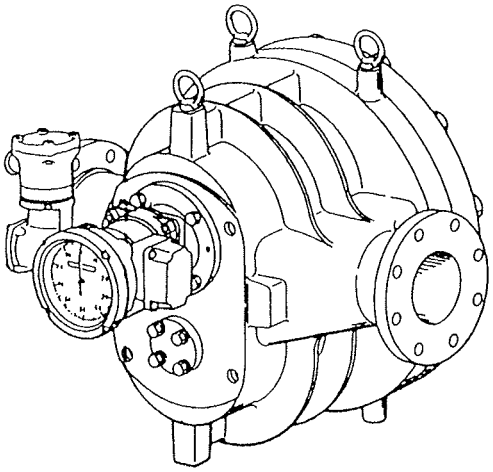
OVAL INSTRUCTIONS

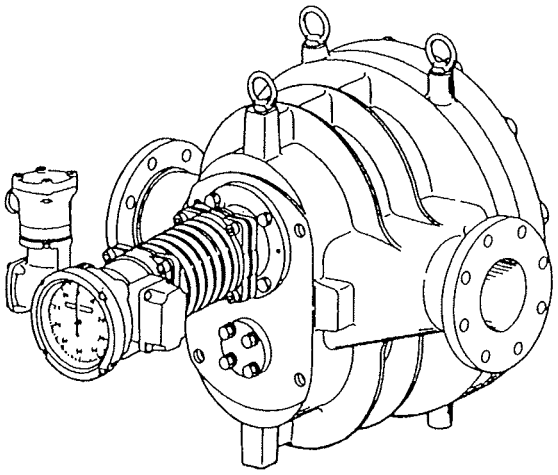
Ins. No. B-313-2-E

OVAL FLOWMETER SIZE 31

Standard, high temp.-, low temp.-service, and jacketed type Pocketless Construction



STANDARD MODEL



RADIATOR FINNED MODEL

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

The standard, high temperature-, low temperature-service, and jacketed type meters all have in common the same specifications described in this instruction manual except for some difference in the jacketed type on its piping procedure and operating precautions. Be careful to observe the instructions given with a reminder *"**See also ⚠ 4 for the jacketed type.**"*

■ Relevant Instruction Manuals

This instruction manual describes in most part the primary elements of OVAL flowmeter. For detailed information on related subassemblies, such as signal generators and registers, please refer to respective instruction manuals:

(1) Signal generators	Prefix T (e.g. T-519-5)	Instruction Manual
(2) Registers	Prefix R (e.g. R-401-3)	〃
(3) Preamplifiers (accuracy adjustors).	Prefix G (e.g. G-003-AG1)	〃
(4) Cooling tubes	Prefix A (e.g. G-901-8)	〃
(5) Air/liquid substitution operation..	G-011	〃

GENERAL

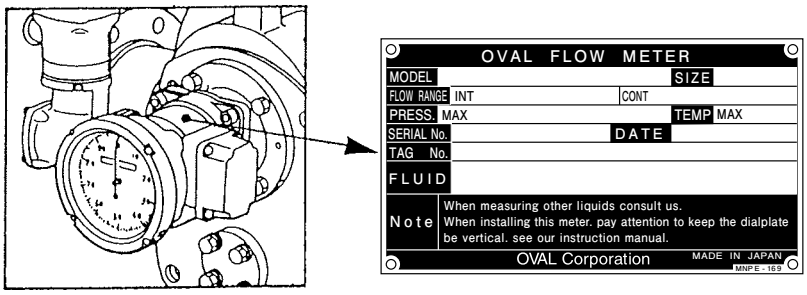
A proprietary magnetically-coupled arrangement incorporated in this meter permits picking up the turning effort of the rotors directly from outside the measuring chamber. With wetted parts count reduced to a minimum - only the rotors and their shafts, this meter has achieved a pocketless construction to eliminate standing liquids totally in any part of it.

Design Features

1. The measuring chamber organized to use the fewest possible wetted components minimizes servicing problems and simplifies disassembly, inspection and assembly routines.
2. All stainless steel measuring chamber is ideal for metering chemical and corrosive liquids.
3. Compatible with a wide choice of registers and pulse generators to meet varying individual needs.

OPERATING CONDITIONS

To fully enjoy the high accuracy and long durability of the meter, make sure that the flowrate, pressure, temperature, and viscosity are within the specified ratings as stamped on the meter nameplate.



