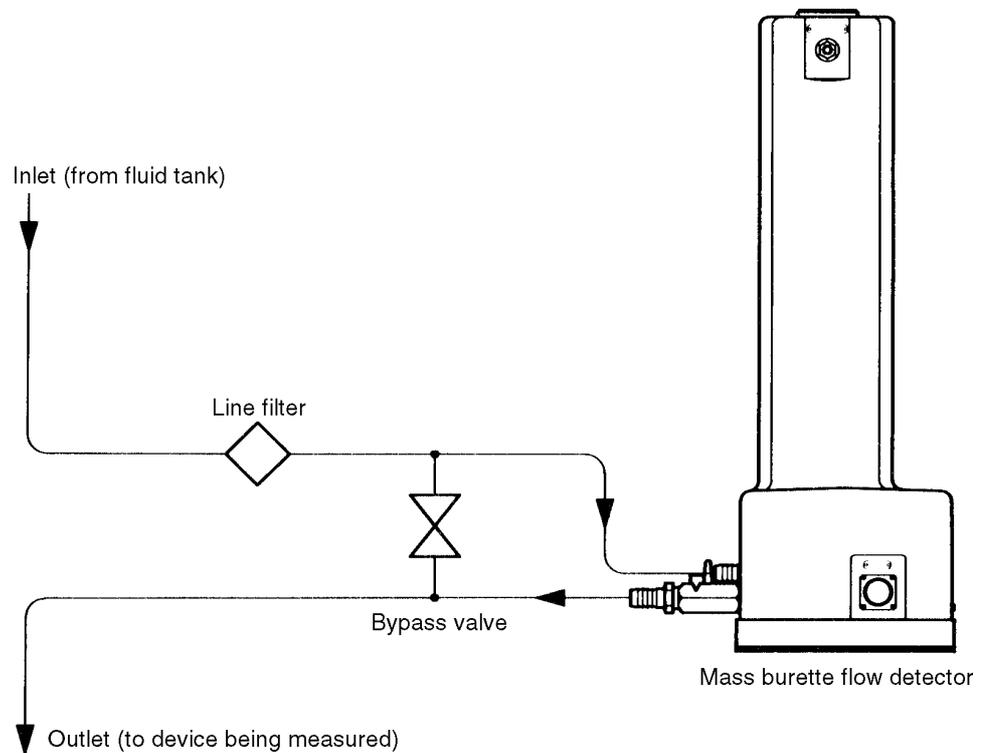
- (6) Perform flashing on the pipe front and back before connecting the pipe to the detector.
- (7) When using rubber hoses for pipes, always use hose bands to firmly secure joints so that the rubber hoses will not come off. Periodically inspect for degradation of rubber hoses. Be sure to quickly replace with new rubber hoses if degradation is detected.
- (8) Do not bend pipes as shown in the figure below. This may cause air to collect because it is harder for air to escape from the top of the bend in the pipe. This may affect the ability to obtain accurate measurement results.



### 3.3 Connecting Pipes

The type of pipe connections to be made differ depending on whether or not there is supply pressure of the fluid supplied to the FX-1100 Series and whether there is supply pressure of fluid from the FX-1100 Series to the engine or other device being measured. Connect pipes by referring to methods (1) through (3) which follow.

