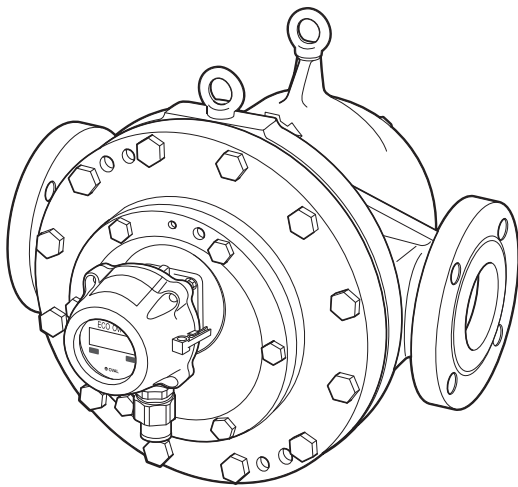


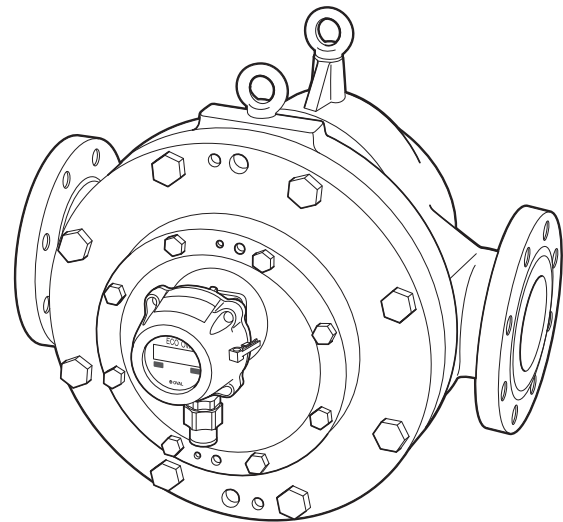


Oval Flowmeter **ECO OVAL**

Meter Sizes 29 and 60



Meter Size 29



Meter Size 60

Every OVAL flowmeter is fabricated and shipped from our factory under strict quality control. In order to maintain its design performance throughout its life, this manual offers the operator the necessary installation, operation and maintenance information. Please be well familiar with these instructions before you place the meter in service and keep this manual ready for reference.

◆Meter size designation◆

The size of OVAL flowmeters is basically identified by a two-digit code.

For details, see Product Code Explanation [figures in brackets () show meter body ID code] on page 11.

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The indications **NOTE**, **CAUTION**, and **WARNING** shown throughout this manual are to draw your attention to specific items:

➡ **NOTE**

Notes are separated from the general text to bring user's attention to important information.

 **CAUTION**

Caution statements call attention to user about hazards or unsafe practices that could result in minor personal injury or property damage.

 **WARNING**

Warning statements call attention to user about hazards or unsafe practices that could result in serious personal injury or death.

1. BEFORE YOU BEGIN

Every OVAL flowmeter is thoroughly tested before its delivery from the factory. When received, the product should be thoroughly inspected for indication of rough handling during transit. Necessary considerations in handling are described in this section; read the instructions carefully.

As for other information, find the respective sections from "CONTENTS" on pages 2 and 3.

For any inquiries, please contact your nearest OVAL sales office.

⚠ CAUTION: When making inquiries, please do not fail to include the product name, model No., serial No. stamped on the nameplate and the periphery of inlet flange, ratings, and other pertinent information.

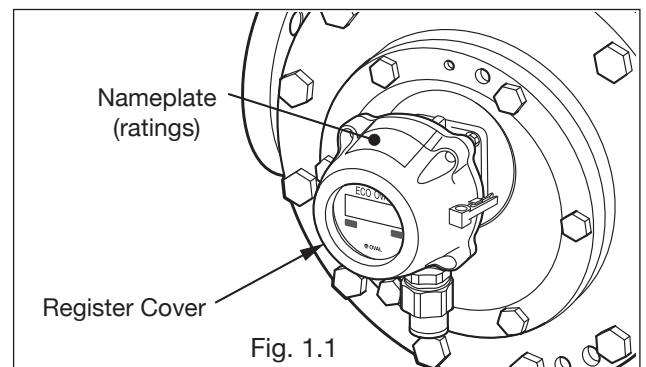
1.1 Confirming the Nameplate

Every OVAL flowmeter is assembled and adjusted according to individual customer specifications.

Product code and ratings appear in the counter tag on top of the register. Make sure that the product you received complies with the specifications in your order.

⚠ CAUTION

The way the measuring elements in this product are factory adjusted varies with the maximum operating temperature. This permissible upper limit stated on the nameplate must not be exceeded. Negligence of this warning may pose unanticipated problems.



1.2 Transportation Considerations

- (1) OVAL flowmeter can best be transported to the installation site in the shipping container used for transit from our factory.
- (2) OVAL flowmeter is adjusted and inspected with all components of the meter body, sensor, and register as one integral assembly; be sure to treat them as one complete assembly.
- (3) The register is precisely configured and adjusted; do not attempt to remove its cover unless it is absolutely necessary.

1.3 Storage Considerations

If your flowmeter is stored for long periods of time upon receipt before installation, unexpected faulty conditions could result. If a long-term storage is anticipated, take the following precautions:

- (1) Keep the meter in store in the same shipping container which used for transportation from OVAL if possible.
- (2) Place of storage should conform to the following conditions:
 - ★ Free from rain and water.
 - ★ Free from vibration and impact shocks.
 - ★ Temperature and relative humidity in the storage place are at or near room temperature and humidity (around 25°C and 65%).
- (3) Purge the meter that has once been placed in service with clean air, N₂ gas, etc. to prevent the metered fluid from adhering to the meter connections, piping inner walls, housing, etc. before storage. (Wash clean with suitable detergent if necessary.)
- (4) In case the meter is stored for extended period of time, it is to be stored under the same good storage conditions as applied during the transit from the factory.
- (5) Battery storage life is about 10 years after shipment. For details, see Sec. 1.9 "About Battery Life".

1.4 Structural Considerations

- (1) The register is of water/dustproof construction for outdoor service. After opening the register lid for battery replacement or other service, be sure to tighten the bolts firmly when closing it. Also, in case of using in nonexplosionproof rating, or if you supply a lead-in fitting (such as a cable gland), confirm the compatibility of the finished outside diameter of the cable, etc., and be sure to apply that of IP66 (equivalent to JIS C 0920) and grade higher to protect from water/dust ingress.
- (2) Do not attempt to replace component parts with third-party parts or make any circuit modification.
- (3) In case of using in explosionproof rating (TIIS)
 - ① Since the lead-in fitting constitutes of the flameproof construction, please be sure not to use lead-in fittings (pressure-tight packing) other than the furnished. A set of four different packings ($\phi 9$, $\phi 10$, $\phi 11$ and $\phi 12$) are supplied. Select the proper size referring to the table below. ($\phi 11$ is furnished on the meter at delivery from the factory.)

Table 1.1 Applicable Cable O.D. (Units in mm)

Packing Code	Packing I.D.	Cable O.D.
9	9.0	8.5 to 9.0
10	10.0	9.1 to 10.0
11	11.0	10.1 to 11.0
12	12.0	11.1 to 12.0

- ② Explosionproof work using sealing fittings, if desired, requires parts specified:
 Manufacturer: Shimada Electric Co., Ltd.
 Model: SFT-16
 "IV" cable shall be used as the lead-in cable. Also, if the ambient temperature exceeds the acceptable range, be sure to use proper heat resistant cables.
 Take care to prevent air bubble formation in the sealing compound.
- ③ In case of using as ATEX explosionproof product, do not fail to use ATEX approved cable gland (NPT 1/2 or M20×1.5)

1.5 External Wiring Connections

- (1) Removing the register cover provides access to the terminal block for external wiring connections.
- (2) The register cover is coupled to its body with a chain to safeguard against potential damage to internal wiring by inadvertent pulling beyond its limit.
- (3) On opening the cover, you can see the sensor leads (shielded). Disconnect sensor leads from CN2 on the substrate (lightly hold the connector with long-nose pliers, or similar tool, without giving a strong pull, and separate.).

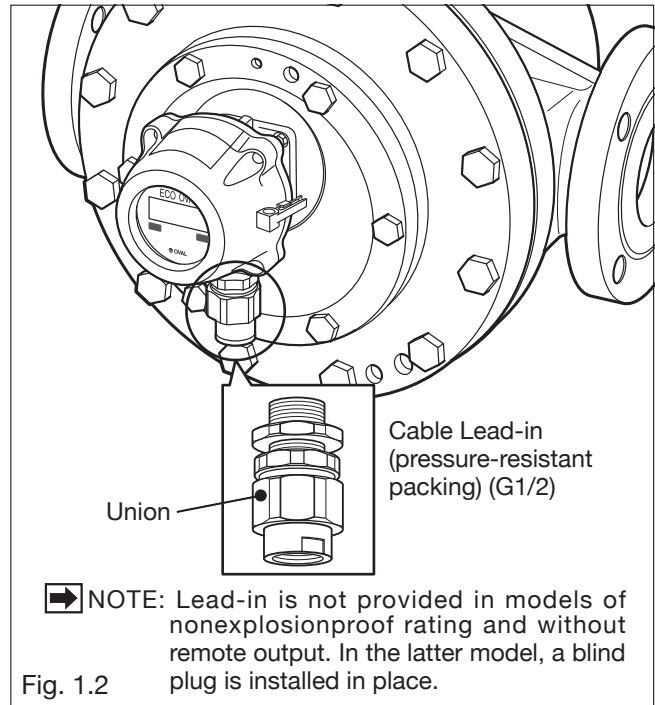


Fig. 1.2

◆ Cable lead-in precautions

Explosionproof type

- Use pressure-resistant packings that comply with the finished cable O.D.
- Tighten up the pressure-resistant union securely upon wiring (strong enough to resist a pull of the cable).

Nonexplosionproof type

- Apply a protective treatment to preclude moisture entry.

⚠ CAUTION: Moisture allowed into the register causes blurred display glass and functional trouble.

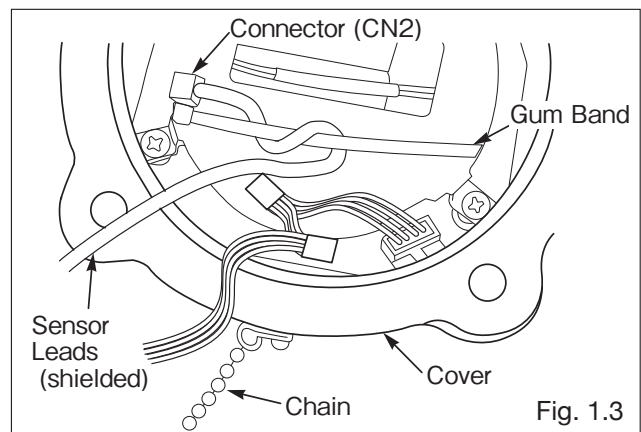


Fig. 1.3

⚠ CAUTION: Pulling the connector by wire leads may lead to poor electrical contact at the connector.

- (4) If uncoupling the connector is not required, secure the cover such that it will not open up beyond 90 degrees. Forcing the sensor leads may cause trouble.

(Battery replacement is to be done in the same manner.)

- (5) When making connections at the terminal block, exercise care to avoid tightening hold-down screws (M4) excessively.
- (6) Output terminals are available in unfactored and factored pulses. Choose the ones that match the configuration of cable used.

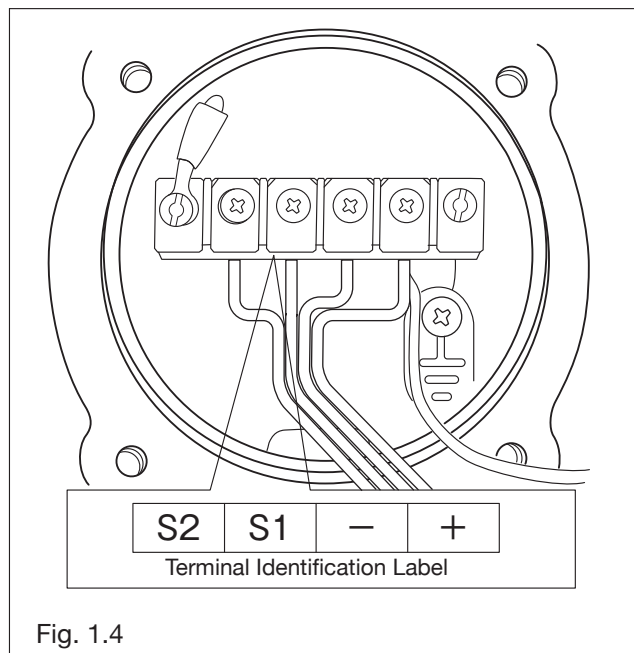
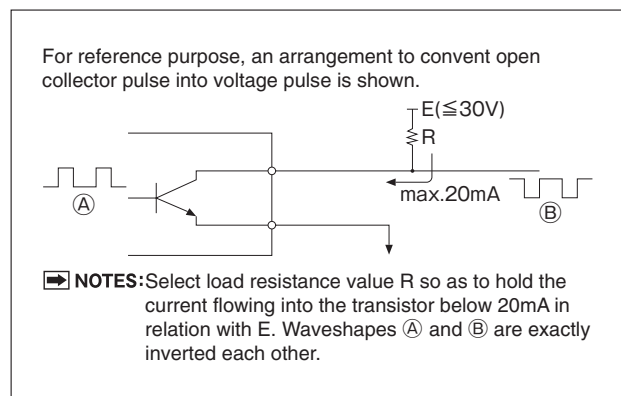
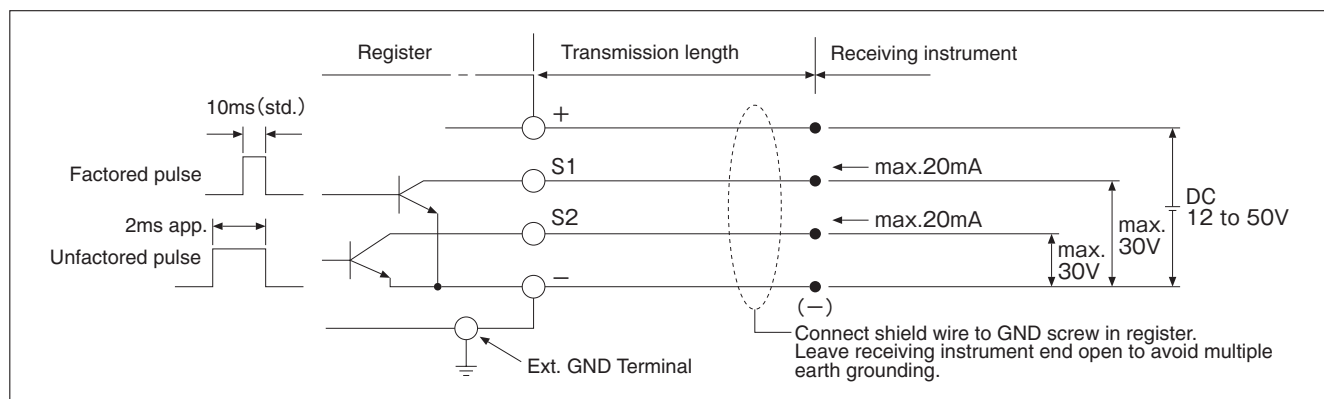


Fig. 1.4

1.6 Wiring Diagram



NOTES:

1. Both factored and unfactored pulse output are of open collector output. Couple a load at the receiving instrument so that the ratings are held within 30VDC and 20mA max.
2. Exceeding the rating and/or negligence of observing polarities in wiring connections may result in failure in the register.
3. Depending on the type of cable used, either the unfactored or factored pulse is selected
4. Earth ground the register's EXT. GND terminal to the instrumentation ground earth.

1.7 Installation Location

- (1) Applying a magnetic sensor on the sensing part, this register detects the magnetic fields created by signaling magnets embedded in the rotor. Separate the register from magnetic field generating sources. Installation of an electromagnetic valve around 10 watts requires separation at least 10 meters from the flowmeter typically. (The distance could differ depending on operating conditions.)
- (2) For use in cold regions
 - ① Install the meter where ambient temperature does not exceed the specified operating temperature range given in Section 14.3 (page 42).
 - ② If heat insulation is applied, avoid heat retention over the register, strainer cover, and drain plug. In arranging the piping with the meter, take an easy meter removal from the piping into your consideration.
- (3) Register operating ambient temperature ranges from -10 to 60°C. Provide a sunshade or similar protection where the register could possibly be exposed to higher temperatures over the range. Also provide a protection against frost and dew condensation for outdoor use to keep the product within the specified operating temperature range.

➡ NOTE: The upper limit of explosionproof rating is +5°C.

1.8 Register Life

The electronic module in the register requires replacement every 10 years or so due to the life expectancy of LCD and other electronic component parts.

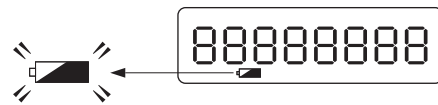
The electronic module life depends on operating conditions. Under such environmental conditions as listed below, it is suggested to replace the entire register assembly in 5 to 6 years.

- ◆ High temperature environment
- ◆ High temperature process fluid measurement
- ◆ Field installation with widely varying temperatures
- ◆ Register LCD display exposed to the sun (ultraviolet rays)
- ◆ Frequent start / stop in process fluid operation

⚠ CAUTION: This flowmeter is not provided with subtract function. If pulsation in the flow (where the fluid moves back and forth in the pipeline under the influence of pressure) or reversal of flow exists, the total counter may show erratic reading, accumulating all incoming pulses irrespective of flow direction.

1.9 Battery Life

- (1) The lithium battery incorporated in the register is good for about 8 years for the battery powered model, about 4 years for the externally powered model. (Life expectancy can be shorter depending on operating and environmental conditions.) If your meter is equipped with pulse generator for remote output, operating it on an external power source is suggested.
- (2) When the battery has almost run down, an alarm message "🔋" comes on in the register front panel. This alarm prompts you to replace the battery within a week. (Battery replacement procedure appears on page 42.)