■ INSTALLATION

1. Piping Instructions

1. Avoid pipe strains when installing the meter.
2. The meter must be installed on the discharge side of the pump.
3. In tank head operation, a head greater than the pressure loss of the meter should be given.
4. The flow direction must conform to the arrow indicated on the meter body.
5. The strainer should be located upstream of, and close to the meter.

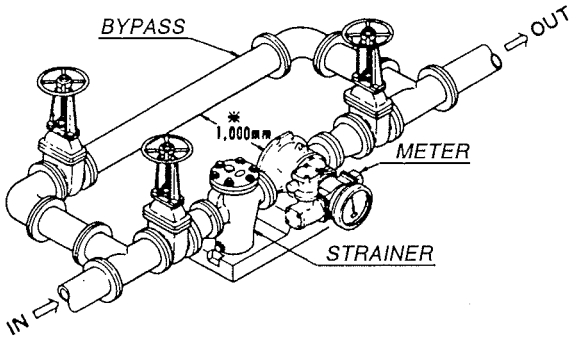
● **Illustrated below are typical examples of meter installation.**

2. Typical Examples of Installation

Standard Installation, Horizontal Line

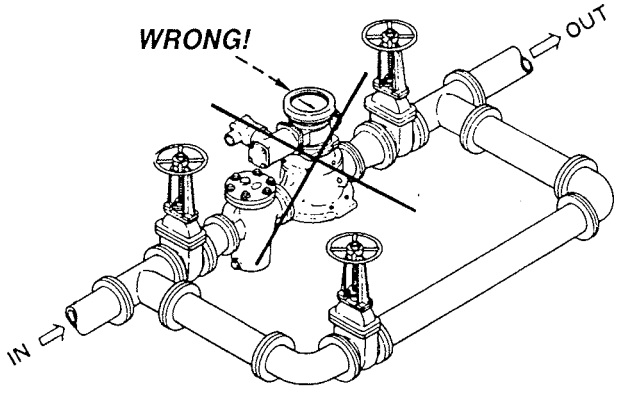
Marked ※ is the space required for disassembly and inspection.

◎ *In case flow direction is from R to L, change places of meter and strainer.*
◎ *Arrange piping so as to facilitate drainage.*
◎ *Strainer net should be inspected on a regular basis.*