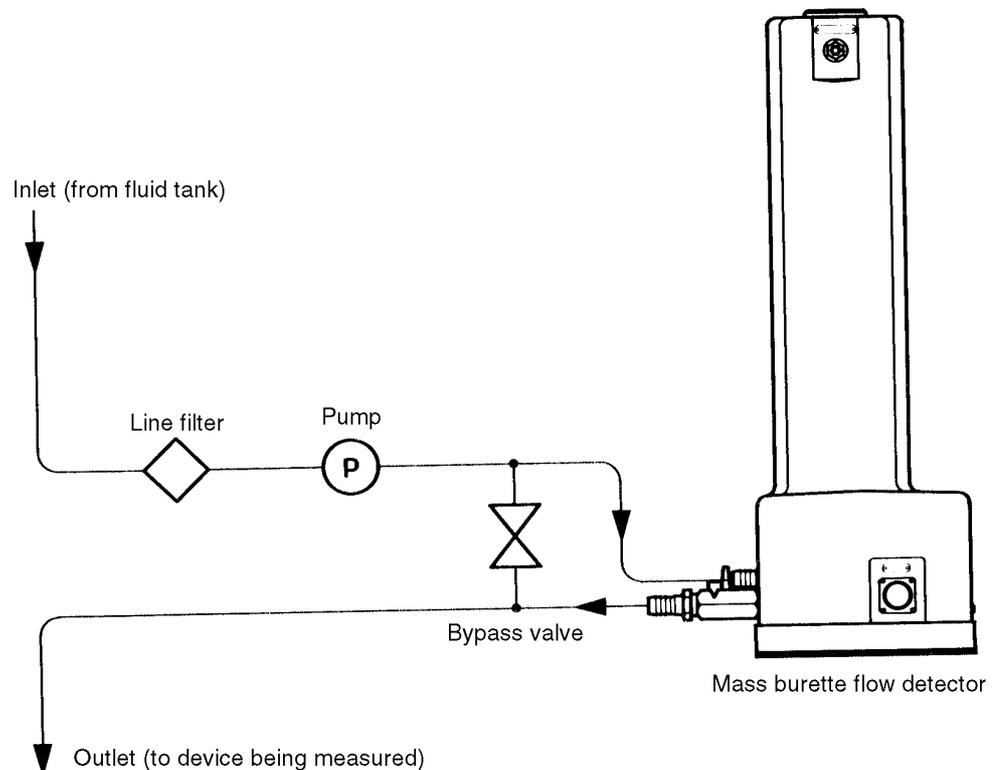
- (1) Connect as follows if there is sufficient supply pressure from the fluid tank, fluid can be replenished to the FX-1100 Series, and fluid can also be supplied from the FX-1100 Series to the engine or other device being measured.



### 3. Installation and Arranging Pipes

- (2) Connect as follows if the supply pressure from the fluid tank is low, fluid cannot be replenished to the FX-1100 Series, and fluid can be supplied from the FX-1100 Series to the engine or other device being measured.

Pressure feed fluid from the fluid tank using a pump to replenish fluid to the FX-1100. Since the pump used here is only for supplying fluid to the detector, a pulsating pump, such as a diaphragm pump, may be used. Note however that since the maximum operational pressure of the electromagnetic valve for charging on the inlet of the FX-1100 is  $1 \text{ kg/cm}^2$ , you should use a relief or stop pump having an outlet pressure of under  $1 \text{ kg/cm}^2$ .