- (3) Storage life of the battery is about 10 years after shipment. Even in an environment where the register operates on an external power source with virtually no power consumption from the battery, battery replacement is required in about 10 years due to storage life limitation. (It follows that, together with Section 1.8 "Register Life," register assembly replacement is required. The following environmental conditions reduce storage life even more:

- ◎ High temperature environment ◎ High temp. process fluid measurement ◎ Cold region

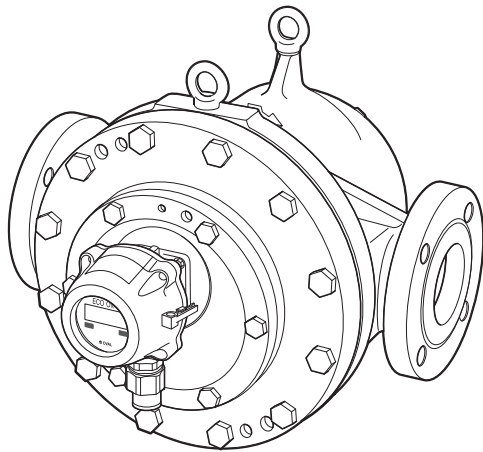
⚠ CAUTION: With pulse generator equipped model, while the receiving instrument does operate on the battery built in the flowmeter, the battery will run out in a short period of time, eventually disabling instrumentation (requiring battery replacement). When power is connected, an automatic switchover takes place from battery to external power source, thus saving battery power. If external power is interrupted for some reason, such as instant power failure, the battery will automatically resume its operation. So keep the battery always in place.

2. OPERATING CONDITIONS

To maintain the stated high accuracy and long service life of the meter, make sure that the flowrate, pressure, temperature and other variables be held within the ratings specified. These ratings appear on the top of meter register nameplate. Read them carefully before you place the meter in service.

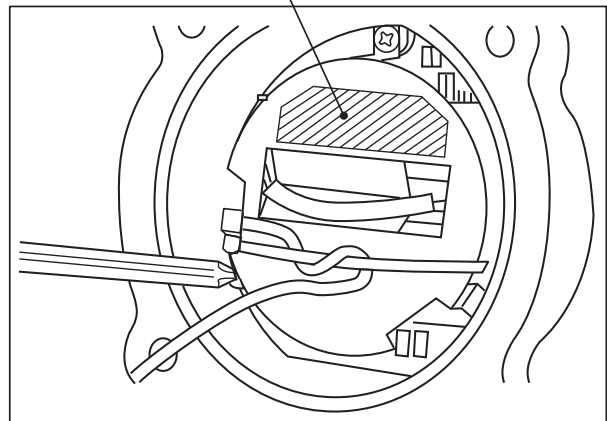
⚠ CAUTION

- (1) By the national measurement law, this flowmeter is not serviceable for certifying or commercial purposes.
- (2) This flowmeter is not provided with subtract function. If pulsation in the flow (where the fluid moves back and forth in the pipeline under the influence of pressure) or reversal of flow exists, the total counter may show erratic reading, accumulating all incoming pulses irrespective of flow direction.



Parameter label

S/N 179001			
F 1,2345-3	Pu 1.00E0		
A 4	At 2	Pon 100	
[バーコード]			



➡ NOTE:

Parameter label appears inside the register.

The description of the Name plate

MODEL	LG	NPE-298 MEDE IN JAPAN	
BORE SIZE		MAX. FLOW RATE	
MAX. TEMP.			
MAX. PRESS.		S/N	
FLUID			
OVAL Corporation			

⚠ CAUTION:

Where the register is potentially exposed to elevated temperatures by the sun or radiated heat, provide a sunshade or similar protection to ensure that the operating temperature be held within the rating.

Fig. 2.1

3. GENERAL

This flowmeter is unique in selecting measuring chamber material and in design. The state-of-the-art electronic expertise is used throughout with multiple-function, all-electronic register.

A magnetic sensor detects magnetic fields created by magnets embedded in the oval rotor in the wetted parts to obtain unfactored and factored pulses of extremely high sensitivity and reliability.

3.1 Features

- (1) Precise flowmetering is attributable to the inherent accuracy of Oval flowmeter.
- (2) The register contains an LCD counter with multiple functions. View angle is freely adjustable.
[Grand total flow, instant flowrate (per-hour or per-minute), and resettable total flow selectable]
- (3) The LCD changes display modes with MODE switch at left of the register.
- (4) Small number of wetted parts contributes to long life.
- (5) Flow output signal is compatible with a wide choice of remote receiving instruments for control, adjust, record, and more applications.

3.2 Component Names

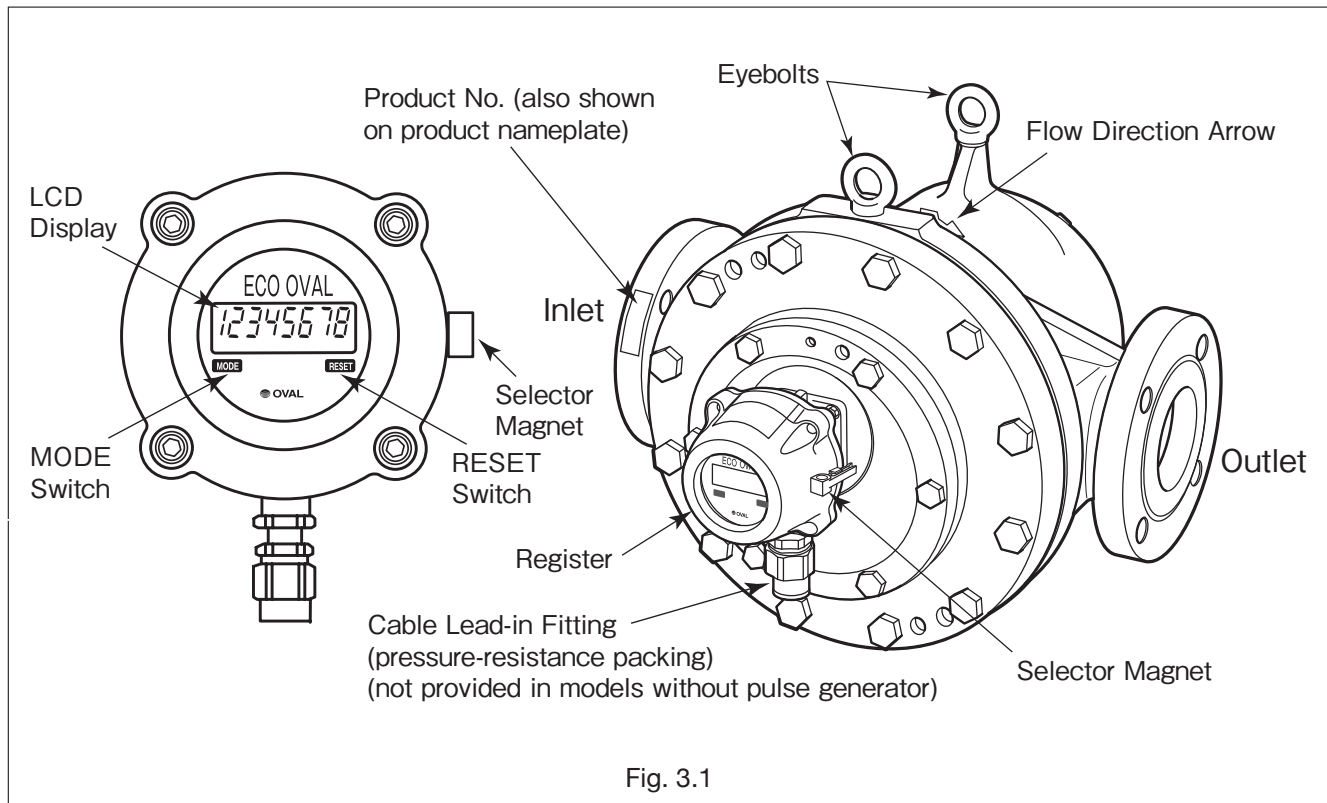


Fig. 3.1

➡ NOTE: Available flow units

The units of registration on the display can be changed.

L, kL, m³ (default) /min.

A change in the unit of registration displayed does not affect the process of calculation in any way.

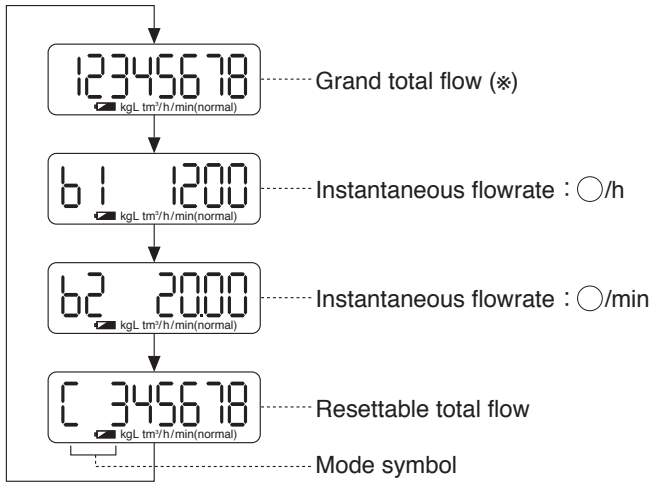
3.3 PRODUCT CODE EXPLANATION

Item	Product code												Description		
	①	②	③	④	⑤	⑥	⑦	⑧	-	⑨	⑩	⑪		⑫	
Model	L	G												ECO OVAL	
Meter body			B											Meter body: FC250 Rotors: FC250	
Process connection			2	9										3" (80mm)	
			6	0										4" (100mm)	
Application						A								Always "A"	
Process connection							1							JIS 10K RF (option)	
							2							ASME 150 RF (standard)	
							0							Max. operating temp. 60°C Linearity ±0.35% (std.)	
							1							Max. operating temp. 60°C Linearity ±0.15% (option)	
							2							Max. operating temp. 120°C Linearity ±0.35% (option)	
							3							Max. operating temp. 120°C Linearity ±0.15% (option)	
Power source													D	Battery powered (less pulse generator)	
													G	Powered from an external source	
Explosionproof rating and CE marking														0	Non-explosionproof
														1	TIIS explosionproof/battery powered: Ex ia IIB T4 Externally powered: Ex d IIB T4/Ex ia IIB T4
														2	ATEX explosionproof/battery powered: II2G Ex ib IIB T4 Gb Externally powered: II 2G Ex d IIB T4
Type of pulse generation														0	Pulse generator not provided
														3	Open collector factored pulse (pulse width 1ms) Unfactored pulse (pulse width 1ms)
														5	Open collector factored pulse (pulse width 10ms) Unfactored pulse (pulse width 1ms)
														6	Open collector factored pulse (pulse width 50ms) Unfactored pulse (pulse width 1ms)
														7	Open collector factored pulse (pulse width 100ms) Unfactored pulse (pulse width 1ms)
Version code													A	Always "A"	

➡ NOTE: If external wiring is not connected, the TIIS explosionproof enclosures meet the requirements for intrinsic safety configuration.

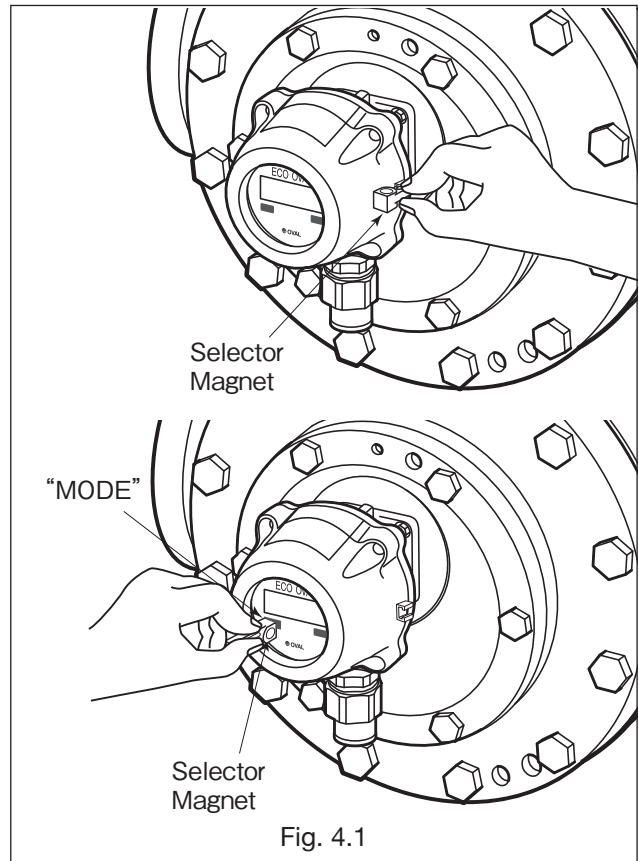
4. LCD COUNTER DISPLAY

4.1 "MODE" Switch



NOTES:

1. Shown above are screens scrolling in the basic mode.
2. To review parameters, see the Transition Chart of Parameter Status on page 22.
3. (*) About grand total reading, see CAUTION (2) on page 9.



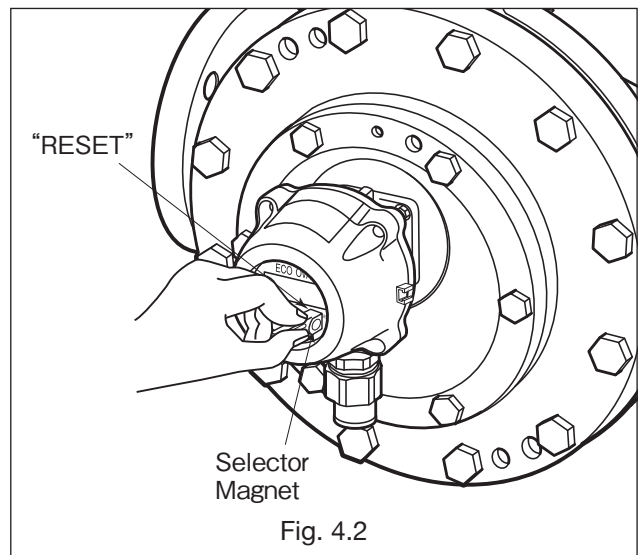
4.2 "RESET" Switch

Only in the resettable total mode, or in Mode Symbol: 'C', the grand total reading is resettable.

- NOTES:**
1. Switching the mode to the instantaneous flowrate while the flowmeter is in operation by no means affect operation in the total counter.
 2. Instantaneous flowrate reads "0" at flowrates below the meter's minimum flowrate. However, total counter continues to count up.
 3. Instantaneous flowrate reading may possibly vary with operating conditions and other factors.

CAUTION:

Do not fail to install the selector magnet in its holder after use lest you will not lose it. Since a magnetic sensor is used in the meter, do not put the selector magnet on the meter body as it could cause erroneous operations. Also, the selector magnet is of an intensive magnet; never hold it close to floppy disks or other magnetic storage items.



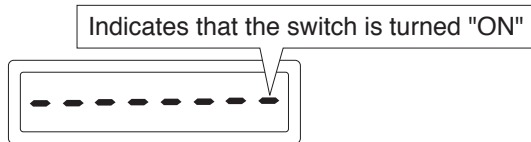
4.3 Displayed Messages during Operation

(1) Ordinary operation

"MODE" switch is turned "ON"

(The selector magnet is contacted: See Fig.4.1)

⇒ 8 bars appear.

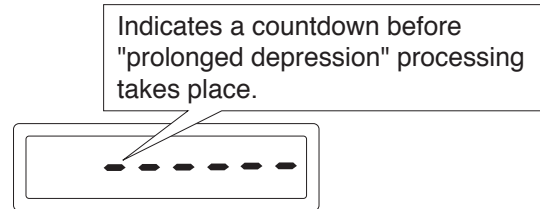


⇒ Immediately turning "OFF" moves the window to the next one.

(2) Prolonged operation

The switch is held turned ON without turning "OFF" immediately by removing the fingers.

⇒ Bars begin to disappear from the leftmost one.



⇒ Holding turned "ON" until the last bar disappears results in "prolonged depression" processing (※) to take place.

(Turning "OFF" before the last bar disappears results in the same behavior as in (1) to take place.)

※ Prolonged operation: An operation required for Normal mode ⇔ Parameter review mode selection, finalizing the parameter setting, etc.

➡ NOTE: While RESET switch is in a valid mode (resettable total mode, etc.), the same message as stated above appears in response to RESET switch operation.

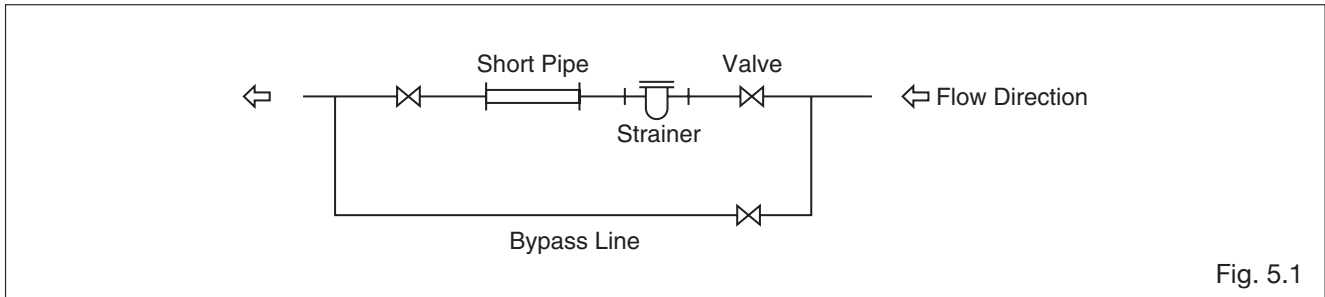
(There is no distinction between ordinary depression and prolonged depression.)

5. INSTALLATION

5.1 Piping Guidelines

- (1) Flush the piping assembly.

Flushing must be performed before meter installation. Instead of the meter, install a short pipe in place of the meter at this time (see diagram below).



- (2) Upon completion of flushing, install the meter in the piping assembly exercising care to avoid pipe stress.

- (3) The meter must be installed on the outlet side of the pump.

- (4) If the meter is to be used under tank head, give a head pressure bigger than the total pressure loss of the piping system, strainer, meter, etc.

➡ NOTE: Pressure losses of OVAL flowmeter and strainer are shown on the product general specifications.

- (5) Meter installation is correct if the flow direction conforms to the arrow mark on the meter body.

- (6) The strainer is to be located upstream of, and as close to, the meter as possible.

- (7) Since the sensing element of the OVAL flowmeter detects the change of magnetic flux density, it must be isolated from the influence of any external magnetic flux. In order to prevent the possible influence of external magnetic flux, meters shall be at least 5 meters away from existing power equipment and conductors - potential sources of creating large magnetic and electric fields, such as motors and generators.

- (8) In case electric heating is desired, consult the factory.

- (9) Lagging material, if used, must not cover the register.

5.2 Lagging Work

⚠ CAUTION: In a cold region where freezing is anticipated, or where a fluid that tends to solidify (heavy oil, for example) is to be metered, lagging on the flowmeter and strainer is required.

- (1) Be sure to check for liquid leaks before working with lagging material.

- (2) Take easy removal, disassembly and inspection of the meter into consideration.