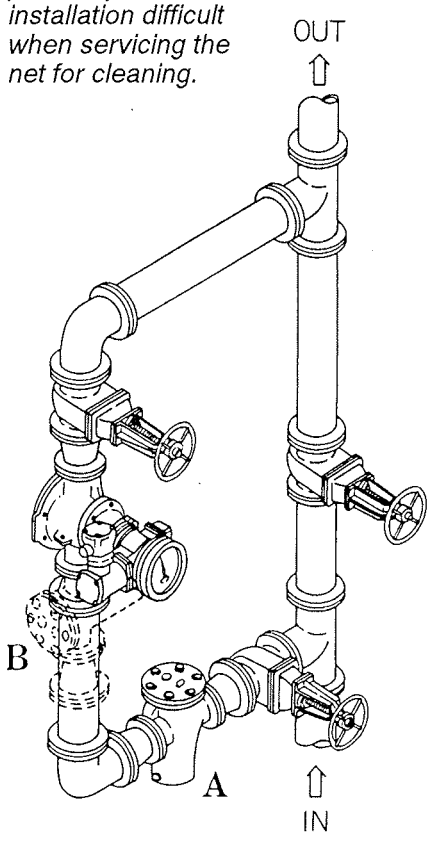
Example of Incorrect Installation

◎ *Do not install the meter in a position like this.*



Standard Installation, Vertical Line

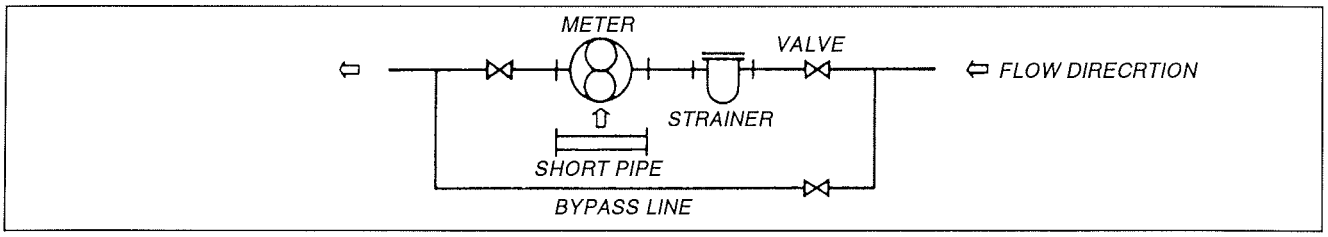
◎ *Install in the bypass line to prevent scales falling from top of the piping assembly.*
◎ *If the flow direction is from top to bottom, change places of meter and strainer.*
◎ *Strainer should be located at point A. For, if the strainer is located at point B, you would find net installation difficult when servicing the net for cleaning.*



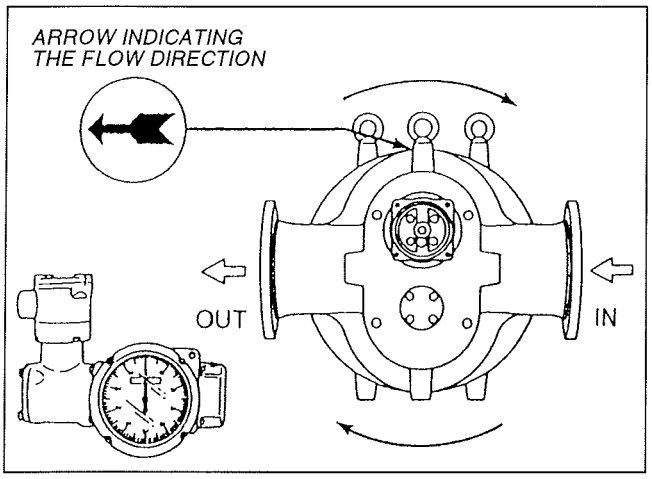
NOTE: As for outline dimensions and connecting pipe dimensions, refer to the approval drawing.

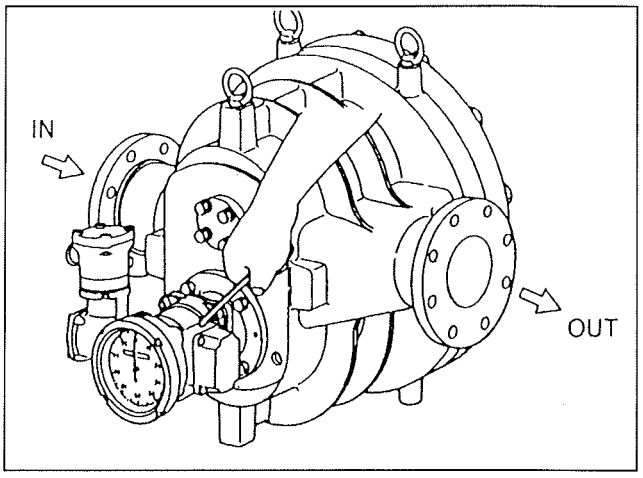
■ FLUSHING THE PIPING ASSEMBLY

Do not fail to remove the meter from the piping assembly and install a short pipe section in place of the meter. Costly damage to the meter could result if you attempt to flush away construction debris and other foreign matter with the meter installed.



■ HOW TO CHANGE METER FLOW DIRECTIONS





① Following flowmeter removal from the piping assembly, remove the register from the piping assembly. Adjust the arrow mark (⇨) indicating the flow direction to the new flow direction. To change flow directions from right-to-left to left-to-right, reverse the meter body by turning it round and then install it in the piping assembly again.

② Adjust the register face direction for correct viewability and secure the register to the meter housing with bolts. The same procedure applies to changing flow directions from right-to-left to top-to-bottom or bottom-to-top.

➡ **NOTE: If the flow direction is from right to left, the register assembly mounts above the centerline of the pipe line; when it is from left to right, the register assembly mounts below it.**

■ OPERATING INSTRUCTIONS

⚠ 1. Operating Considerations

1) Read well the information stated on the nameplate before commencing operation and make sure the operating conditions conform to the specification.

2) Carefully follow the valve operations sequence given below (refer to the piping diagram below):

   (1) Shut off valves (A) and (B).

   (2) Progressively open valve (C) to allow the fluid in the bypass line.

   (3) Slightly open valves (A) and (B). If necessary, slightly close valve (C). The flowrate at this point is correct if the register pointer moves slightly.