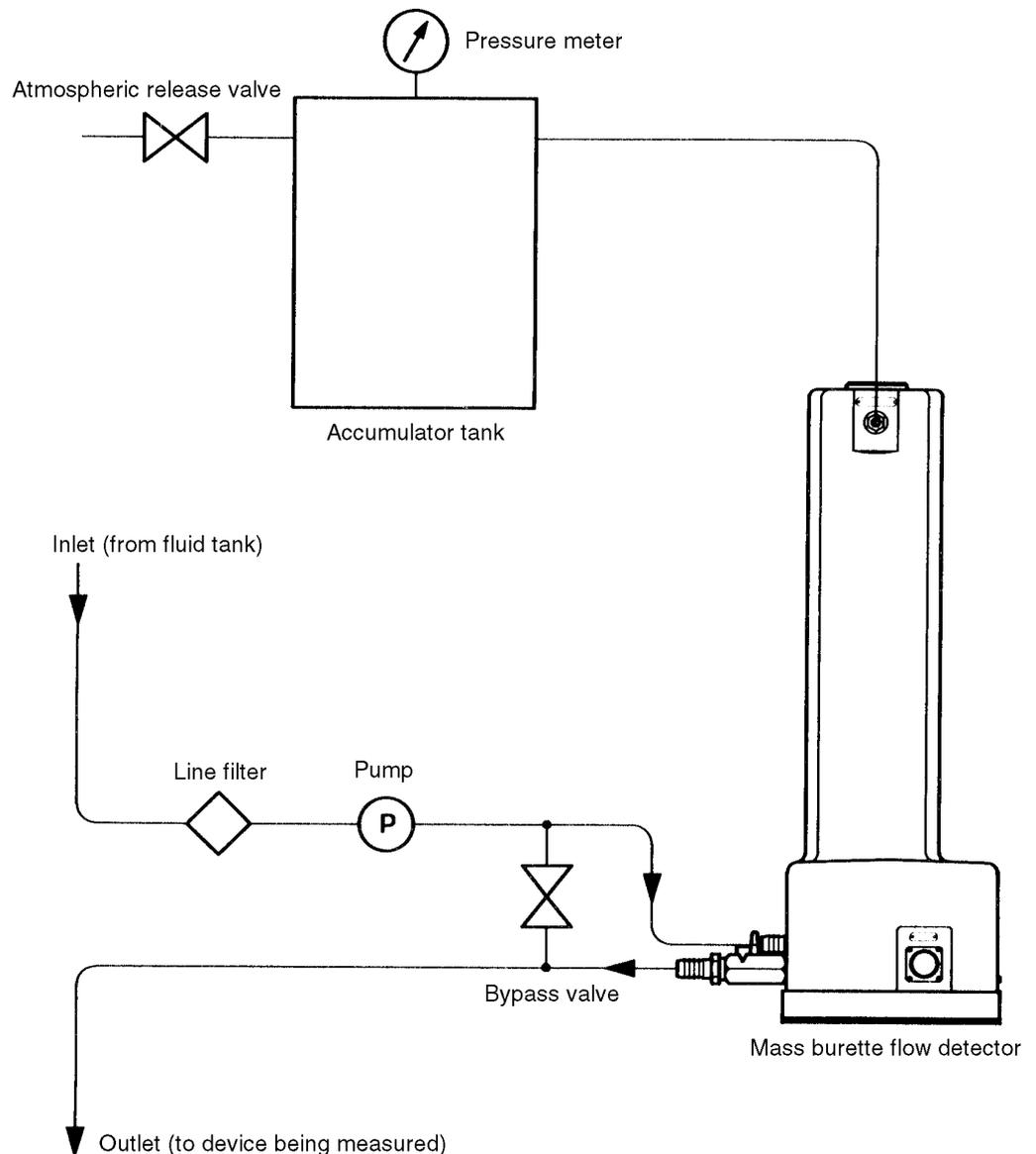


### 3. Installation and Arranging Pipes

- (3) Connect as follows if fluid cannot be supplied from the FX-1100 Series to the engine or other device being measured for some reason such as because the FX-1100 Series cannot be installed in a high location.

Although it is possible to supply fluid by inserting a pump between the FX-1100 and the device being measured, measurement values may fluctuate due to the effect of this pump. Under the recommended method, you should send fluid to the device being measured by pressurizing the top of the FX-1100 Series.

Refer to the following figure as an example of pressurizing the detector using an accumulator tank.



### **3. Installation and Arranging Pipes**

The maximum operational pressure of the electromagnetic valve for charging on the inlet of the FX-1100 is 1 kg/cm<sup>2</sup>. The pump used to replenish fluid has a discharge pressure higher than the pressure of the accumulator tank. Be sure to use a relief or stop pump at a pressure of (pressurized pressure) + 98 kPa (1 kg/cm<sup>2</sup>) or less.

- Jus as with the pump described in connection method (2), a pulsating pump may be used for replenishing fluid to the FX-1100 Series.
- This pump may be omitted if the supply pressure from the fluid tank to the FX-1100 Series is high enough to replenish the FX-1100 Series.

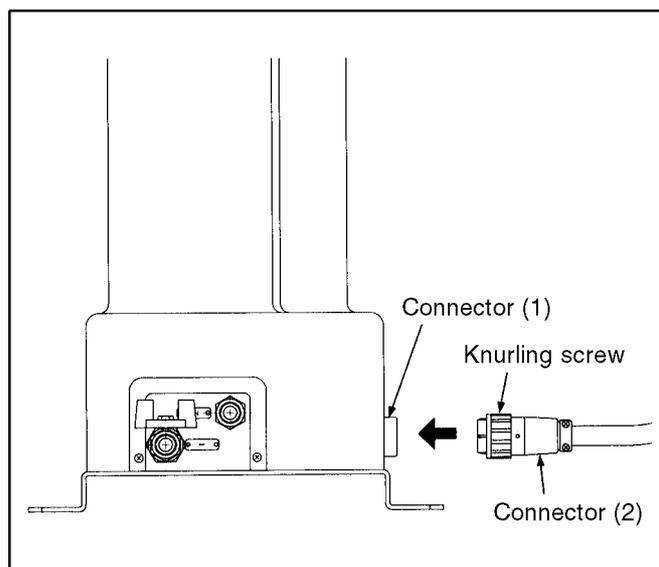
Decide the capacity of the accumulator tank depending on the allowable variance in pressure between when the FX-1100 Series fluid level is high and when it is low.