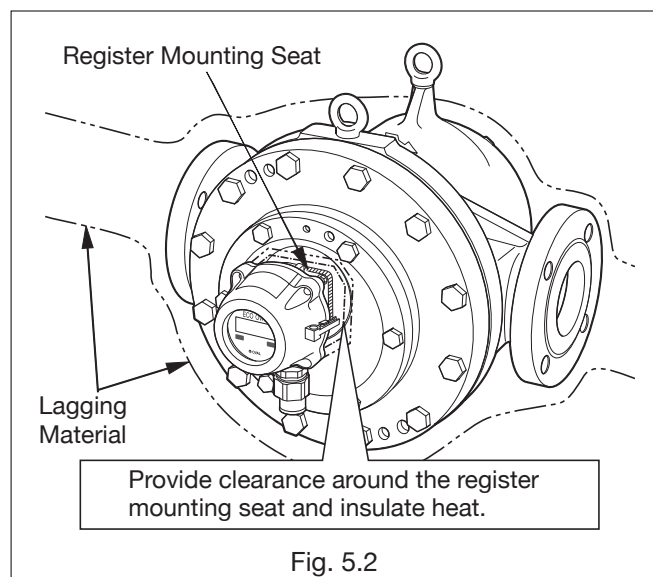
- (3) Lag the strainer so as to remove its top lid easily. Strainer net needs to be cleaned periodically.

- (4) **Never apply thermal insulation to the register and pulse generator.**

Lagging them may cause excessive temperature rise which could lead to a trouble or accident.

- (5) Avoid lagging the register's front cover seat.

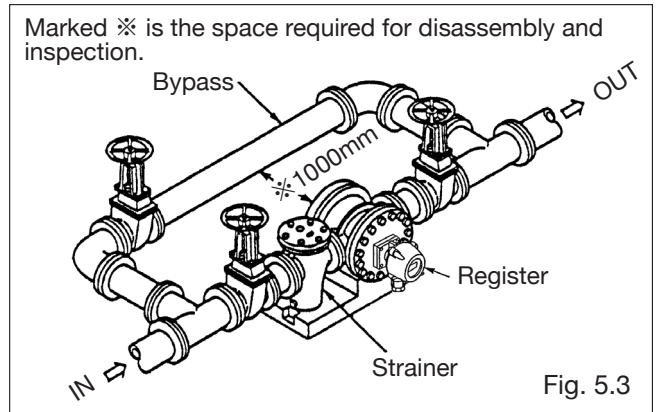
- (6) Lagging should be so made as to facilitate servicing (for easy disassembly and removal).



• Typical OVAL flowmeter Installations

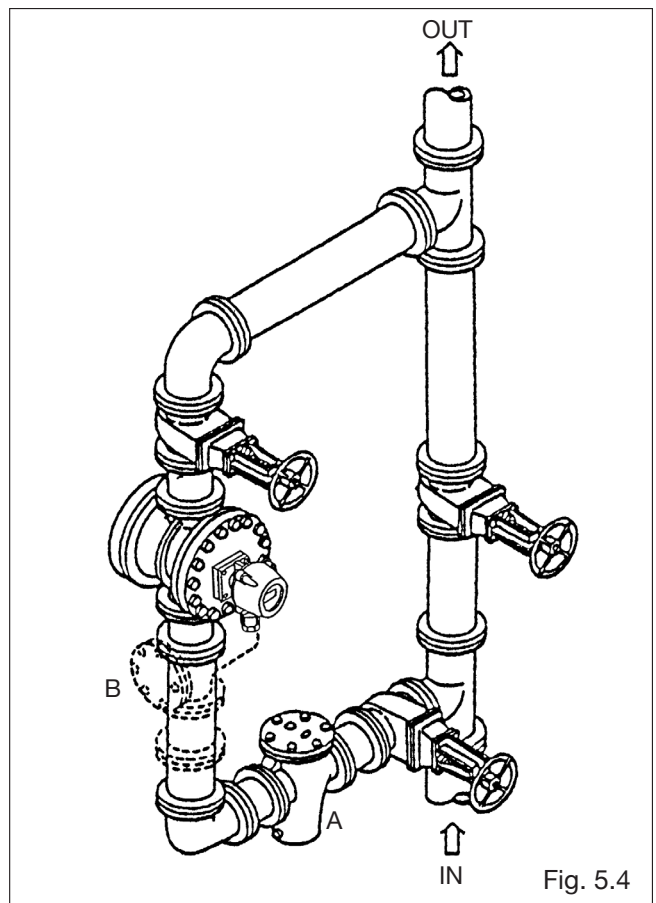
5.3 Standard Piping, Horizontal Run

- (1) The picture on the right is of flow direction, right to left. If the direction is to be changed from left to right, the meter and strainer are interchanged.
- (2) Arrange piping for easy drain.
- (3) Strainer net should be checked on a regular basis.



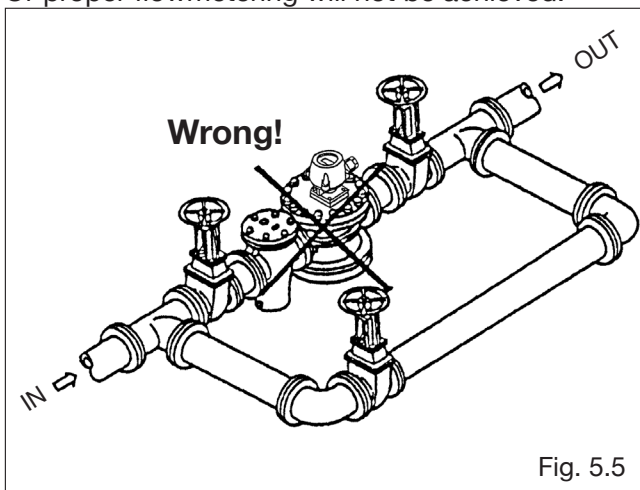
5.4 Standard Piping, Vertical Run

- (1) If flow direction is from top to bottom, interchange the meter and strainer.
- (2) If the strainer is located at point B, reinstalling the strainer net is difficult after cleaning it. We suggest to locate the strainer at point A.



5.5 Example of Wrong Installation

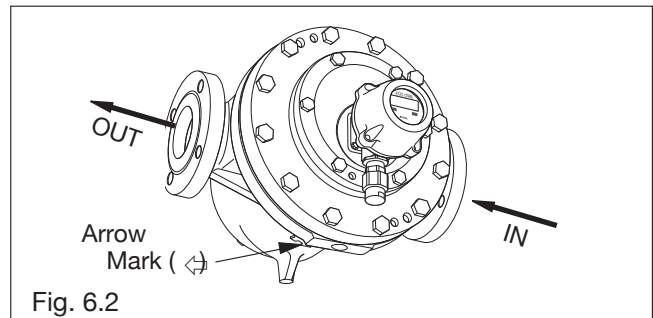
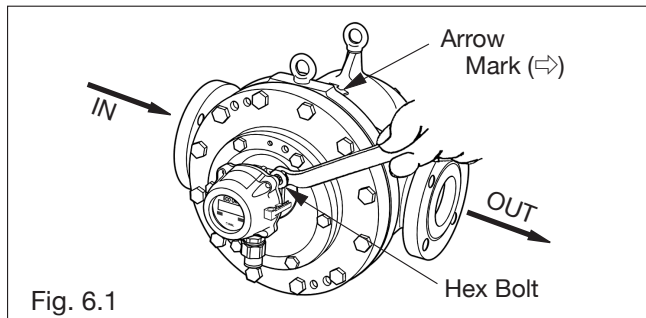
Do not install the meter in a position like this.
Or proper flowmetering will not be achieved.



6. HOW TO CHANGE FLOW DIRECTION AND PHYSICAL ORIENTATION

(1) How to change flow directions

- The register is set to flow direction "left→right" at delivery from the factory. The register orientation, in accordance with a change of flow direction, can easily and readily be changed.



- ① Remove the meter from the pipeline and separate the register from the meter body. Adjust the flow direction arrow (⇒) with actual flow direction. To change the flow direction from left→right to right→left, invert the meter body as shown in the figure and reinstall in the pipeline.

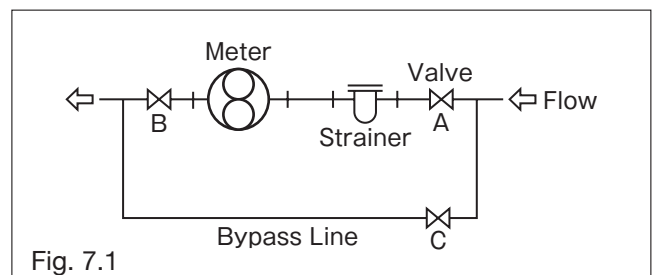
- ② Orient the register properly as shown in the figure, and secure it with bolts. The same procedure applies to changing from left→right to top→bottom, or to bottom→top.

7. OPERATION

7.1 Operations Sequence

At operation start-up, carefully follow the valve operations sequence given below and ensure that the flow range is held within the specification (refer to the piping diagram below).

- (1) Shut off valves (A) at upstream and (B) at downstream of the meter, respectively. Then open valve (C) in the bypass line to allow the fluid in the bypass line to remove weld chip, construction debris, and scale in the piping assembly.



⚠ CAUTION: This is particularly important on the newly installed piping assembly.

- (2) Carefully and slowly open upstream valve (A), and then slightly open downstream valve (B).
- (3) Progressively close valve (C) in the bypass line, and make sure the register counter counts. Maintain a flowrate at 10 to 20% of the max. flowrate (making sure in the instantaneous flowrate mode), allow the fluid to flow for more than 15 minutes, and make sure that air in the piping assembly has totally been expelled. In applications where the temperature exceeds 60°C in particular, a minimum break-in meter operation for 30 minutes is required to uniform heat distribution in the measuring chamber.
- (4) Following the break-in run (preheating), shut off valve (C) in the bypass line completely, progressively open upstream valve (A) until fully open, and slowly open downstream valve (B) until the rated flowrate is obtained.
- (5) Flowrate should be regulated with downstream valve (B) while confirming the flowrate in the instant flowrate mode of the register, and maintain operation within the specified rate.
- (6) The strainer net should be inspected for condition and cleaned periodically. On a new installation, in particular, inspect daily first and, according to the net condition of clogging observed, inspection intervals may be reduced progressively to, say, once a week.

7.2 Considerations in Operation

- (1) When changing flowrates;
In changing flow rates, and in open/close of flow limit valves in batch applications, make sure not to have rapid change of flow rate on the flowmeter.
Operating the meter at flowrates in excess of the maximum allowable flowrate will nullify the guaranteed accuracy, reduce the meter life and may result in faulty conditions, such as the burn of bearings or the rotor-to-measuring chamber contact.
- (2) Where the temperature of metered liquid changes;
Avoid rapid temperature changes in the meter. Temperature changes of the liquid in the meter should be held within 3°C per minute. Extra care should be taken particularly in measurement in batch operation without the provision of heat tracing of the piping where the liquid temperature differs from atmospheric temperature.
If rapid temperature changes are anticipated, heat trace shall be applied on the piping assembly as well as on the meter.
- (3) Liquids of low steam pressure;
Liquids with low viscosity (0.4mPa·s or lower) and low steam pressure are not measured since those are apt to vaporize.
During operation, the temperature of the meter bearings is usually higher than that of the metered fluid. Vapors around the bearings may causes faulty conditions, such as unusual noise and bearing burn.

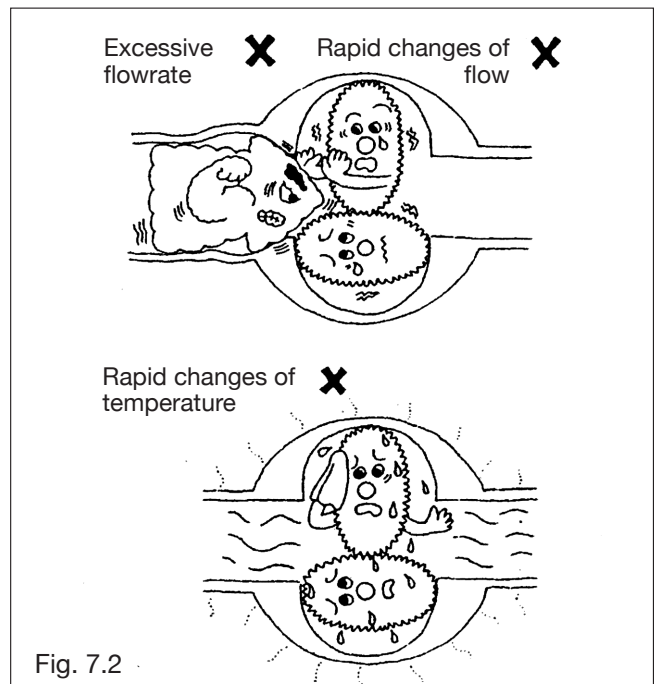


Fig. 7.2

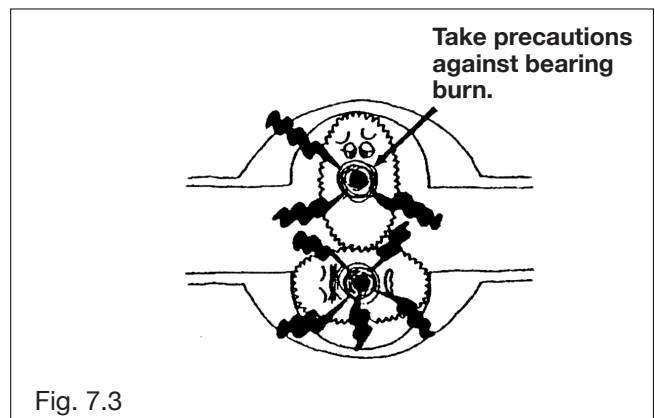


Fig. 7.3

7.3 Considerations in Shutdown

- (1) Valves should be closed progressively.
Rapid valve closure could, under certain piping conditions, cause a sharp pressure rise by water hammer, or hydraulic shock, resulting in damage to the meter.
- (2) Precautions against pressure buildup on closure:
Complete closure of valves upstream and downstream of the meter makes the affected section a totally enclosed chamber. Pressure rise within the chamber, may be caused by rise of atmospheric temperature, etc., raises internal pressure of the chamber and could lead to an unexpected damage to the meter.
- (3) Liquids prone to adhere or turn into a gel at no flow:
The meter internal must be washed out thoroughly by flowing detergents before shutdown in case operated with liquids that tend to adhere and solidify or gel at no flow, or, without the treatment, resume of the meter operation can not be done.

8. TROUBLESHOOTING

Status	Possible Cause	Action
1. Totalizer fails to count.	1. Flowrate is too low.	1. Open valves progressively.
	2. Insufficient pump pressure or head pressure.	2. Taking pressure loss of entire piping assembly into consideration, correct pump pressure or head pressure.
	3. Power line voltage is out of specification or current capacity of power source is insufficient.	3. Provide a 12 to 50VDC power to the register. (12 to 24VDC for open collector or voltage pulse output.) Current capacity 10mA min. is required from power supply.
	4. Battery has run down.	4. Referring to Section 13, replace battery pack.
	5. Rotors jammed with foreign matter, rotors locked; metered liquid fails to run.	5. Referring to Disassembly and Inspection Procedure (Section 11), disassemble meter body and clean the rotors and other components thoroughly.
	6. Rotor installed in inverse direction.	6. Refer to "Assembly Procedure" in Disassembly and Inspection (Section 11) and reinstall the rotors.
2. Abnormal noise.	1. Air is entrapped.	1. Decrease flowrate and eliminate air in the piping assembly.
	2. Liquid in meter is vaporizing in the piping.	2. Decrease flowrate and control the liquid temperature and pressure to prevent vaporization.
	3. Rotors revolving being in contact with measuring chamber.	3. Refer to Disassembly and Inspection Procedure (Section 11) and disassemble and inspect for condition.
3. "BATT" stays on.	1. Battery voltage is low.	1. Refer to Section 13 and replace battery pack.
4. Liquid leaking	1. Incomplete seal of the pipeline.	1. Inspect bolts at connections for tightness or replace gaskets.
	2. Incomplete seal on rear cover of meter body.	2. Retighten bolts at pipeline connections and replace O-ring with new one.
5. Counts while valve remains closed.	1. Valve and pipeline leaks.	1. Inspect valves and pipeline.
	2. Air pockets between valve and flowmeter; rotors in rocking motion in response to pump's pulsating pressure.	2. Vent air. Provide a check valve and accumulator.
	3. Supply power voltage fluctuates.	3. Eliminate voltage fluctuation.
6. Total flow over counting	1. Rotors in rocking motion in response to a pulsating flow.	1. Add a check valve and accumulator.
	2. Influenced by external magnetic fields (Meter sensor picks up external magnetic fields created by a motor, generator, etc.)	2. Keep out external magnetic fields.
	3. Air entrapped.	3. Provide an air vent.
7. Total flow under counting	1. Influenced by external magnetic fields.	1. Keep out external magnetic fields.
8. Process fluid flows but no total flow reading.	1. First and second rotors installed the wrong way.	1. Disassemble the meter body and reassemble correctly.
	2. Reassembled wrong after disassembly.	2. Disassemble and reassemble correctly.
9. Counting while valve remains closed (counts with no flow).	1. Due to liquid leak or air pockets between the valve and meter, rotors in rocking motion caused by pulsating pump pressure.	1. Provide an air vent. 2. Add a check valve and accumulator.
10. Message bDATA appears.	1. Appears following MODE operation for 5 sec. min. in the basic mode scroll.	1. From bDATA , continue MODE operation for 5 sec. min. to return to the basic mode scroll.

➡ NOTE: If trouble is not covered in the table above, please contact your nearest OVAL office. In this case, supply us with complete information as to product name, model code, symptoms, etc.