   (4) In applications where temperature exceeds 80°C, run the meter at least for 10 minutes in the conditions (3) to ensure uniform heat distribution in the measuring chamber.

   (5) Following the preheating period above, progressively close valve (C) in the bypass line and progressively open valves (A) and (B) until the rated flow is reached.

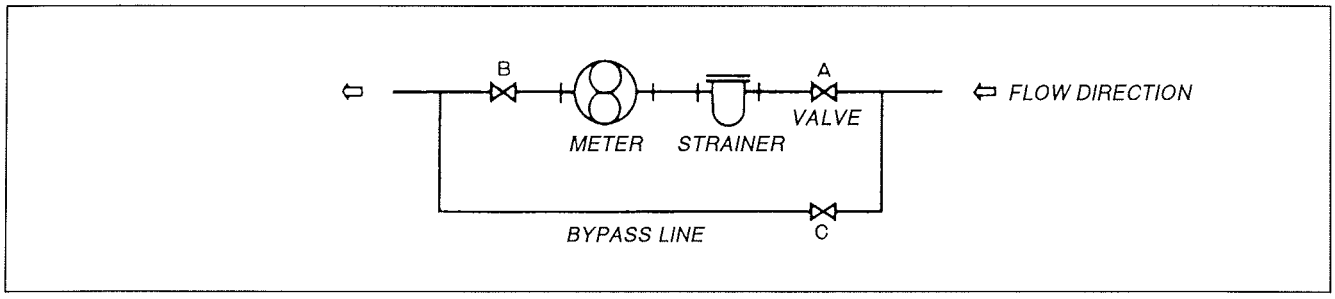
   (6) Flowrate should be regulated with valve (B) downstream of the meter and should be held within the rating.

3) The strainer net should be inspected for condition and cleaned on a regular basis. On a new installation, in particular, inspect daily first and, according to the clogged condition of the net being observed, inspection intervals may be reduced progressively to, say, once in two or three days.

How to Measure the Flowrate

When the total counter is used, the flowrate is determined by the formula below, using a stopwatch:

$$\text{Flowrate } Q \text{ (L/h)} = \frac{3600 \times \text{Volume by one pointer rev. = 100 liters or 1000 liters}}{\text{Time required for one pointer revolution (sec)}}$$

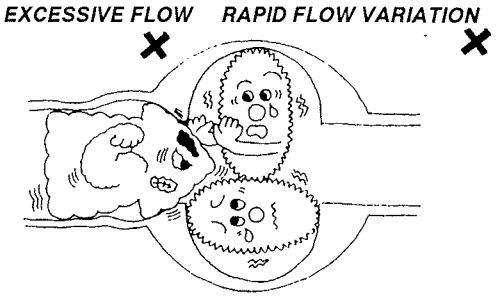


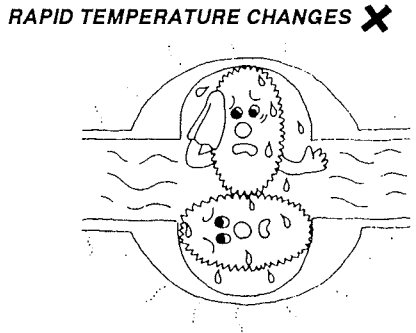
⚠ 2. Operating Precautions

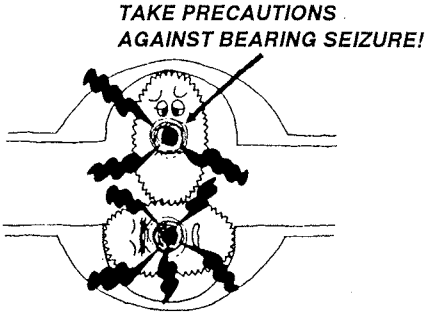
(1) **When changing flowrates**

In applications where the flowrate varies or where shutoff valve opening and closure takes place in batch operation, avoid rapid changes in flowrate across the meter.

As a rule of thumb, one second per 25 millimeters (1") in connecting pipe diameter is acceptable as the permissible changes in flowrate.
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 seizure of bearings or the rotor-to-measuring chamber contact.







(2) **Where the temperature of metered fluid changes**

Avoid rapid temperature changes in the meter. Temperature changes of the fluid in the meter should be held within 3 °C per minute (except for Model LUT).