## 4. OPERATIONS

### 4.1 Connecting a Flow Signal Cable

Connect a flow signal cable (see below) to the SIG connector of the FX-1100 Mass Burette Flow Detector in order to send signals and supply power to the detector.

- Align the cut-outs on Connector (1) and Connector (2).
- Plug Connector (2) into Connector (1).
- Turn the Knurling screw clockwise to secure the connection.



When the display device is an FX-3400 Mass Burette Flow Meter  
Connect the connector on the other end of the flow signal cable to the  
DETECTOR connector of the FX-3400.

|  |  |  |
|--|--|--|
|  | FX-0021/0022/0023<br>(5 m) (10 m) (20 m) |  |
| Flow signal cable<br>(sold separately) | [FX-1100 connector]                      | [FX-3400 connector]<br>[POWER BOX connector] |
|  | TRC-25P16F                               | PRC04-12A16-14M1.25                          |

## **4.2 Checking Pipe Connections**

- (1) Before allowing fluid to flow, be sure to check that all pipes are connected securely.
- (2) Check that points of connection for hoses are firmly secured by hose bands.
- (3) Check that fluid does not leak or ooze from pipes.

## **4.3 When Fluid is Flowing**

- (1) Close the outlet valve of the detector (FX-1100 Series). Close the bypass valve also if one is installed.
- (2) Supply fluid to the FX-1100 Series.
- (3) Turn on the power of the display device FX-3400 Mass Burette Flow Meter and the POWER BOX.
- (4) Open the outlet valve of the FX-1100 Series.

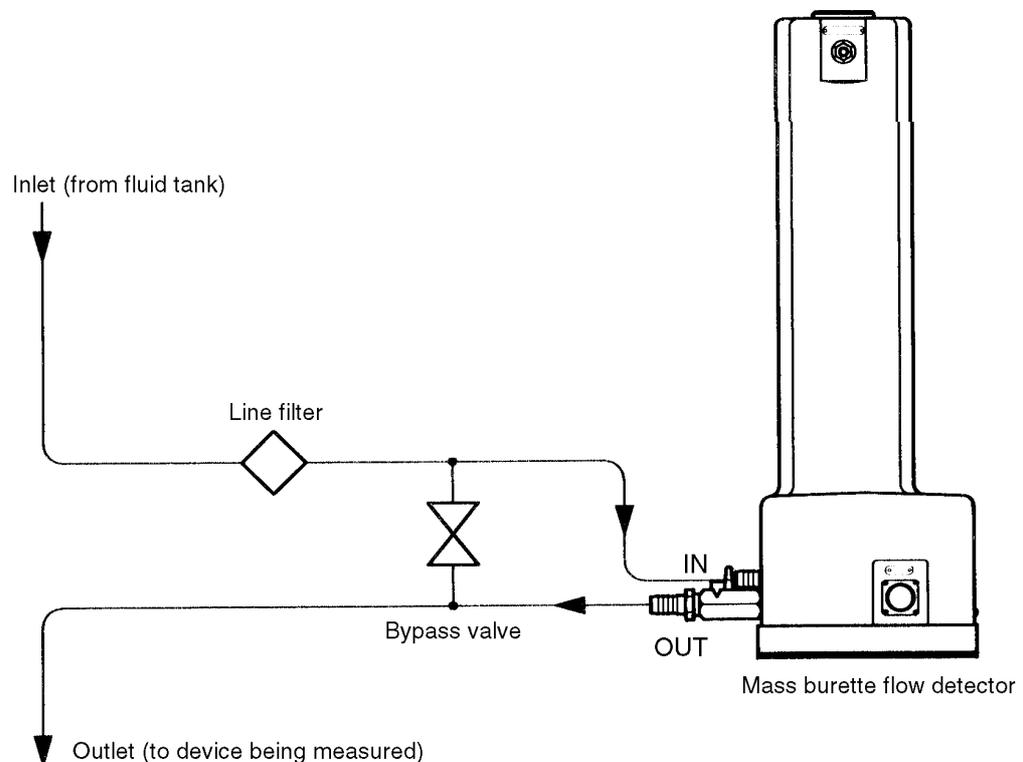
## 4.4 Releasing Air

Before starting measurements, be sure to sufficiently release air from inside pipes and inside the detector. If air is not sufficiently released it may result in measurement errors or fluctuations in instantaneous flow.