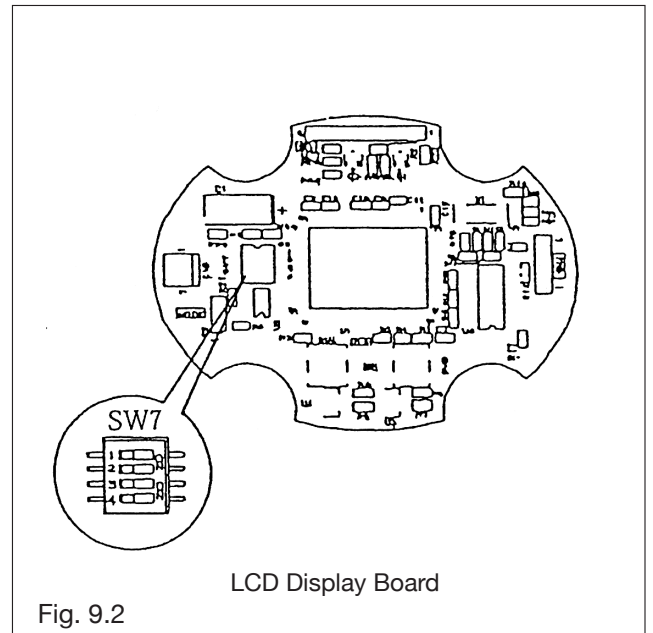
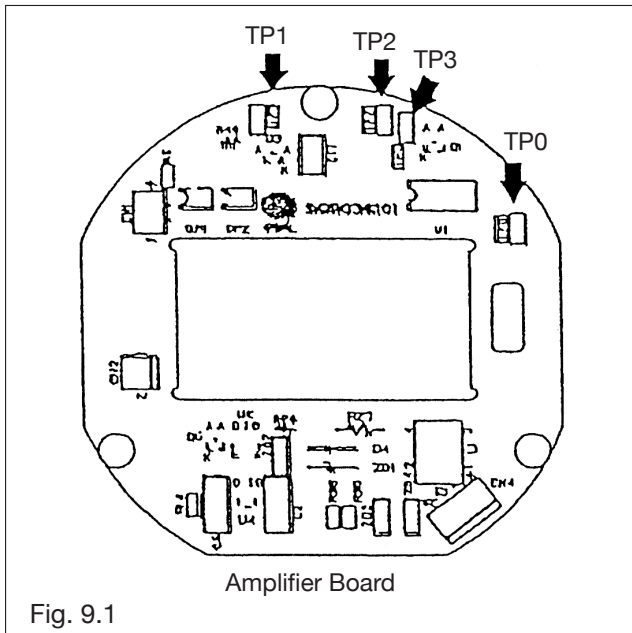
9. INTERNAL SWITCHES AND TEST PINS

Using test pins (TP0 through TP3) on the register amplifier board, you can monitor signal waveforms.

Amplifier Board

Name	Label	Description
Amplified waveform	TP0 (-) to TP1 (+)	Monitors waveform of amplified magnetic sensor signals.
Triggered waveform	TP0 (-) to TP2 (+)	Monitors waveform of triggered TP1 signal (square wave).
Waveform past doubler	TP0 (-) to TP3 (+)	Monitors the frequency-doubled waveform of TP2 signal. Monitors pulse waveform with constant width (2ms) at TP2 waveform rising edge and falling edge.

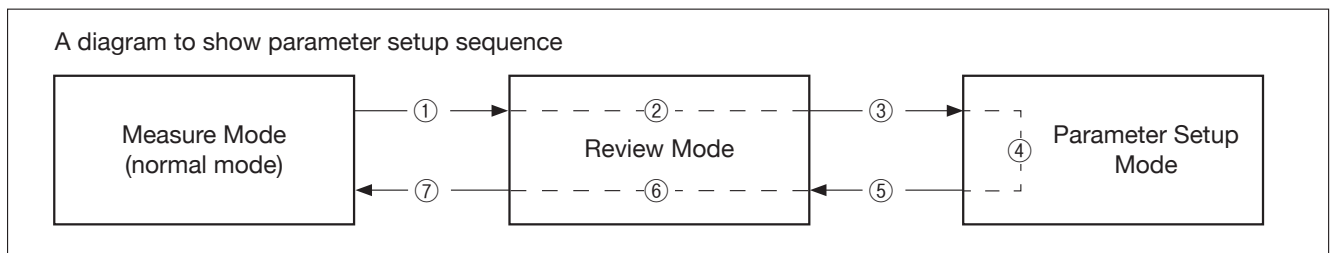
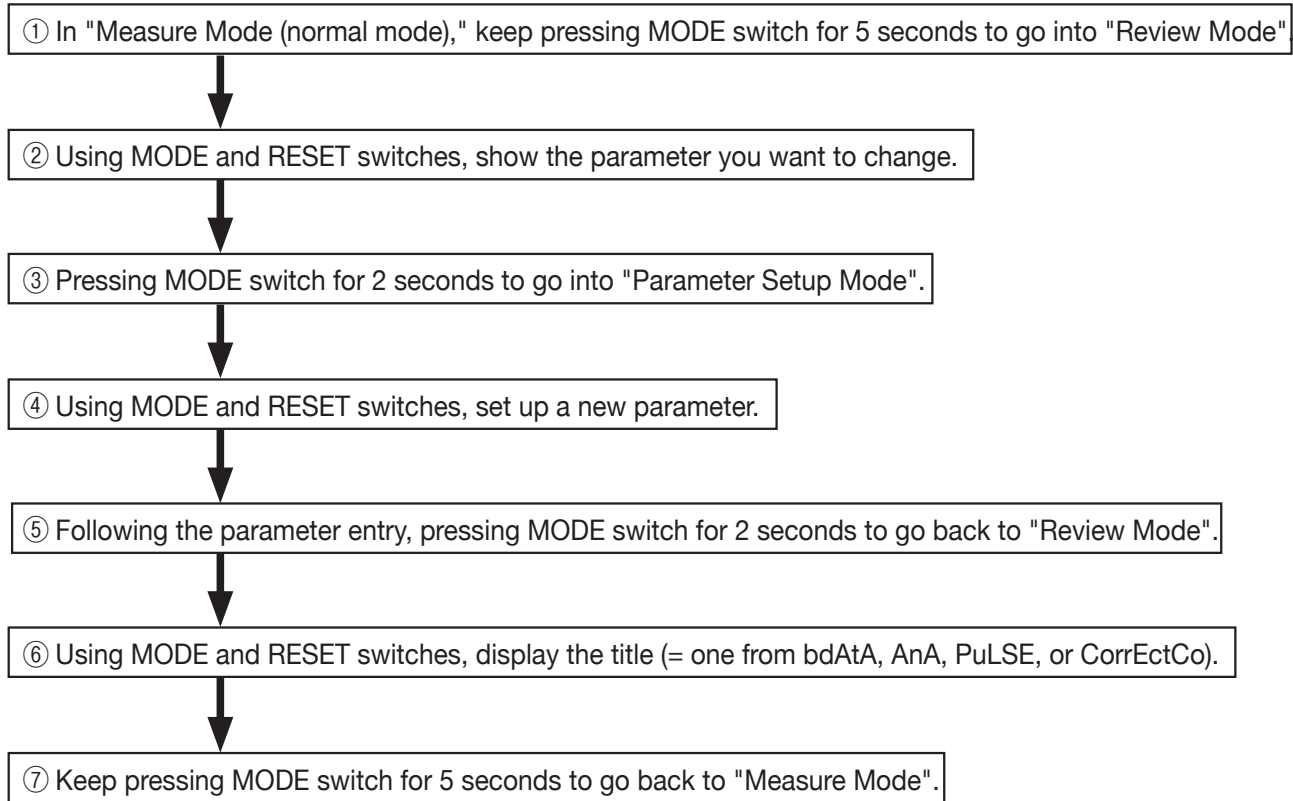
NOTE: SW7 on the LCD display board is only for adjustment at factory. Do not attempt to readjust. Factory set to "OFF" in all positions before shipment.



10. PARAMETER SETUP PROCEDURE (Manual setup)

10.1 Parameter Reconfiguration

Given below is the sequence of parameter changing.



➡ NOTE: For complete detail of MODE and RESET switch operation at ①, ②, ⑥, and ⑦, see Section 10.3 "Transition Chart of Parameter Change".

10.2 Parameter List

Parameter	Code	Default	Description	Setup Examples
Meter factor	F	10000-2	<ul style="list-style-type: none"> Meter factor (Unit : [□ /Pulse]) Setting range: 0.9999-9 to 9.9999E7 	Ex.: Given meter factor 9.918mL/P To change the indicated flowrate to [L] → 9.918[mL/P] = 9.918 × 10 ⁻³ [L/P] Therefore set to 「F99 180-3」 (L/P)
Conversion factor	H	10000E0	<ul style="list-style-type: none"> Unit conversion factor (Unit : [△ /L]) △ : Unit after conversion (If not converted △=□) Setting range: 0.9999-9 to 9.9999E7 	Changes units of total flow and instant flowrate to any units desired. (If not converted, it should be H1.0000E0) Ex.: At 1.5kg per 1L, change the flowrate to read in kg. → Conversion factor is 1.5[kg/L](=1.5000 × 10 ⁰ [kg/L]) Therefore set to 「H 15000E0」 (kg/L) (※ 1)
Pulse weight	Pu	100E0	<ul style="list-style-type: none"> Factored pulse output weight (Unit : [△ /Pulse]) Setting range: 0.99-9 to 9.99E7 	Ex.: To change factored pulse wt. 1 L/P → 10L/p (=1.00 × 10 ⁻¹ [L/P]) → Set to 「Pu 100E 1」 (L/P) (※ 2)
Measurement units	Un	(L)	<ul style="list-style-type: none"> Information shown below the LCD 	Sets up the units of registration to read in the LCD.
Instant flowrate decimal point	bP	0	<ul style="list-style-type: none"> Decimal point location of instant flowrate b1 Setting range: 0, 1, 2 	Ex.: To change the indicated min. reading in instantaneous flowrate from 1L → 0.1L/h (= decimal place 1 digit.) → Set to 「bP .1」
Total flow decimal point	SP	0	<ul style="list-style-type: none"> Upper time limit in inst. flowrate sampling Setting range: 0, 1, 2, 3 	Ex.: To change the indicated min. reading in total flowrate from 1L → 0.01L (=decimal place 2digits). → Set to 「SP 2」
Sampling time	At	5	<ul style="list-style-type: none"> Upper time limit in inst. flowrate sampling (Unit : [sec]) Setting range:1 to 999 	If a set number of pulses fail to come during At [sec], the instantaneous flowrate shows 0.
Sampling cycle number	A	4	<ul style="list-style-type: none"> Frequency of sampling Setting range: 1 to 999 (※3) 	Instantaneous flowrate is determined by measuring the time for incoming flow in a set number of pulses. If the spread of instant. flowrate indicated is too great, increasing the number of pulses eases the fluctuation.
Pulse width	Pon	1	<ul style="list-style-type: none"> ON width of unfactored pulse output (Unit : [msec]) 	Ex.: To change pulse width from 1ms → 50ms → Set to 「Pon 50」 (ms) (※ 4)

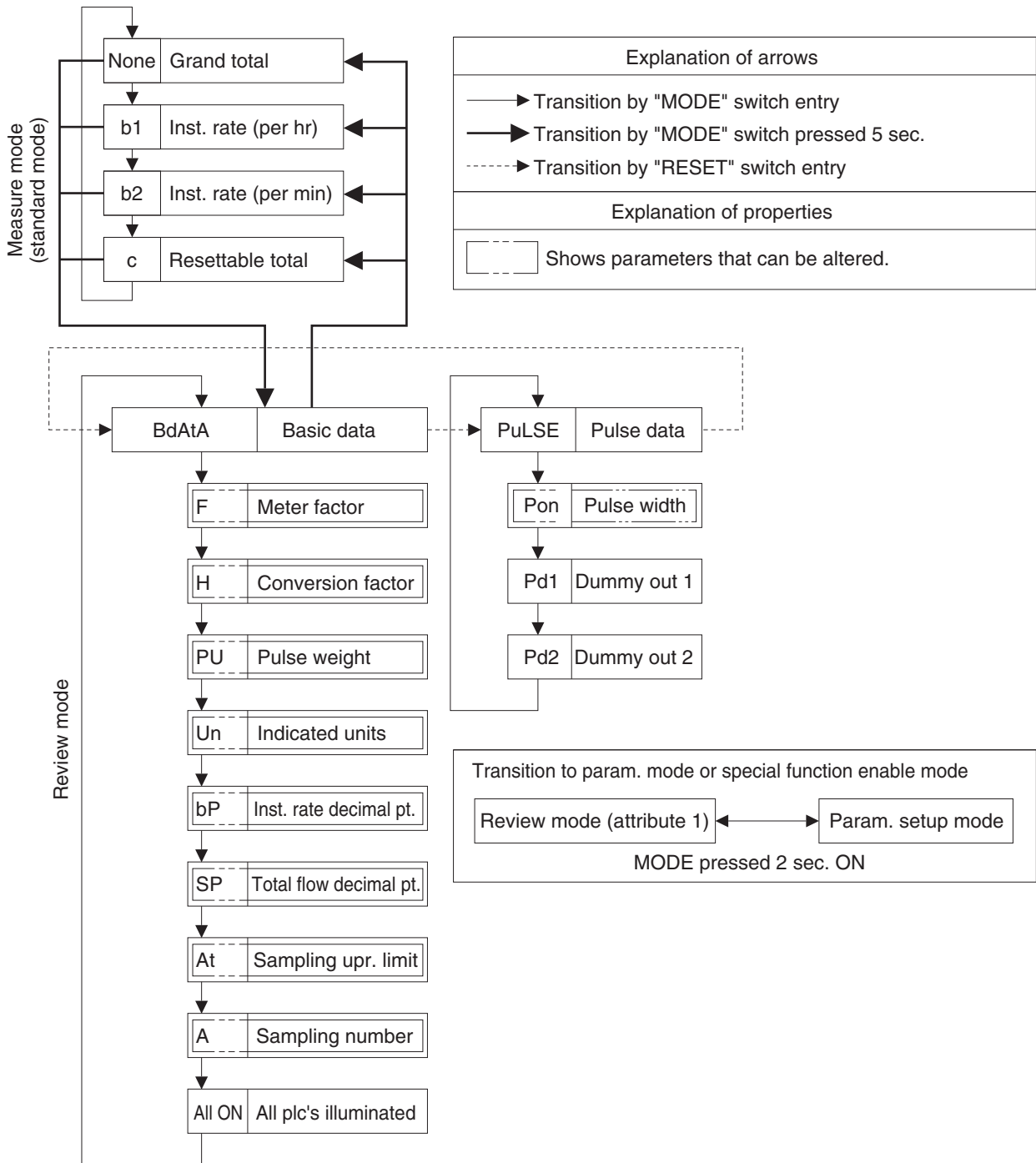
➡ NOTES: ※1. A change in conversion factor (H) requires uniformity of units, such as pulse weight (Pu), displayed units (Un) and other related parameters to that after conversion.

※2. Do not fail to select a value that satisfies requirements $\frac{F \times H}{2} \leq Pu \leq F \times H \times 10000$.

※3. To determine the most appropriate sampling cycle number, multiply the frequency (P/s) of flowrate used by the sampling time and choose the nearest value of 2ⁿ
 Example: If the frequency of flowrate used is 7Hz (7 P/s) with sampling time at 5 s, then we obtain
 7×5=35. The nearest 2ⁿ is 2ⁿ = 32. So 32 is the sampling cycle number to be chosen.

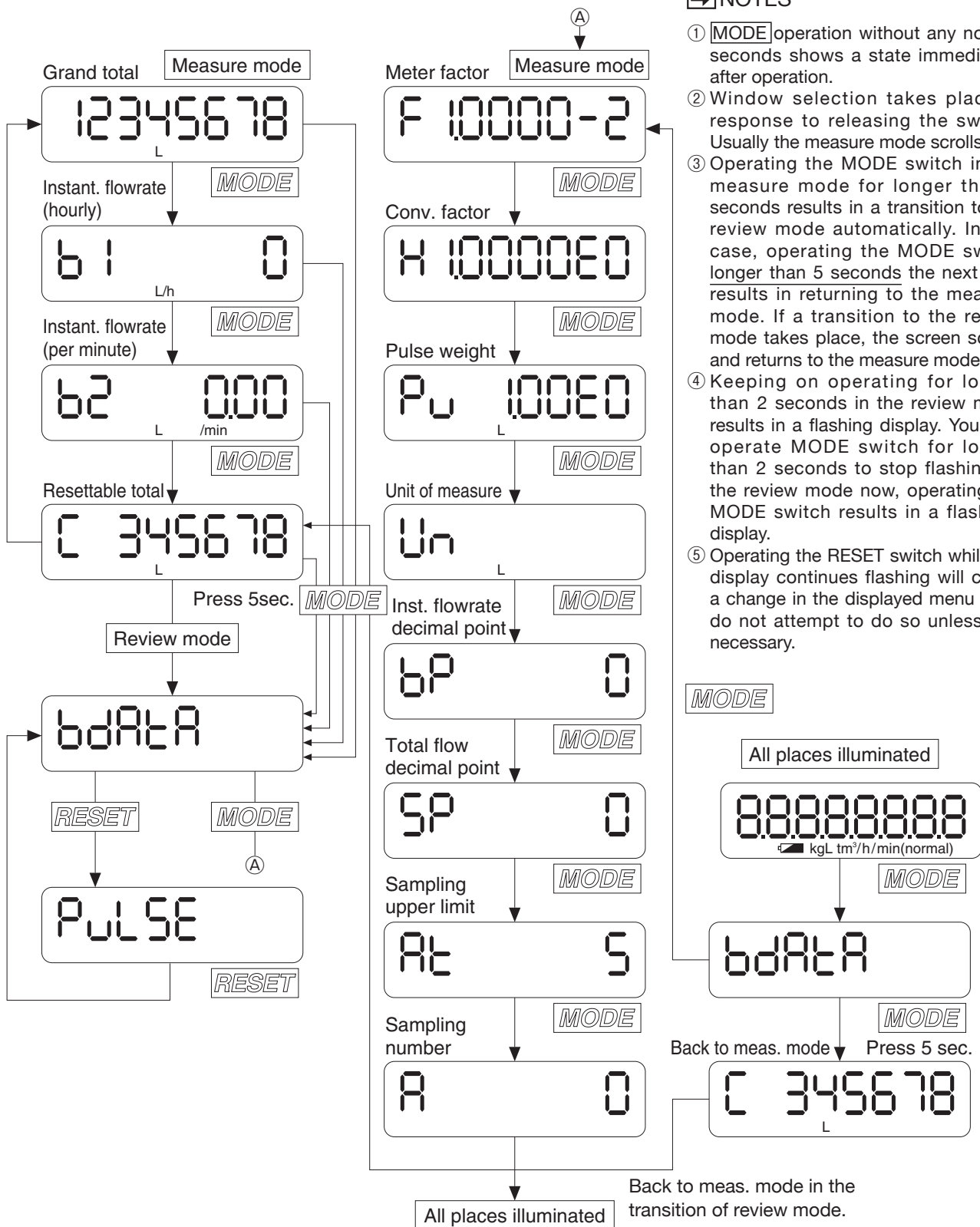
※4. Select a value that satisfies without fail: Factored pulse "OFF" width>1ms.