Extra care should be used particularly when making a flow measurement in batch operation without the provision of heat tracing of the piping where the fluid temperature differs from atmospheric temperature.

If rapid temperature changes are anticipated, heat trace the piping assembly as well as the meter.

(3) **Liquids of low steam pressure**

Temperature and pressure of LPG, polyvinyl chloride monomers or anything with low viscosity and low steam pressure that are too ready to vaporize should strictly be controlled.

During operation, the temperature of bearings in the meter is usually higher than that of the metered fluid. Vapors around the bearings can be causes of faulty conditions, including generation of unusual noise and bearing seizure.

(4) **Corrosive liquids**

When you make a measurement of highly corrosive liquids, such as nitric acid and sulfuric acid, appropriate materials should be used for tanks and piping assembly. Heterogeneous materials originally contained in the metered fluid or corrosive substances liquated out from tanks and pipes of inappropriate materials may lead to costly downtime, as a result of locked rotors, for example, when they are allowed into the measuring chamber.

⚠ 3. Precautions at Operation Shutdown

"See also ⚠ 4 for the jacketed type."

(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 and a pressure buildup relative to a rise in atmospheric temperature could lead to an unexpected damage to the meter.

(3) Liquids ready to adhere or gel at zero flow velocity
Liquids that tend to adhere and solidify or gel at flow velocities around zero must thoroughly be washed away from the meter interior with running cleaning fluid before shutdown. Negligence of this instruction may leave the meter as an immovable unit when the operator attempts to resume meter operation the next time.

⚠ 4. Piping Instructions and Operating Precautions of Jacketed Meters

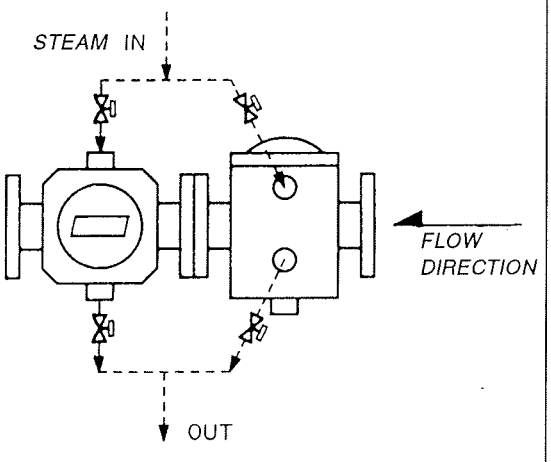
Hot water or steam jacketed meters require piping work in the following matter:

(1) Piping to the meter body remains the same as that of standard meters (meters not jacketed).

(2) Adhere to the following instructions for the piping to the jacket:

Steam Jacketed

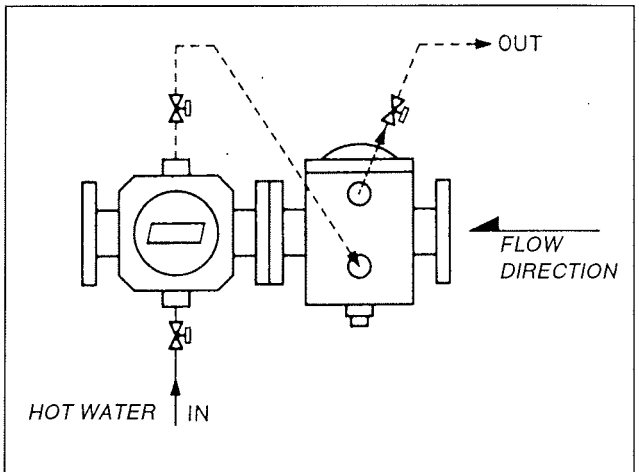
Basically, the piping should be so arranged that steam flows from the top and leaves from the bottom. Provide steam traps at outlet ports (see figure below).



Steam Jacketed Type, Horizontal Run

Hot-water Jacketed

Basically, the piping should be so arranged that hot water flows from the bottom and leaves from the top (see figure below).



Hot Water Jacketed Type, Horizontal Run

(3) The measuring chamber is heat treated, but sharp changes in temperature should be avoided, taking into consideration the resultant pipe strain, as well as the expansion and contraction of the piping assembly. Good practice is to heat the components involved at least four hours before initiating service operation.
(4) As for outline dimensions and connecting pipe dimensions, refer to the approval drawing.
(5) If lagging work is desired, ease of maintenance must be kept in mind. If covering with lagging material is the case, ensure that it is free of process fluid leaks.
(6) Provide lagging over the strainer such that its top cover can simply and readily be removed. It is necessary that the strainer net be serviced periodically for cleaning.
(7) Never provide any lagging over radiator fins. Negligence of this precaution would result in excessive heat buildup in the register and pulse generator, possibly leading to a costly downtime.