If a Bypass Valve is Attached

Close the outlet valve of the detector (FX-1100 Series).

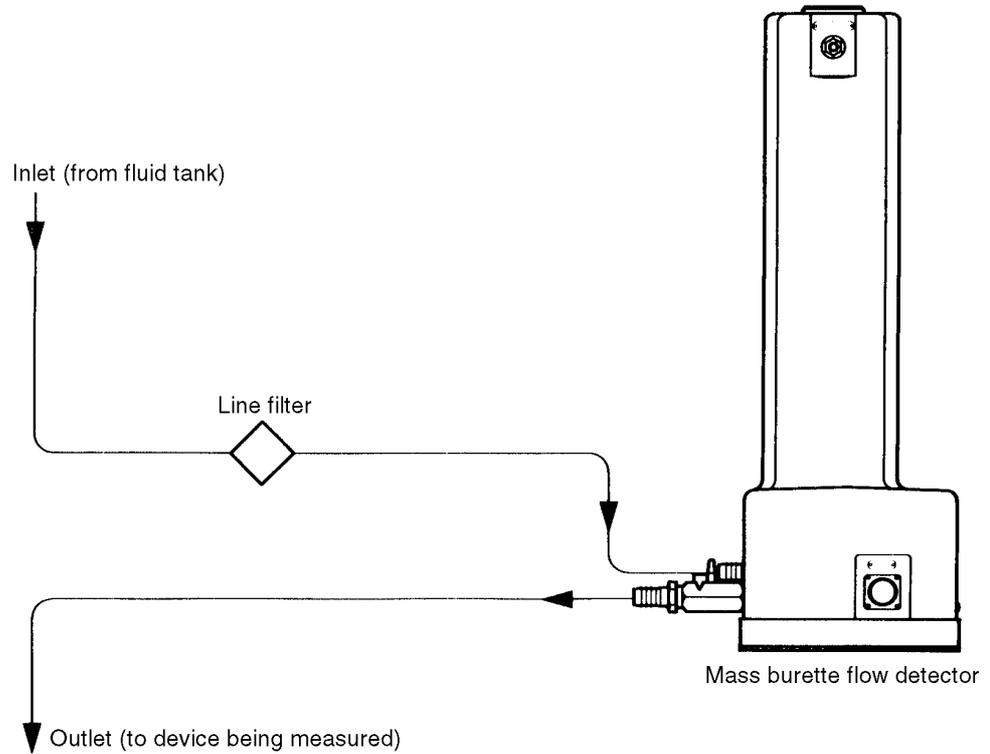
- (1) Fully open the bypass valve and allowing fluid to begin flowing.
- (2) Leave the bypass valve open and allow fluid to continue flowing and release air from inside pipes connected before and after the detector.
- (3) Close the bypass valve after air is released from the pipes. Then, open the valve on the OUT side of the detector and release air from inside the detector.



**Caution :** Opening the bypass valve while the detector's outlet valve is open will result in an overflow. Always close the outlet valve before opening the bypass valve.

If There is No Bypass Valve

Allow fluid to continue flowing for a while and then release air from inside the detector and inside pipes.