10.3 Transition Diagram of Modes and Parameters



10.4 Menu Selection

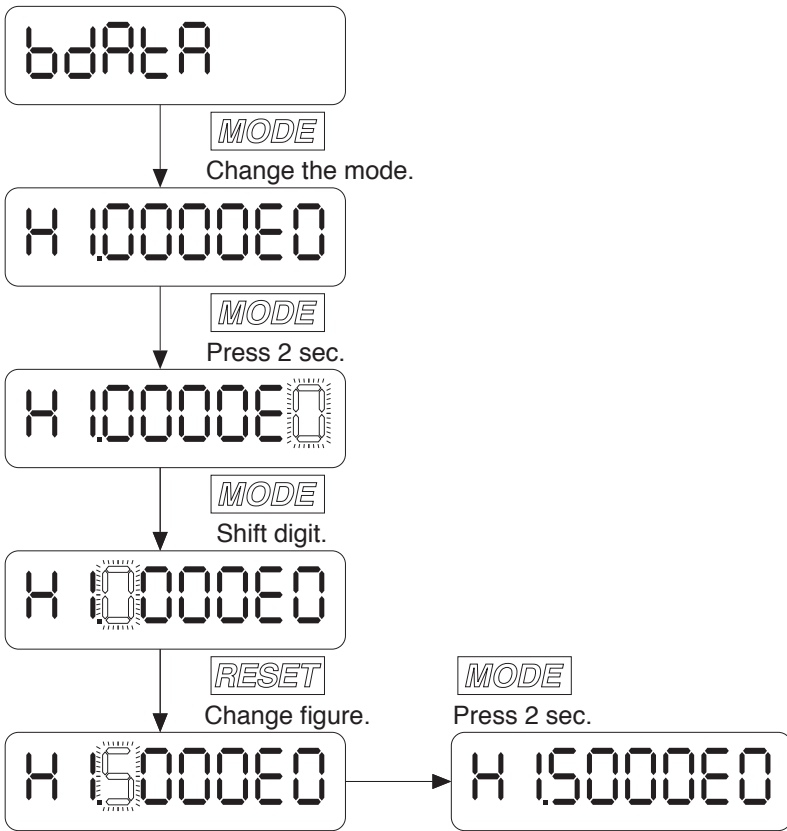
10.4.1 Transition from Measure Mode to Review Mode



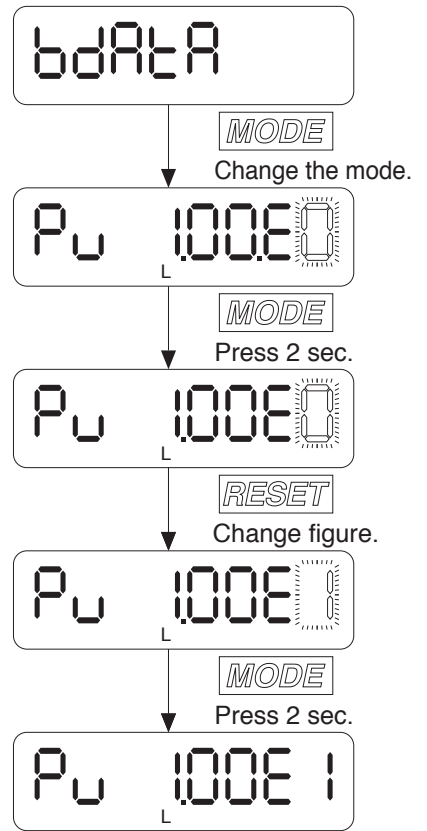
➡ NOTES

- ① [MODE] operation without any note in seconds shows a state immediately after operation.
- ② Window selection takes place in response to releasing the switch. Usually the measure mode scrolls.
- ③ Operating the MODE switch in the measure mode for longer than 5 seconds results in a transition to the review mode automatically. In this case, operating the MODE switch longer than 5 seconds the next time results in returning to the measure mode. If a transition to the review mode takes place, the screen scrolls and returns to the measure mode.
- ④ Keeping on operating for longer than 2 seconds in the review mode results in a flashing display. You may operate MODE switch for longer than 2 seconds to stop flashing. In the review mode now, operating the MODE switch results in a flashing, display.
- ⑤ Operating the RESET switch while the display continues flashing will cause a change in the displayed menu item; do not attempt to do so unless it is necessary.

b. Conversion factor

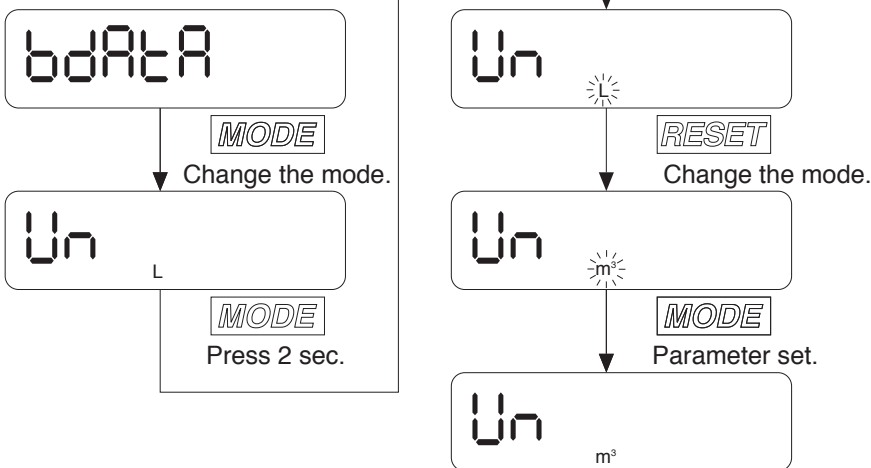


c. Pulse weight



d. Measurement Units

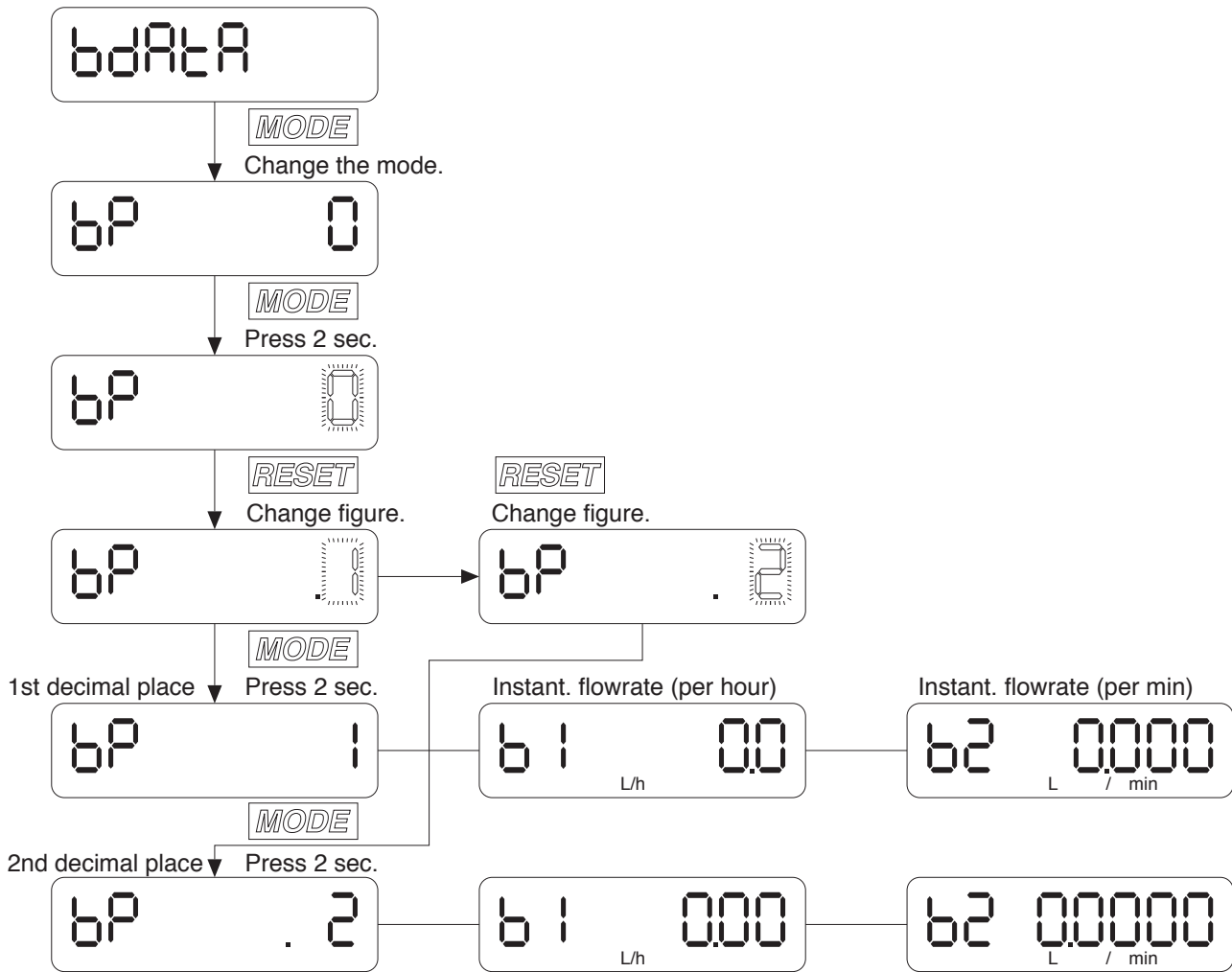
To change from L to m³



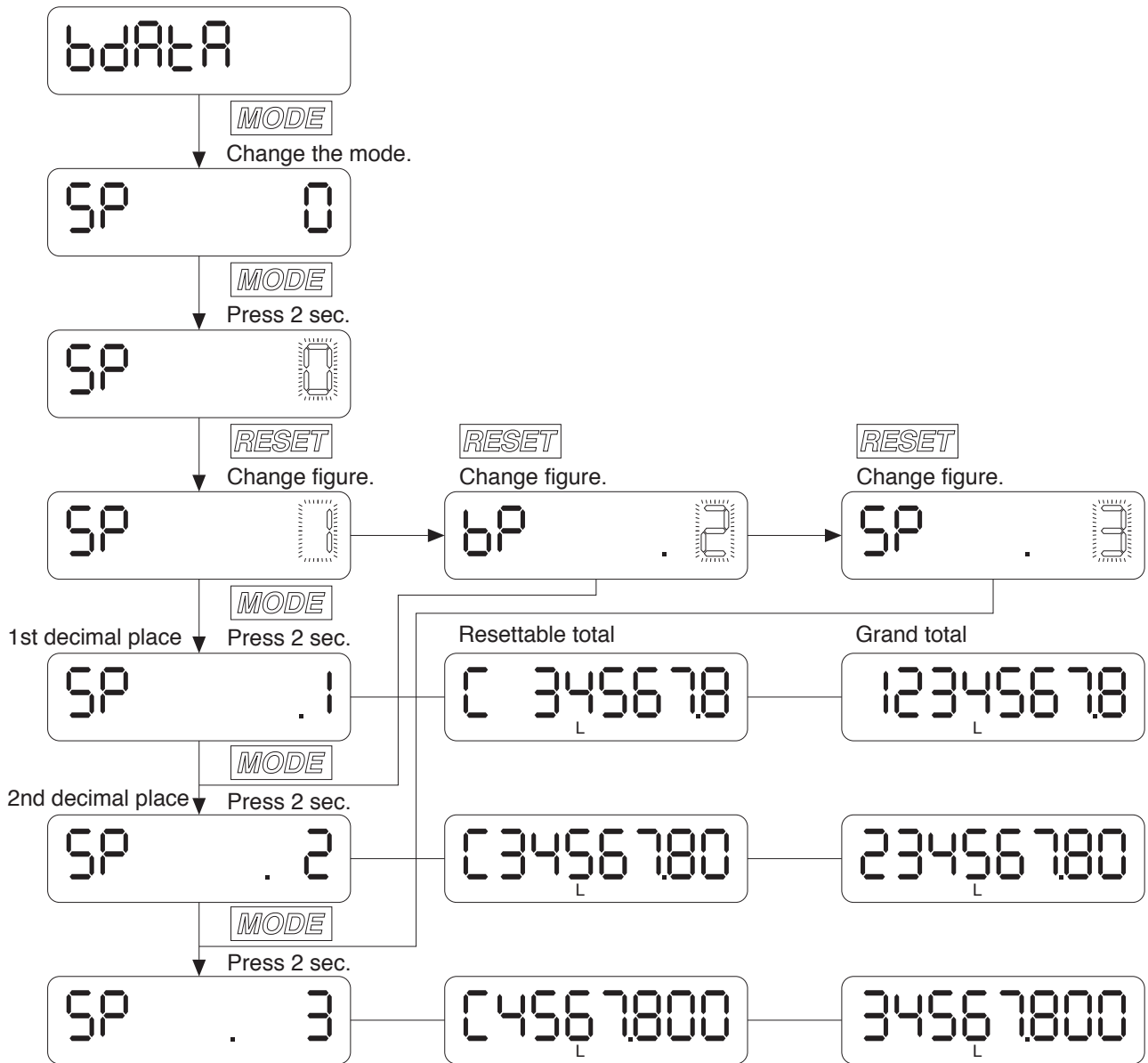
RESET

L → kL → m³ → L(normal) → kL(normal)
 m³(normal) → g → kg → t

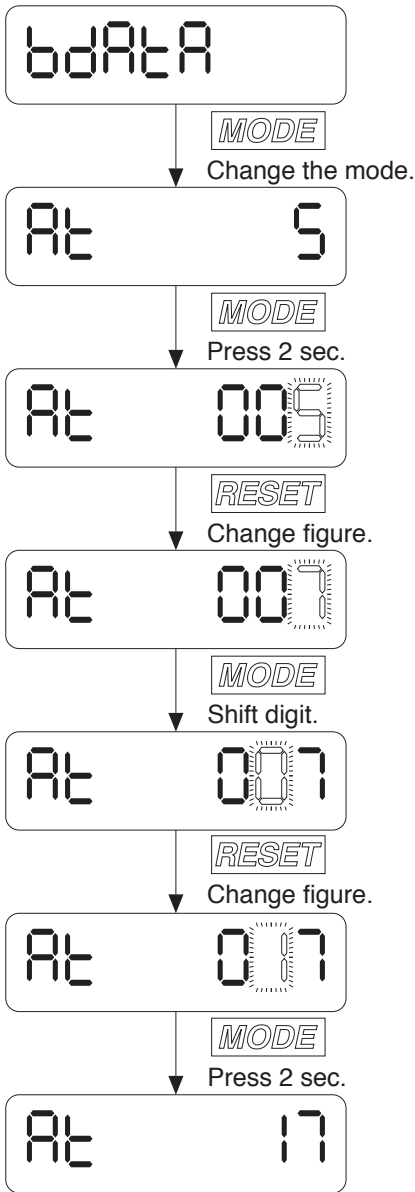
e. Instantaneous flowrate decimal point



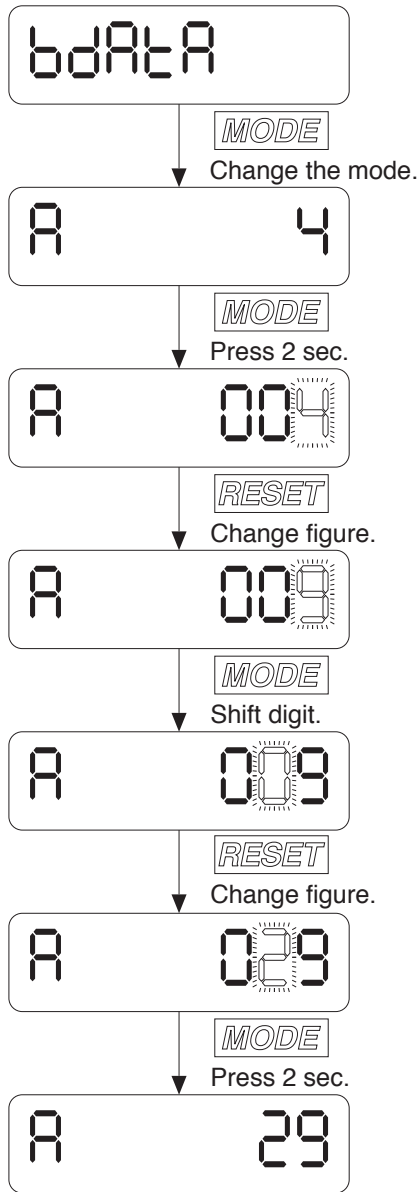
f. Total flow decimal point



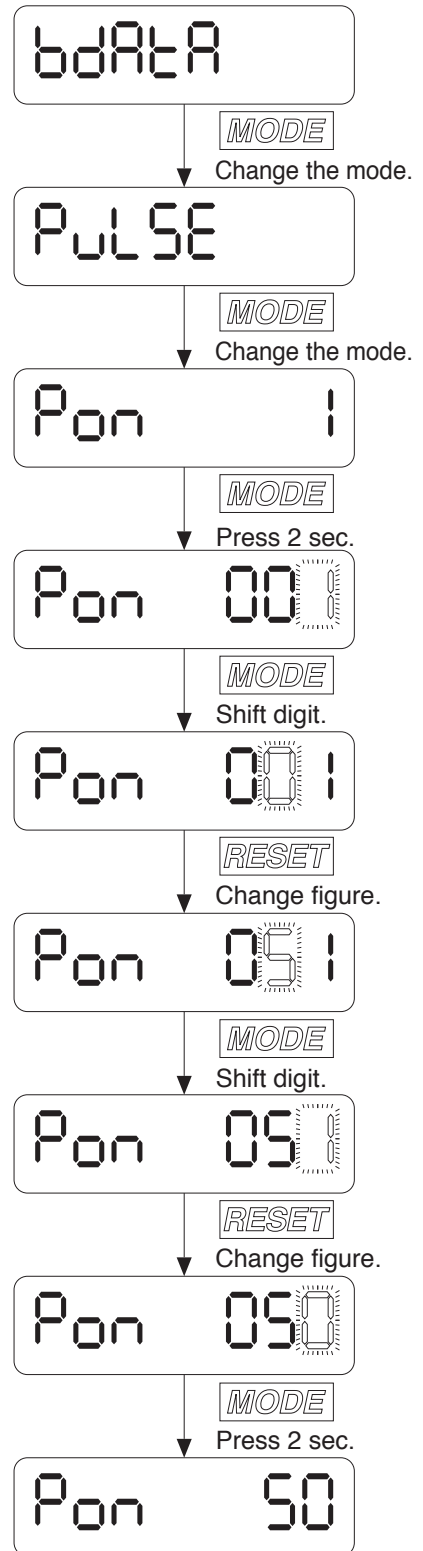
g. Sampling time



h. Sample cycle number



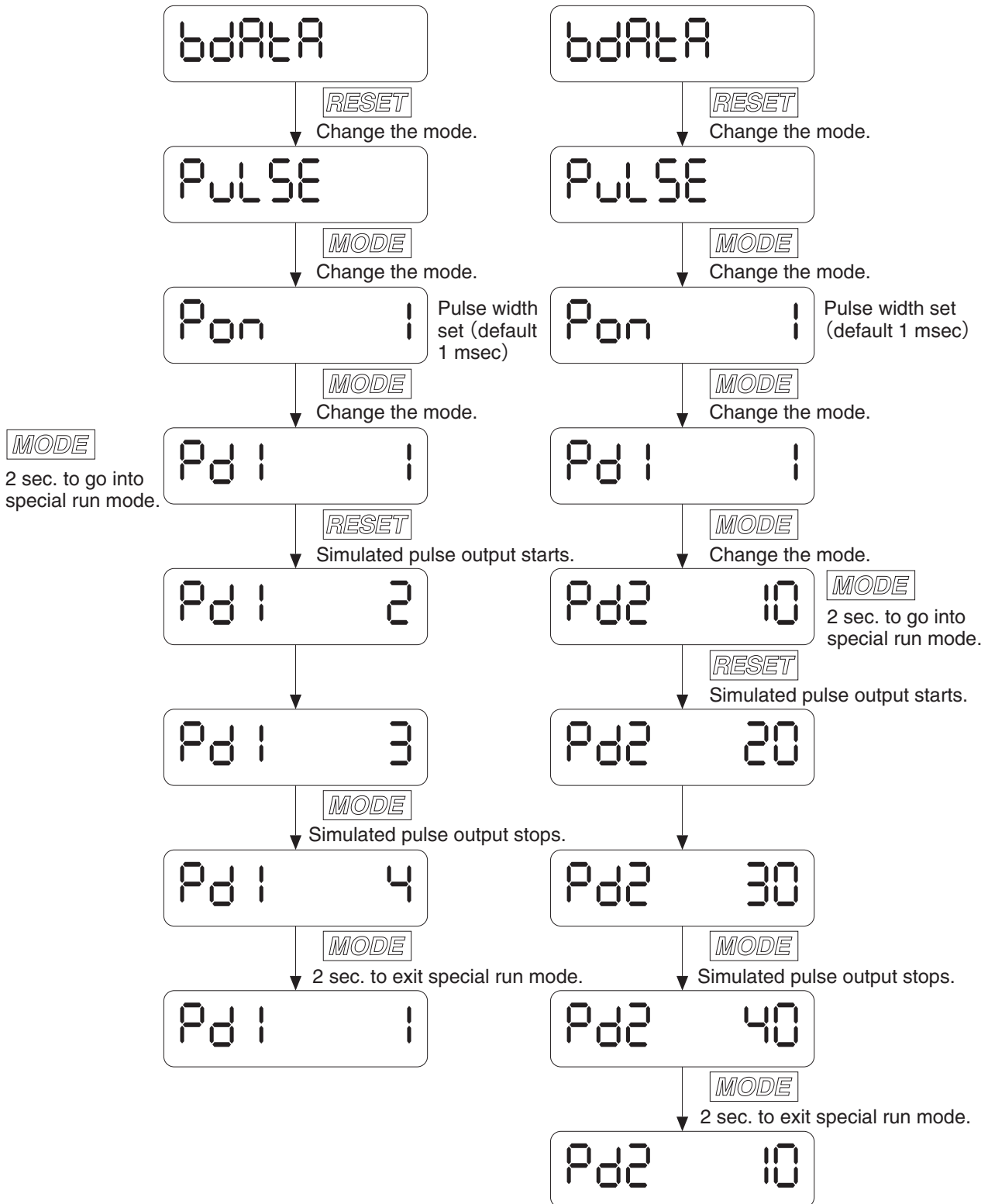
i. Pulse width



j. Dummy output

(1) 1Hz (pulse width 1 msec)

(2) 10Hz (pulse width 1 msec)



➡ NOTE: In(2)10Hz dummy output above, typical indications are shown.

10.5 Total Flow and Instant Flowrate Calculation and Factored Pulse Output

(1) Total flow

In response to a single incoming pulse, an $[F \times H]$ is added up to the current total reading.

where F: Meter factor H: Conversion factor

Down to the decimal places set up at SP (total flow decimal point location), the variable is shown.

As the counter reading reaches the maximum capacity (99999999), the counter returns to 0.

(2) Instant flowrate

On counting the number of incoming pulses within sampling time A_t (in seconds), their period T is measured and the instant flowrate is determined by the following formula (resolution of measurement: $30\mu\text{sec}$).

$$\text{Flowrate/h } b1 = 3600 \times F \times H \times A / T$$

$$\text{Flowrate/min. } b2 = 60 \times F \times H \times A / T$$


$b1$ reads to the decimal places set up at menu item bP .

$b2$ reads to the decimal places of $b1 + 2$ decimal places.

If incoming pulses are missing within sampling time A_t [seconds], the instant flowrate reads "0".

10.6 Error Messages

The new register tells the operator on the front panel LCD the occurrence of any faulty conditions with error messages as shown in the table below.

Message	Name	Description	Action
PRERR.	Parameter setup error	An attempt is made to rewrite a parameter while parameters are write-protected. (In the standard model, write-protect feature is set in OFF and will not appear.)	Can be reset by placing No.1 of display board SW7 in OFF. (This enables you to change parameters.)
PRERR.1	Parameter error 1	Backup data retained for parameters has been damaged.	CPU initialization and then reconfiguration of parameters are required.
PRERR.2	Parameter error 2	Some of the backup data retained for the display mode, grand total flow reading, or resettable total flow reading have been damaged.	Measure mode can be restored with MODE switch, but the grand total flow and resettable total reading will be reset to 0.
PRERR.Pu	Pulse weight error	Pulse weight "Pu" setting is too small with respect to meter factor "F" and conversion factor "H".	Change the setting to an appropriate value that the relationship between F, H, and Pu satisfies the following formula: $\frac{F \times H}{2} \leq Pu \leq F \times H \times 10000$
OutErr.	Pulse output error	Pulse "OFF" width in the factored pulse output falls short of 1 msec for either reason: ① Flowrate excessive ② Factored pulse width setting too great	① Reduce flowrate ② Choose an appropriate factored pulse width "Pon" relative to the flowmeter specification.
"  " (BATT mark comes on.)	Battery life	Supply voltage has dropped.	Replace the battery with a new one.

11. DISASSEMBLY AND INSPECTION

⊙ Intervals of periodic inspection may vary with individual operating conditions. However, in principal, once a year periodic disassembly and checking are recommended.

◆ Meter body inspection ◆ Process fluid fails to flow probably due to locked oval rotors with scale lodged between gear teeth.

⚠ **CAUTION:** Because ECO OVAL is a precision industrial instrument, disassembly and inspection should be performed indoors as a rule. If it is desired to disassemble and inspect it as installed in the field, internal pressure of the piping assembly shall be reduced to a safe level, shut off valves upstream and downstream of the meter fully, drain the piping assembly and then place a suitable fluid receptacle directly below ECO OVAL. Exercise care to keep disassembled parts free from grit and dust.

⚠ **CAUTION:** If the meter is of externally powered type, make sure to cut off the power before you work.

11.1 Meter Sizes 29 and 60 Disassembly and Inspection

11.1.1 Preparation Before Disassembly and Inspection

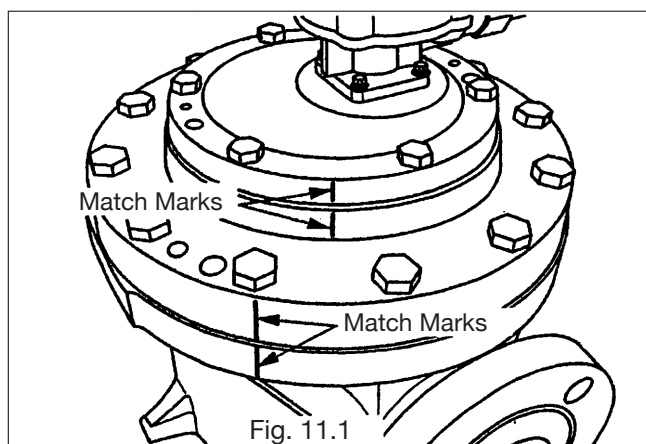
To avoid unexpected or unintentional personal injury, including burns, observe the following preparatory steps :

- ① Meter body, front cover and other heavy components pose an immediate danger to personnel and equipment. Prepare a tripod stand, chain pulley block and hanger bolts (you can make use of two M12 bolts with Meter size 29 or meter body hanger bolts with Meter size 60).
- ② Before disassembly, make certain that the meter is not under pressure and that the temperature has dropped to room temperature.

➡ **NOTE:** For the flowmeter part names in this section appear in Section 12 "Exploded Views and Part Names".

11.1.2 Disassembly

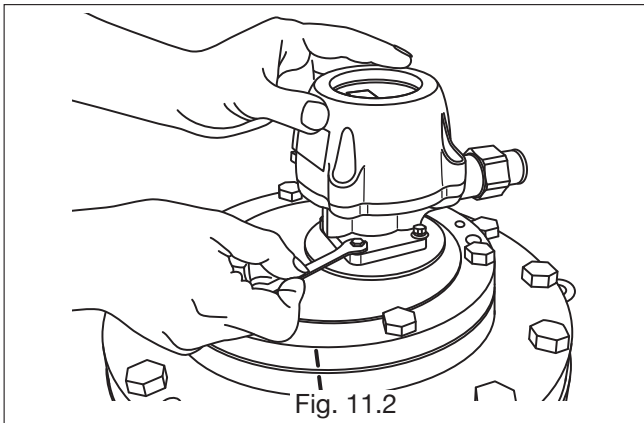
- ① Remove the meter body from the piping assembly and, with the register up, place it on a level surface. To ensure proper orientation of the front cover and register fitting disc at reassembly, it is good practice to put "match marks" with a felt-tip marker before disassembly (Fig. 11.1).



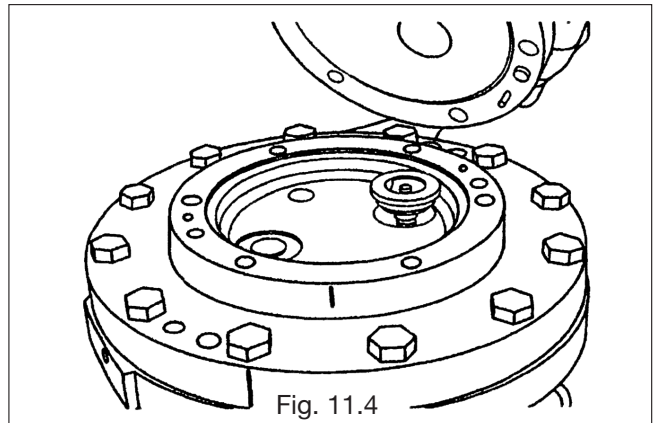
⚠ **CAUTION**

The front cover and register fitting disc are keyed to their proper place with locating pins. To avoid their misplacement at assembly, do not forget to put "match marks" before disassembly.

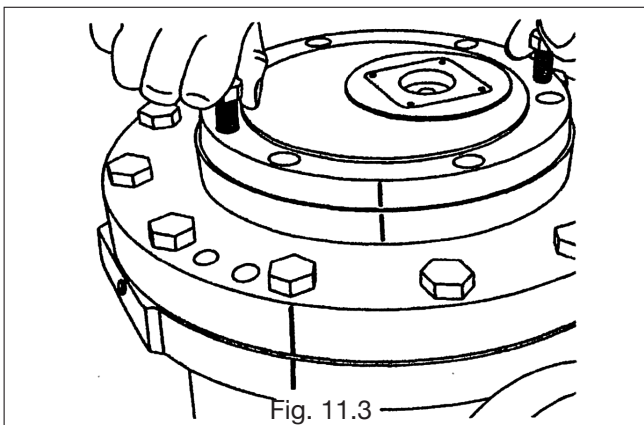
- ② Taking off four register fitting bolts, remove the register assembly from the meter body (Fig. 11.2).



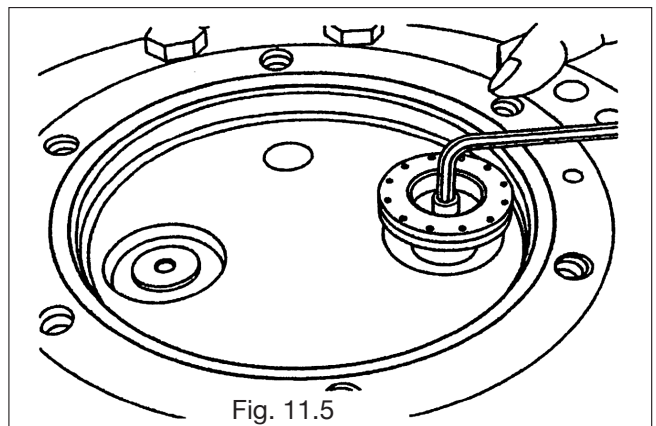
- ④ Screw two jacking bolts in little by little until the register fitting disc comes off (Fig. 11.4).



- ③ Take off bolts on the register fitting disc and screw two of the bolts just removed into jack screw holes in the register fitting disc. (Fig. 11.3).



- ⑤ By loosening the bolt securing the signal magnet disc in place, remove the signal magnet disc from the first rotor shaft. If the bolt will not come loose due to freely turning rotor shaft, good practice is to insert a wooden object (such as the handle of a hammer) from the meter entrance as a chock (Fig. 11.5).



⚠ CAUTION

1. Screw bolts in carefully observing the jacking process. Uneven tightening may result in distorted locating pins and eventual difficulty in register fitting disc installation.
2. Upon register fitting disc removal, take precautions against the presence of residual process fluid inside.

⚠ CAUTION

1. It is very dangerous to put your hand into the inlet or outlet of the meter. Caught between the rotors or in the measuring chamber, you might suffer serious hand injuries.
2. Using a wooden chock to prevent freely turning, pull it out immediately after seeing the magnet disc to come off. A metallic object, such as a metal pipe, can damage the rotors and measuring chamber.

- ⑥ Take off front cover fitting bolts and screw two of the bolts just removed into the front cover jacking screw holes. Install two hanger bolts in the tapped holes that had been used for securing the register fitting disc.

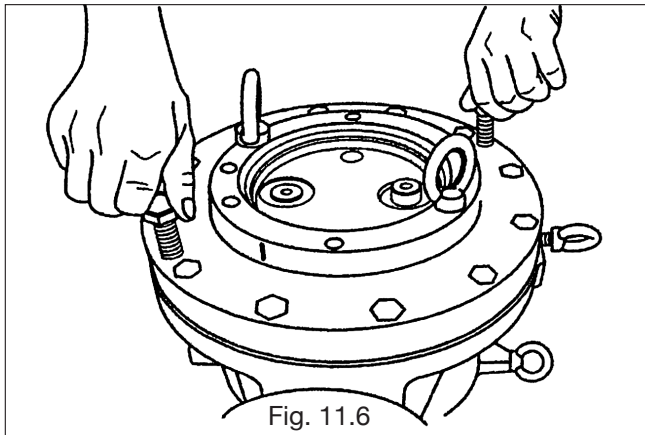


Fig. 11.6

- ⑦ Tighten two jacking bolts slowly and equally to raise the front cover off its seat. When the jacking bolts have been tightened to their full depth, carefully lift the front cover, using a chain pulley block (Fig. 11.7).

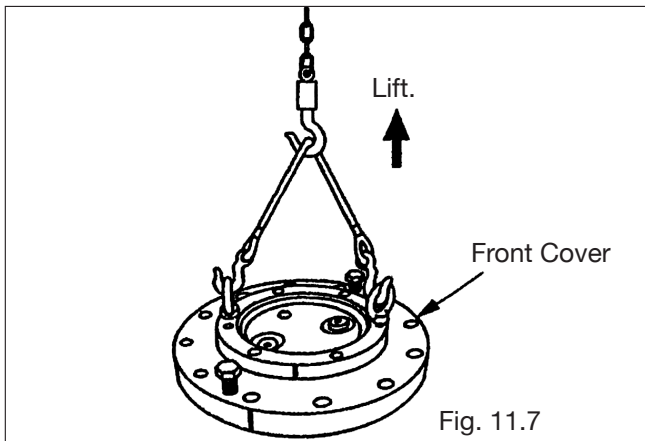


Fig. 11.7

⚠ WARNING

- 1. The front cover is heavy. Never put your hands into the space for holding it. Be very careful to prevent your fingers from being pinched.

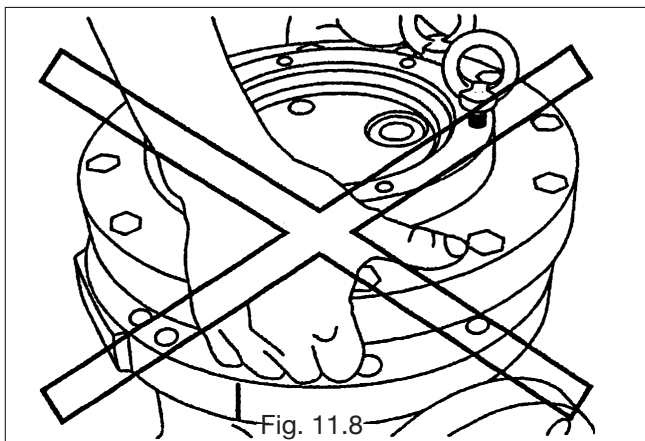


Fig. 11.8

- 2. Upon front cover removal, take precautions against the presence of residual process fluid.

- ⑧ With the front cover removed, carefully extract the rotors upwards. The rotors are heavy and slippery with lubricant: use extra care to avoid dropping them.

⚠ CAUTION

Inadvertent dropping of the rotors can damage rotor tooth profile and rotor shafts; exercise care in lifting them up.

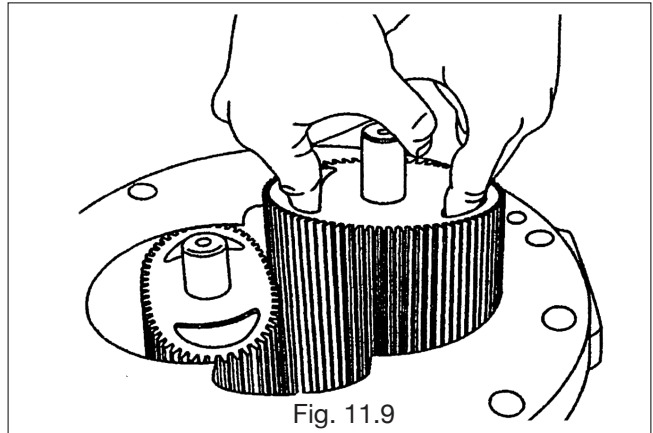


Fig. 11.9

- ⑨ Disassembly is now complete. Cleanse component parts in cleaning solvent and examine them for entrapment of solids, score marks, scratches, or wear. Use a flat oilstone to smooth the surface of minor damage if any.