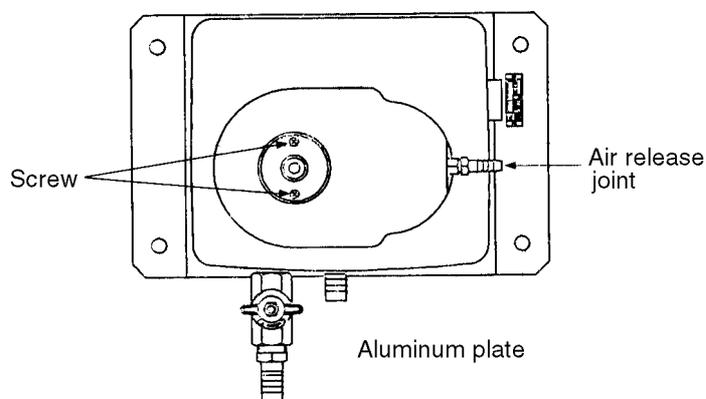
## 5. MAINTENANCE

### 5.1 Checking the Reference Pipe

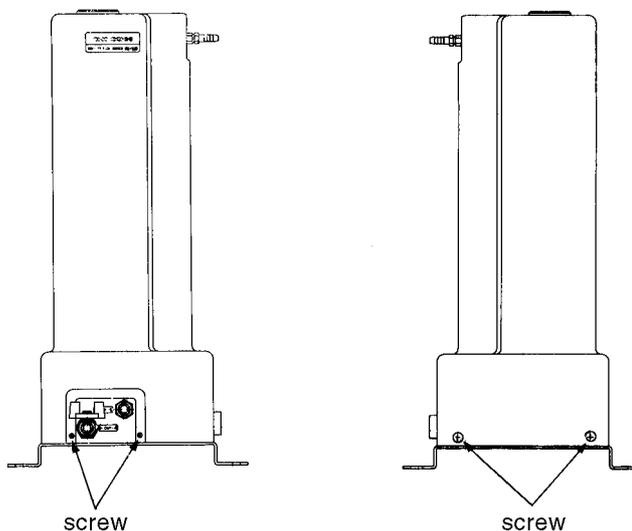
Turning the detector sideways while there is measurement fluid inside will cause fluid to enter the reference side of the differential pressure detector. This may cause large changes in the fluid levels which start and stop replenishment and may make measurements impossible.

If this happens, check that there is no fluid in the reference pipe. Check this as follows.

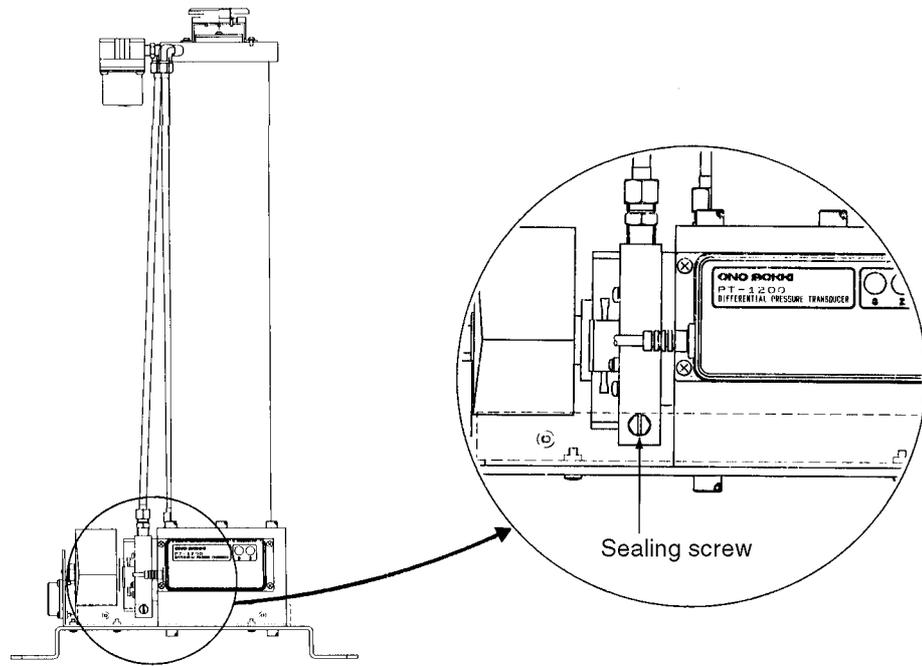
- (1) Turn off the power of the display device FX-3400 Mass Burette Flow Meter.
- (2) Remove the air release joint.
- (3) Remove the two screws from the level and remove the aluminum plate.



- (4) Remove the four screws at the bottom of the cover and take off the cover.



- (5) Loosen the sealing screw and slowly remove it. Since any fluid present will flow out of the referent pipe at this time, place a piece of cloth underneath this location.