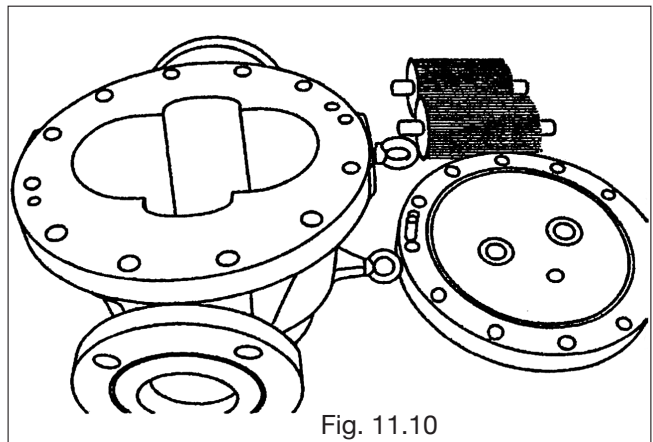


Fig. 11.10

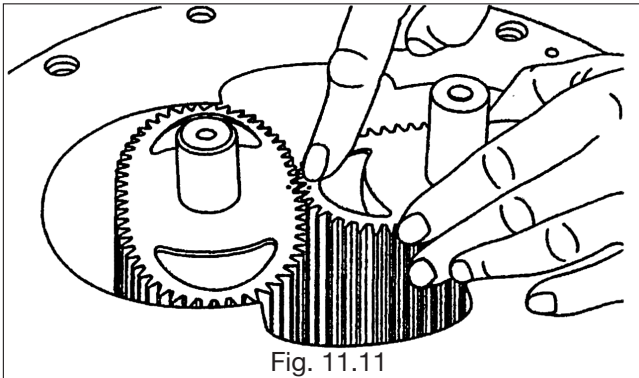
⚠ WARNING

Rotor bearings are press fitted onto the bottom of measuring chamber and front cover, using special tools for exact dimensional control. So, never attempt to remove them. Unauthorized bearing removal can, after reassembly, result in serious problems, such as locked rotors. If bearing replacement is required, consult the OVAL sales office in your area for assistance.

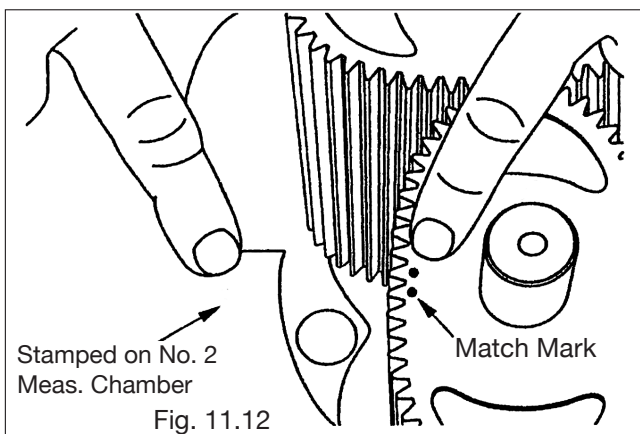
11.1.3 Assembly

Assembly is the reverse of the removal procedure.

- ① Rotors are differentiated from No. 1 to No. 2 and are aligned with "match marks" : Alignment is correct if a single dot " · " comes between two dots " : " (Fig. 11.11).

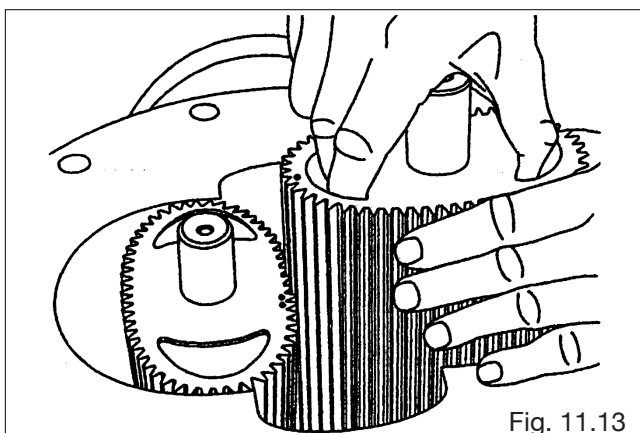


Match mark " · " is stamped on No. 1 rotor;
" : " on No. 2 rotor.

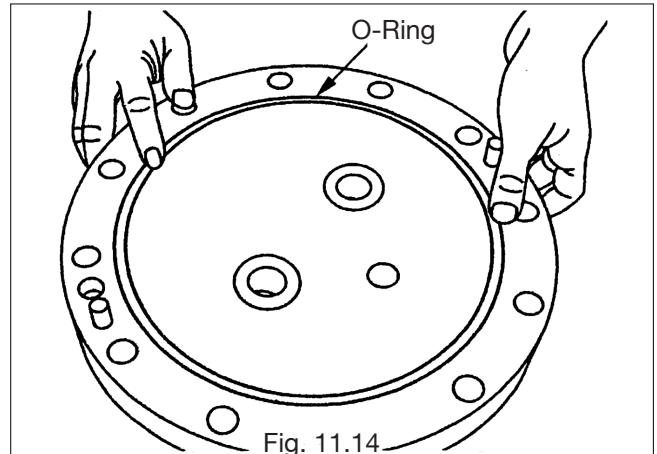


No. 2 Meas. Chamber and No. 2 rotor

With "match mark" on the rotor up, acknowledge the number stamped on the measuring chamber and carefully install the rotors individually into their right place. Upon rotor installation, confirm their smooth rotation by slowly hand rotating for one complete revolution.



- ② Install an O-ring in the groove at the rear of front cover. The O-ring tends to come off when installing the front cover onto the meter body: good practice is to apply grease for retention (Fig. 11.14).



⚠ CAUTION

Ensure that the O-ring is seated in place around perimeter of the groove. An O-ring partially unseated from the groove will result in a (pinched and) broken ring which causes fluid leaks.

- ③ In line with "match marks" placed at disassembly, install the front cover onto the meter body. To ensure correct alignment of rotor shafts at two places and locating pins at two places, carefully lower them perpendicularly.

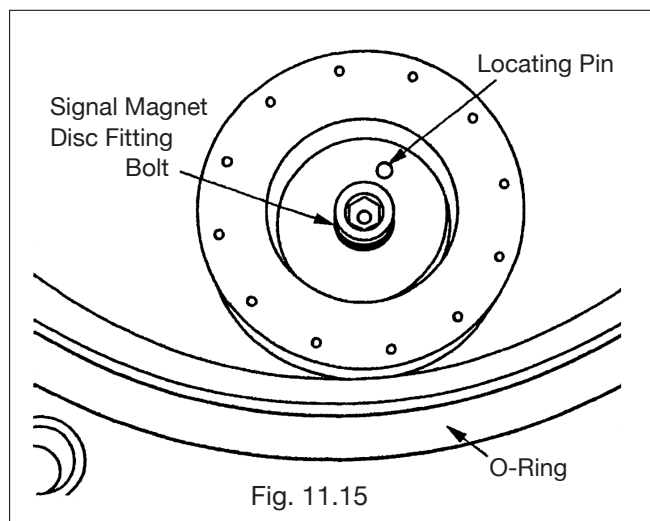
⚠ CAUTION

Do not forget to remove the two jacking bolts used for separating the front cover before you position the front cover.

⚠ CAUTION

When you hand rotate the rotors, be careful to avoid getting your hand pinched.

- ④ Install the signal magnet disc onto No. 1 rotor shaft. The No. 1 rotor must be in phase with the signal magnet: be sure to assemble with locating pin in place (Fig. 11.15).



- ⑤ After fitting an O-ring onto the front cover, mount the register mounting bracket to the front cover with "match marks" aligned.

⚠ CAUTION

Do not forget to remove the two jacking bolts used for separating the register mounting bracket before you attach the register mounting bracket.

- ⑥ Install the register assembly onto the meter body. Check each bolt for looseness.

⚠ CAUTION

When you tighten the signal magnet disc fitting bolt, insert from the meter outlet the wooden block that was once used as a chock at disassembly to take up looseness.

12. EXPLODED VIEWS AND PARTS LIST

12.1 Meter Size 29

Exploded view

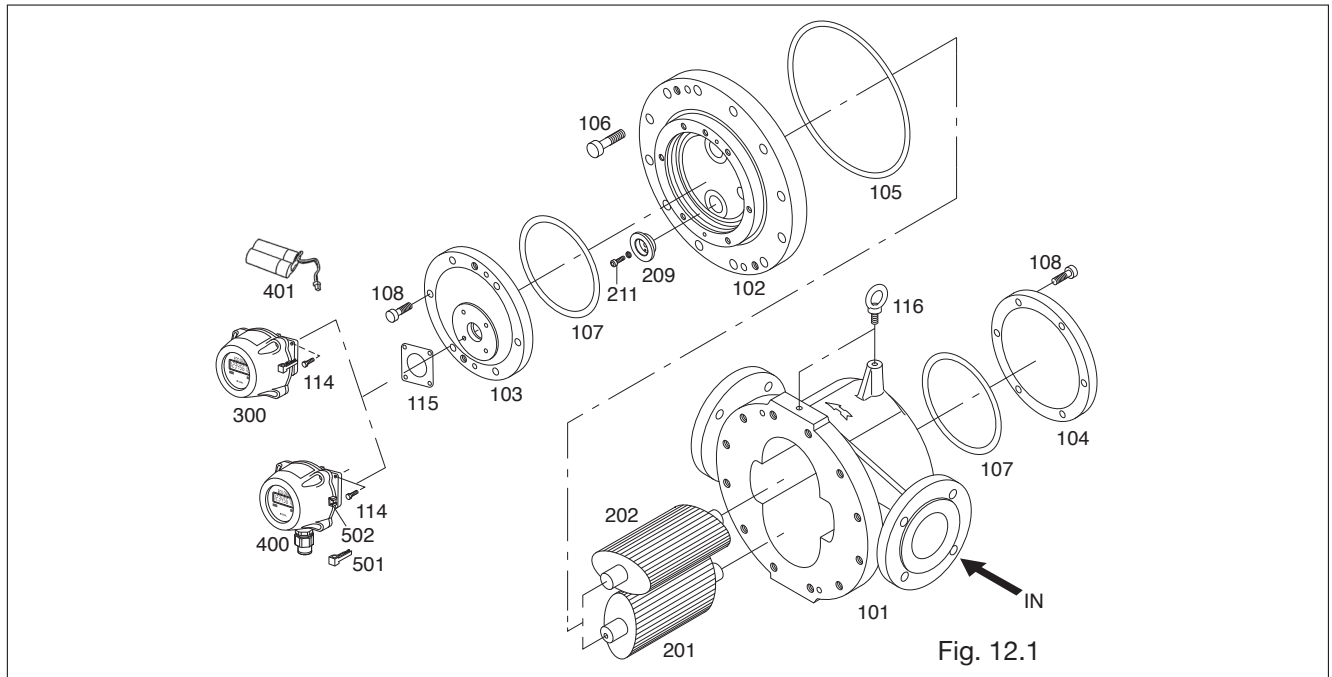


Fig. 12.1

Parts list

Sym.No.	Part Name	Q'ty	Remarks
101	Meter Body	1	Rotor bearing bushings (204) provided
102	Front Cover	1	Locating pins (109), rotor bearing bushings (204) provided
103	Register Mounting Disc	1	Loc. pin (110), sealing plate (112), O-ring G25 (113) provided
104	Rear Cover	1	
▲105	O-Ring A	1	JIS G260 (Viton only)
106	Front Cover Bolt	12	M16×55 with washer
▲107	O-Ring B	2	JIS G170 (Viton only)
108	Rear Cover Bolt, Register Mtg. Disc	12	M12×35 with washer
114	Register Fitting Bolt	4	M5×20
115	Gasket	1	
116	Eyebolt	2	M10×18
※201	No. 1 Rotor	1	No. 1 rotor shaft with non-turn pin (205)
※202	No. 2 Rotor	1	No. 2 rotor shaft with non-turn pin (205)
※209	Signal Magnet Disc	1	Signal magnet (208), locating pin (210) provided
※211	Hex Socket Head Bolt	1	Spring washer (212) provided
300	Register Assembly	1 set	Battery pack (401) incorporated
400	Register with Pulse Generator	1 set	Battery pack (401) incorporated
401	Battery Pack	1 set	
501	Selector Magnet	1	
502	Magnet Holder	1	w/M3×5 flat head screw

➡ NOTES 1. ▲: Replacement parts (recommended)

2. ※: (1) No. 1 and No. 2 rotors are available as a matched pair.

(2) Signal magnet disc and hex socket head bolt are available as a matched pair.

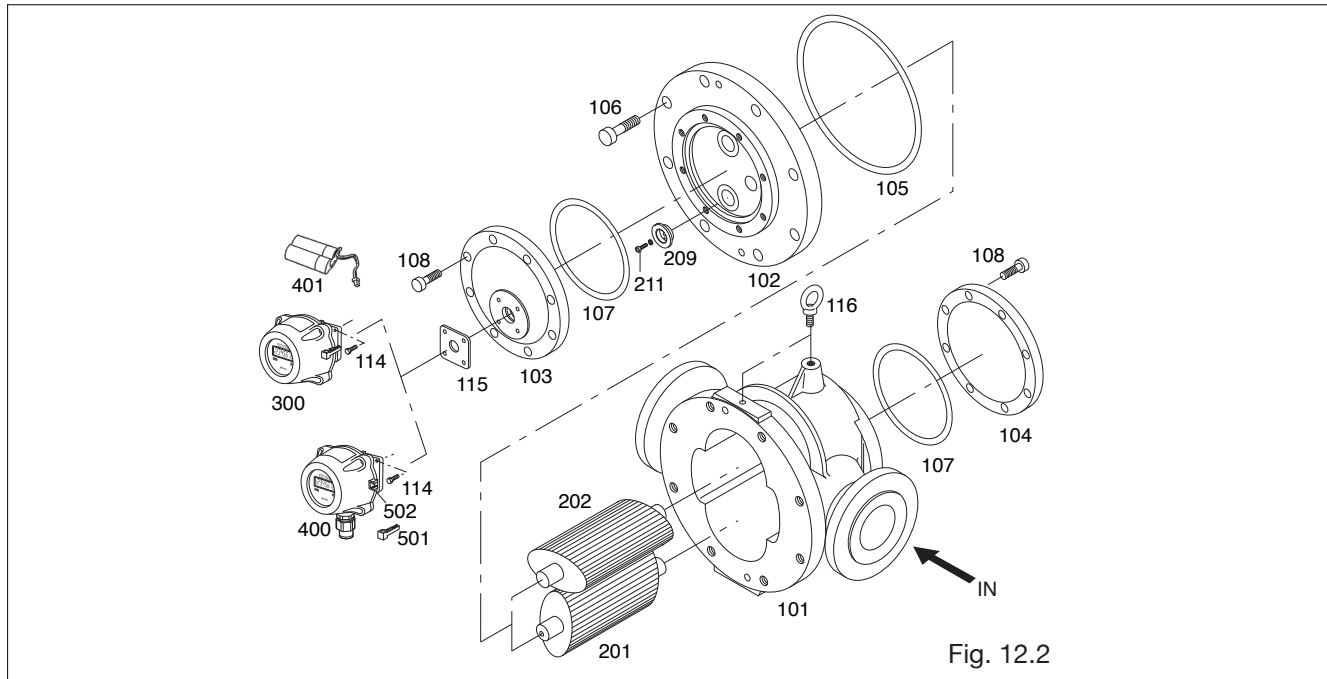
●Parts Ordering

1. Specify by symbol No. Supply us with the model code, instruction manual No., unit name, and the quantity required.

2. If a replacement register is required, supply us also with the specifications of the register.

12.2 Meter Size 60

Exploded View



Parts list

Sym.No.	Part Name	Q'ty	Remarks
101	Meter Body	1	Rotor bearing bushings (204) provided
102	Front Cover	1	Locating pins (109), rotor bearing bushings (204) provided
103	Register Mounting Disc	1	Loc. pin (110), sealing plate (112), O-ring G25 (113) provided
104	Rear Cover	1	
▲105	O-Ring A	1	JIS G320 (Viton only)
106	Front Cover Bolt	8	M20×70 with washer
▲107	O-Ring B	2	Special dims. (Viton only)
108	Rear Cover Bolt, Register Mtg. Disc	16	M12×40 with washer
114	Register Fitting Bolt	4	M5×20
115	Gasket	1	
116	Eyebolt	2	M12×22
※201	No. 1 Rotor	1	No. 1 rotor shaft with non-turn pin (205)
※202	No. 2 Rotor	1	No. 2 rotor shaft with non-turn pin (205)
※209	Signal Magnet Disc	1	Signal magnet (208), locating pin (210) provided
※211	Hex Socket Head Bolt	1	Spring washer (212) provided
300	Register Assembly	1 set	Battery pack (401) incorporated
400	Register with Pulse Generator	1 set	Battery pack (401) incorporated
401	Battery Pack	1 set	
501	Selector Magnet	1	
502	Magnet Holder	1	w/M3×5 flat head screw

☞ NOTES 1. ▲: Replacement parts (recommended)

2. ※: (1) No. 1 and No. 2 rotors are available as a matched pair.

(2) Signal magnet disc and hex socket head bolt are available as a matched pair.

•Parts Ordering

1. Specify by symbol No. Supply us with the model code, instruction manual No., unit name, and the quantity required.

2. If a replacement register is required, supply us also with the specifications of the register.

13. BATTERY PACK REPLACEMENT

(1) Take off four bolts (M6) and detach the register cover (Fig. A).

⚠ CAUTION:

The register body is coupled to its cover with a chain. Avoid to damage the internal wiring by pulling strongly when removing the cover.

(2) Disconnect wire leads from the register body (Fig. B).

Disconnect two wire leads from their connectors on the register substrate. Lightly holding the connector with long-nose pliers, or similar tool, uncouple perpendicularly in this process. (Do not give them a strong pull.)

⚠ CAUTION:

Do not remove the black cable from the gum band. The gum band is attached to prevent the cable from being tucked. If it is removed, twist it around the gum band again referencing Fig. B after the step ④ shown in the section (5) to be described.

(3) Separate the metal cover (Fig. C).

Loosen three setscrews (M3) holding the metal cover over the battery pack and separate the cover.

(4) Remove the battery pack (Fig. D).

Holding and uncoupling the battery pack connector on the register substrate, remove the battery pack.

(5) Installing a new battery pack:

Install a new battery pack in place on the register substrate and couple the connector.

① The connector is polarized to prevent installation in incorrect orientation. Do not force into position.

② Connector installation with wrong electrodes result in no current drain and no display. Try to install into correct position.

③ Register substrate has four rectangular slots to secure the battery pack. Install the battery in line with these slots.

④ Lay the lead wires on center of the battery pack exactly the way they were installed and retain with the metal cover. (Only battery powered model)

⚠ CAUTION:

1. When you remove the register housing, exercise care to preclude moisture and dust into the housing. Keep your fingers, etc. off electronic components.

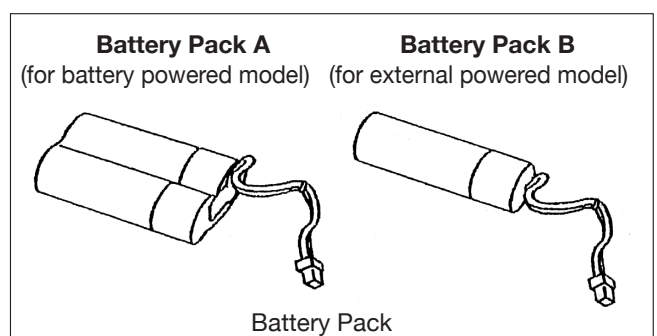
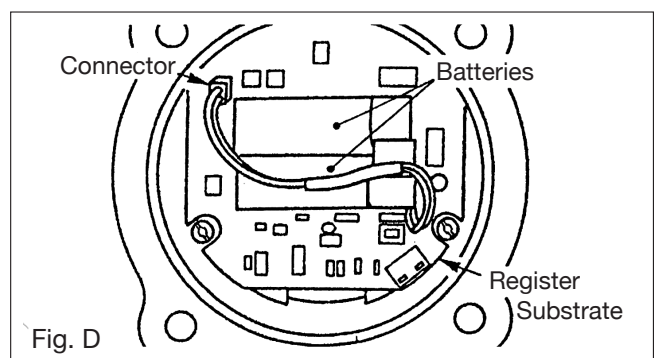
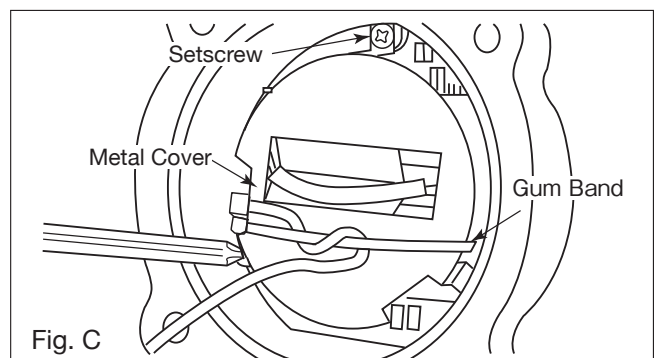
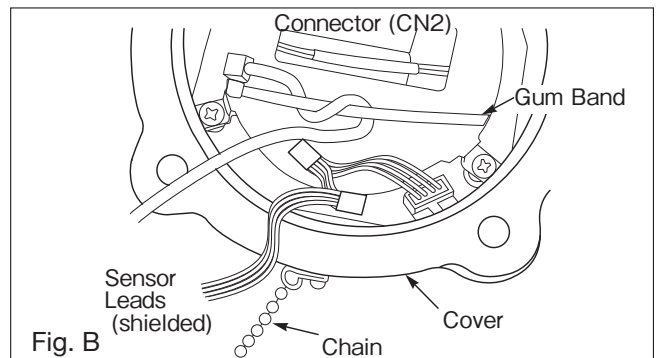
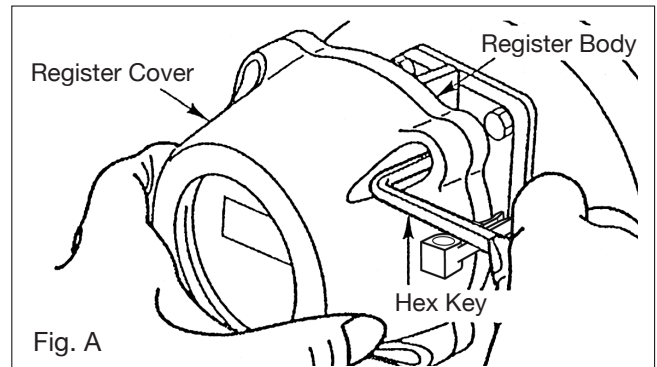
2. When you install the housing cover, make sure of proper cable accommodation. (See register cover installation procedure outlined on page 7.)

3. Ensure that there is no explosive fumes around the housing before you open the cover.

Battery Pack Specification

Manufacturer	: TOSHIBA Co.,LTD
Type	: ER17500V-2CY
Nominal voltage	: 3.7VDC
Rated capacity	: 2700mAh

● Contact our sales representatives for replacement battery.



14. GENERAL SPECIFICATIONS

14.1 Flowmeter Specifications

Table 14.1

Item	Description	
Meter Size	29	60
Process Connection	3 in. (80mm)	4 in. (100mm)
Flange Ratings	ASME 150 RF (standard) or JIS 10K RF (option)	
Face-to-Face Dimension (mm)	444 (ASME) or 440 (JIS)	532 (ASME and JIS)
Linearity	±0.35% (standard) or ±0.15% (option)	
Acceptable Liquids	Gasoline, kerosene, light oil, heavy oil (200mPa · s max.)	
Flow Range	See Table 14.2 (±0.35%) or Table 14.3 (±0.15%).	
Max. Operating Pressure	1.18MPa (12kgf/cm ²)	
Max. Operating Temperature	0 to 60°C (standard) or 0 to 120°C (option)	
Construction	Single case with basic magnetic coupling system "5"	
Material	Meter body: FC250, Rotors: FC250	
Meter Body Finish	Munsell 2.5G8/2	
Register	Electronic register	See Sec. 14.3 (on page 42).
Enclosure Protection Grade	IP66	
Nominal Meter Factor	198.62 mL/P	338.9 mL/P
Standard Strainer	SR081B031 (40-mesh)	SR101B031 (40-mesh)

14.2 Flow Ranges

Table 14.2 Flow Ranges with ±0.35% Linearity (accuracy ±0.5%) Units in m³/h

Meter size	Operating conditions	Above 0.3mPa · s to 0.8mPa · s	Above 0.8mPa · s to 2mPa · s	Above 2mPa · s to 5mPa · s	Above 5mPa · s to 200mPa · s
29	Continuous	10 to 50	8 to 50	6 to 70	4 to 70
	Intermittent	10 to 70	8 to 70	6 to 90	4 to 90
	Maximum	90	90	90	90
60	Continuous	20 to 85	15 to 85	8 to 120	5 to 120
	Intermittent	20 to 125	15 to 125	8 to 150	5 to 150
	Maximum	150	150	150	150

Table 14.3 Flow Ranges with $\pm 0.15\%$ Linearity (accuracy $\pm 0.2\%$) Units in m^3/h

Meter size	Temp. category	Operating conditions	Above 0.3mPa · s to 0.8mPa · s	Above 0.8mPa · s to 2mPa · s	Above 2mPa · s to 5mPa · s	Above 5mPa · s to 200mPa · s
29	Up to 6°C (std.)	Continuous	15 to 50	13 to 50	9 to 70	6 to 70
		Intermittent	15 to 70	13 to 70	9 to 90	6 to 90
		Max.	90	90	90	90
	Up to 12°C	Continuous	22 to 45	19 to 45	13 to 63	9 to 63
		Intermittent	22 to 63	19 to 63	13 to 81	9 to 81
		Max.	81	81	81	81
60	Up to 6°C (std.)	Continuous	30 to 85	25 to 85	12 to 120	8 to 120
		Intermittent	30 to 125	25 to 125	12 to 150	8 to 150
		Max.	150	150	150	150
	Up to 12°C	Continuous	45 to 76	37 to 76	18 to 100	12 to 100
		Intermittent	45 to 110	15 to 110	18 to 130	12 to 130
		Max.	130	130	130	130

14.5 Factored Pulse Width Selector

Table 14.5 Register Display Capacities and Output Pulses

(※): Optional

Meter size	Total counter capacity	Factored pulse		Selectable unfactored pulse width				Unfactored pulse	
		Pulse units	Freq.	1ms	50ms	100ms	250ms	Nom. meter factor	Freq.
29	99999.999×m ³	1L/P	25Hz	○	—	—	—	199.8mL/P	125.1H
	(※) 999999.99×m ³	10L/P	2.5Hz	○	○	○	—		
	(※) 9999999.9×m ³	100L/P	0.25Hz	○	○	○	○		
60	99999.999×m ³	1L/P	41.6Hz	○	—	—	—	338.9mL/P	106.5Hz
	(※) 999999.99×m ³	10L/P	4.16Hz	○	○	○	—		
	(※) 9999999.9×m ³	100L/P	0.41Hz	○	○	○	○		

14.6 Meter Errors and Pressure Losses

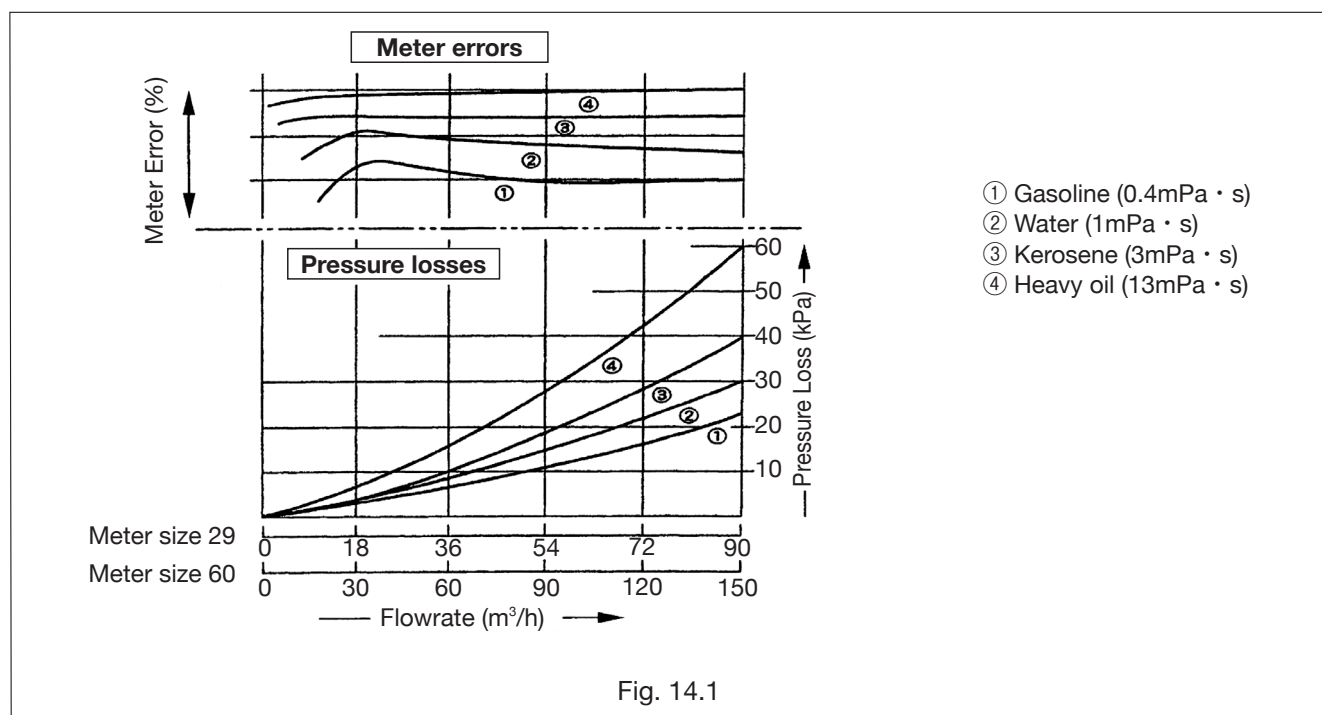
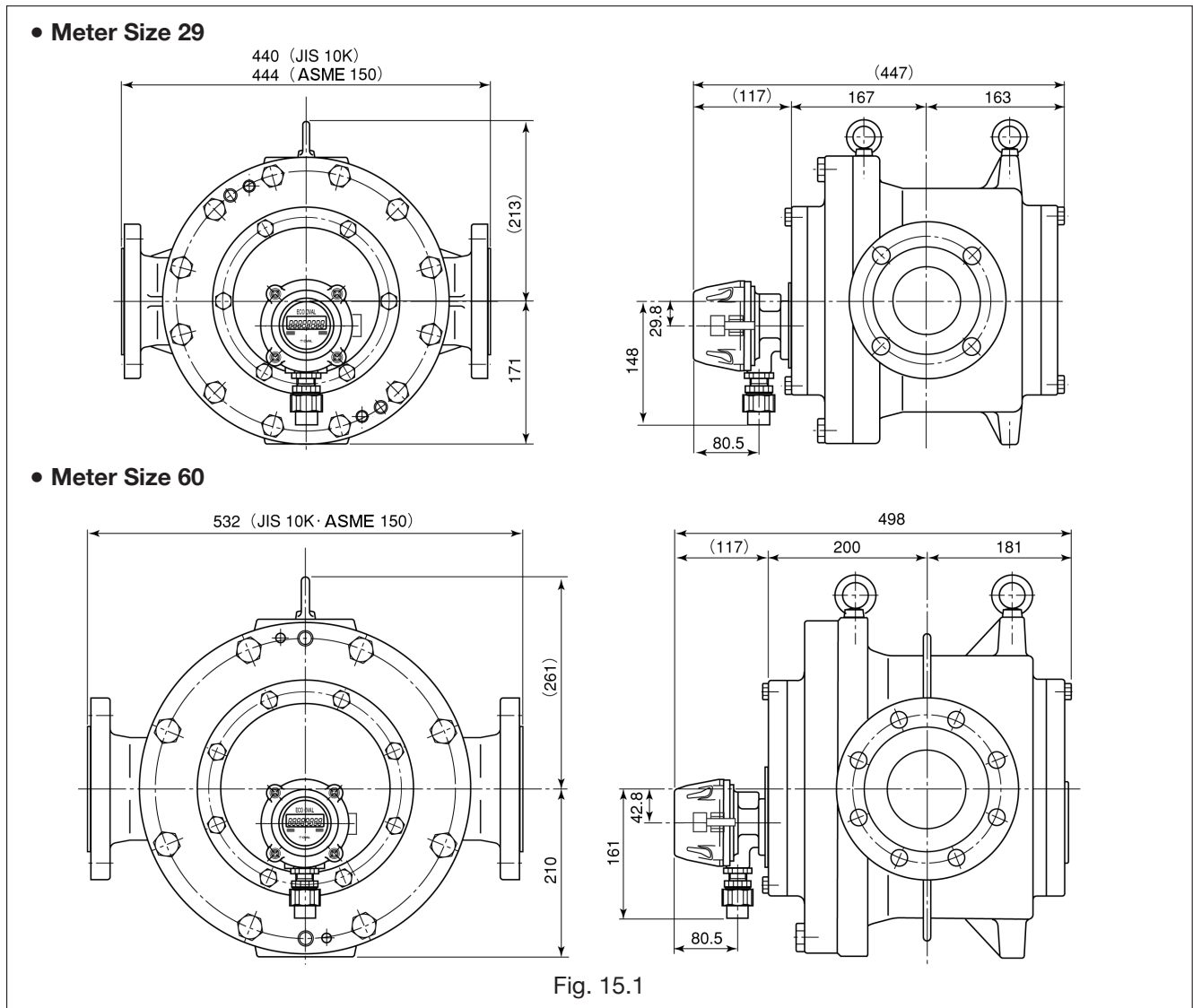


Fig. 14.1

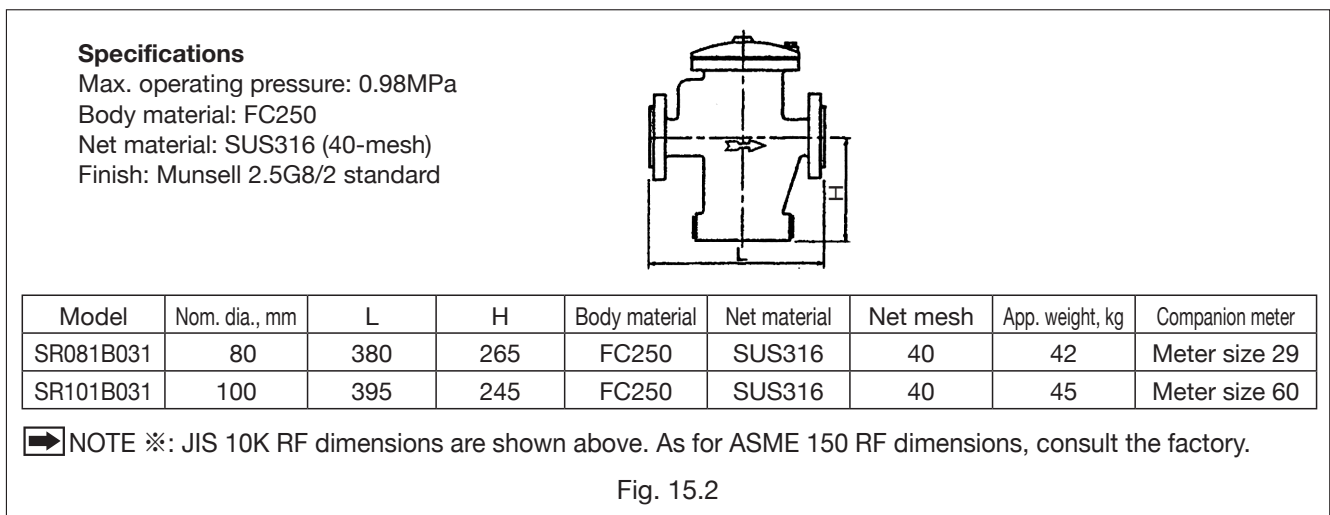
15. OUTLINE DIMENSIONS

15.1 ECO OVAL

Outline Dimensions



15.2 Standard Strainer



All specifications are subject to change without notice for improvement.

2025.07 Revised △
2008.05 Released
B-156-6-E (1)



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