- (6) Turn on the power of the display device FX-3400 Mass Burette Flow Meter.
- (7) Once all of the fluid has been released from inside the reference pipe, tighten the sealing screw.
- (8) Turn off the power of the display device FX-3400 Mass Burette Flow Meter.
- (9) Return the cover and tighten the four screws at the bottom of the cover.
- (10) Attach the aluminum plate to the level and tighten the two screws.
- (11) Completely remove any remaining sealing tape from the air release joint. Wrap with new sealing tape and attach.
- (12) Turn on the power of the display device FX-3400 Mass Burette Flow Meter.

## **5. Maintenance**

### **5.2 Periodic Inspection and Calibration**

Periodically inspect and calibrate the detector in order to maintain its performance and operation. For details on periodic inspection and calibration, please contact your Ono Sokki nearest business office.

## 6. TROUBLESHOOTING

| Symptom   | Cause   | Solution  |
|---|---|---|
| Fluid is not supplied to the detector               | There is not enough pressure to supply fluid to the detector                              | Install a pump to supply more pressure [See Section 3.3 (2)]                                |
|   | A flow signal cable is not connected  | Connect a flow signal cable   |
|   | The counter's power is turned off   | Turn on the counter's power   |
| Fluid does not flow                                 | A flow signal cable is not connected  | Connect a flow signal cable   |
|   | The counter's power is turned off   | Turn on the counter's power   |
| Fluid does not flow easily                          | There is a kink in a the pipe   | Remove the kink   |
|   | There is not enough pressure to supply fluid to the engine or other device being measured | Obtain supply pressure by using an accumulator tank or by other means [See Section 3.3 (3)] |
| The counter reads zero even though fluid is flowing | A flow signal cable is not connected  | Connect a flow signal cable   |
| The instantaneous flow reading fluctuates           | Air inside the pipes and detector was not completely released                             | Release air according to Section 4.4, "Releasing Air"                                       |
|   | There is not enough pressure to supply fluid to the engine or other device being measured | Obtain supply pressure by using an accumulator tank or by other means [See Section 3.3 (3)] |
|   | Fluid inside the pipes or inside the detector is releasing vapor                          | Keep the pipes and the detector away from heat sources                                      |
| The measured value differs from the actual flow     | Fluid is inside the reference pipe  | Release the fluid inside the reference pipe [See Sections 5.1 and 5.2]                      |
|   | The bypass valve is open  | Close the bypass valve  |

## 7. Specifications

# 7. SPECIFICATIONS

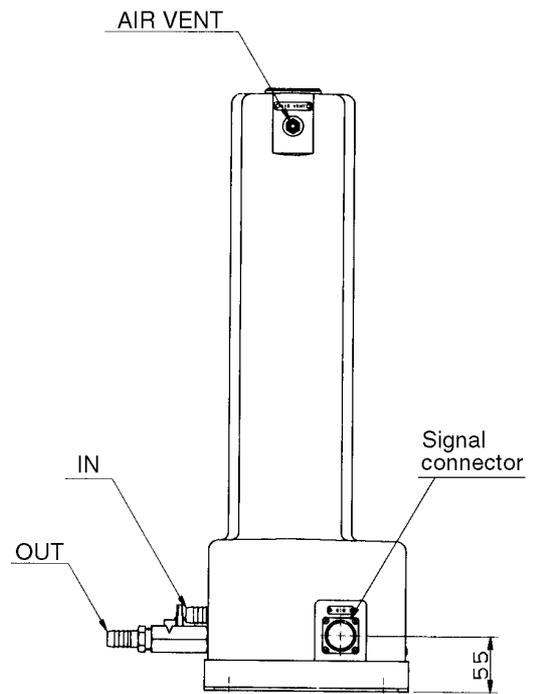
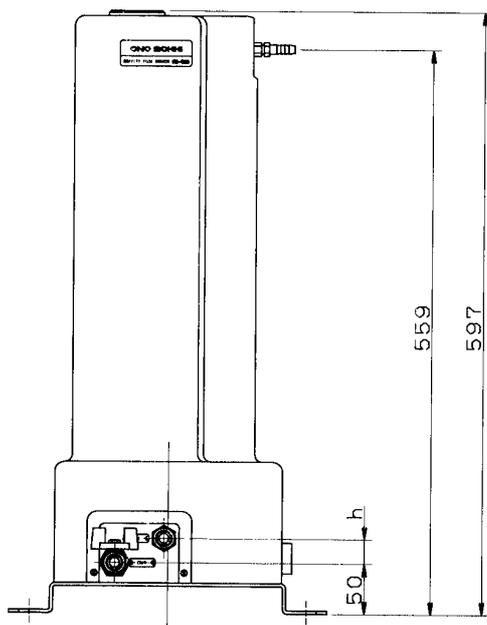
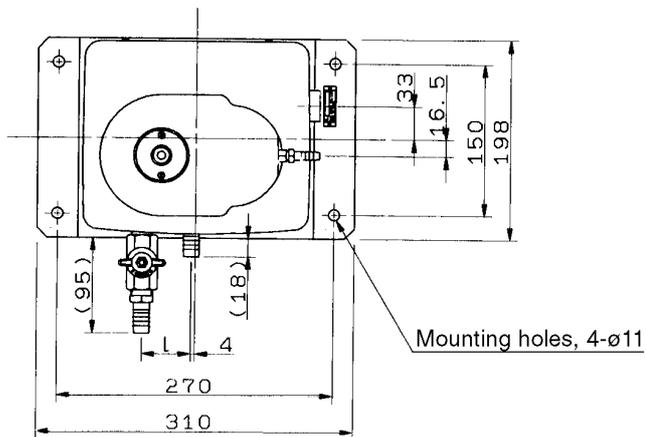
There are three products in the FX-1100 Series of mass burette flow detectors: the FX-1110, FX-1120, and FX-1130. These differ in their allowable flow range.

|  | FX-1110   | FX-1120  | FX-1130                  |
|--|---|--|--------------------------|
| Flow range                               | 0~10 g/s<br>(0~36 kg/s)   | 0~25 g/s<br>(0~90 kg/s)  | 0~50 g/s<br>(0~180 kg/s) |
| Maximum cumulative flow<br>(One fill-up) | 200 g   | 500 g  | 1000 g                   |
| Conversion rate                          | 17 g/mA   | 42.5 g/mA  | 85 g/mA                  |
| Resolution*                              | 0.001 g/s   | 0.01 g/s   | 0.01 g/s                 |
| Minimum cumulative unit*                 | 0.01 g  | 0.01 g   | 0.1 g                    |
| Inlet joint                              | Rc 3/8 inner diameter $\phi$ 6,<br>outer diameter $\phi$ 9,<br>volute joint                               | Rc 1/2 inner diameter $\phi$ 12,<br>outer diameter $\phi$ 16, volute joint |                          |
| Outlet joint                             | Rc 3/8 inner diameter $\phi$ 6,<br>outer diameter $\phi$ 9,<br>volute joint                               | Rc 1/2 inner diameter $\phi$ 12,<br>outer diameter $\phi$ 16, volute joint |                          |
| Weight                                   | Approx. 13 kg   |  |                          |
| External dimensions                      | w.310 h.597 d.198 (not including joint length of 95 mm)   |  |                          |
| Pressure resistance                      | 196 kPa (2 kg/cm <sup>2</sup> )   |  |                          |
| Measurable fluids                        | Gasoline, light oil, kerosene   |  |                          |
| Output signal                            | 4~20 mADC   |  |                          |
| Replenish valve                          | 12-V DC direct drive electromagnetic valve (orifice diameter $\phi$ 7)<br>(closed when power not applied) |  |                          |
| Overflow prevention valve                | 12-V DC direct drive electromagnetic valve (orifice diameter $\phi$ 4)<br>(closed when power not applied) |  |                          |
| Operational temperature range            | 0 to 40°C (no condensation)<br>(both ambient temperature and fluid temperature)                           |  |                          |

\* When using a display device FX-3400

# DIMENSIONAL DIAGRAM

|                        | FX-1110           | FX-1120            | FX-1130            |
|------------------------|-------------------|--------------------|--------------------|
| h                      | 26 mm             | 24 mm              | 9 mm               |
| L                      | 42.5 mm           | 48 mm              | 48 mm              |
| OUT<br>Ball valve      | EH-201            | EH-204             | EH-204             |
| IN OUT<br>Bamboo joint | Outer diameter Ø9 | Outer diameter Ø16 | Outer diameter Ø16 |
|                        | Inner diameter Ø6 | Inner diameter Ø12 | Inner diameter Ø12 |
|                        | Rc 3/8            | Rc 1/2             | Rc 1/2             |



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