NOTE: As for outline dimensions and connecting pipe dimensions, refer to the approval drawing.

■ MAINTENANCE (Simple Troubleshooting)

◎ **Although it depends on individual operating conditions, periodic disassembly and inspection should be performed at least once a year.**

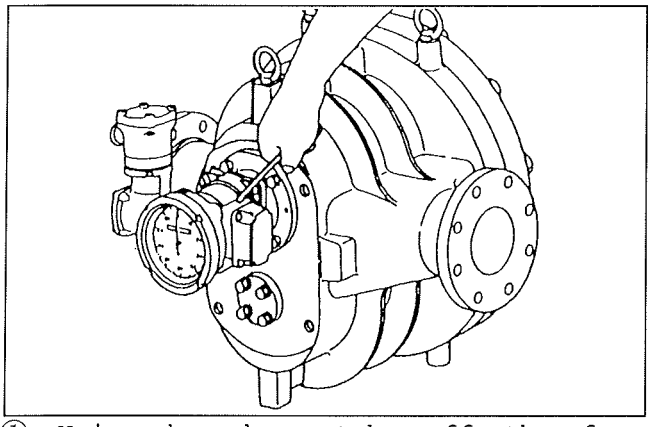
SYMPTOM	*TREATMENT*
Process fluid suddenly fails to flow.	*Disassemble the meter body (measuring assembly).*
With the register integral with the cooling tube removed, the internal transmission gear train fails to turn in response to process fluid flow.	*Disassemble the magnetic coupling (following magnet) assembly.*
The input gear in the transmission gear box (cooling tube) will not turn or is hard to rotate by hand.	*Inspect the register assembly and transmission gear box.*
The input gear does turn but the pointer and total counter drums fail to advance.	

■ DISASSEMBLY AND INSPECTION

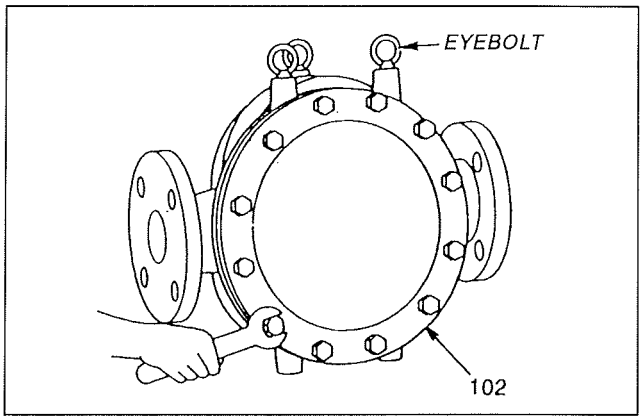
◎ Although service intervals may vary with the given operating conditions, it is suggested that the meter be disassembled and inspected regularly - once a year in normal use.

⚠ **IMPORTANT: Be sure to follow the procedure given here, referring to the exploded view on page 14.**

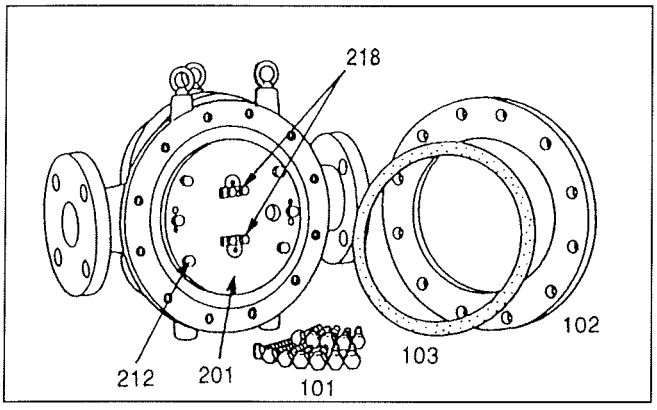
1. Oval Rotor Inspection



① Using hex key, take off the four bolts securing the transmission gear box (or cooling tube) and, holding the transmission gear box (or cooling tube) in both hands, carefully draw it out horizontally.

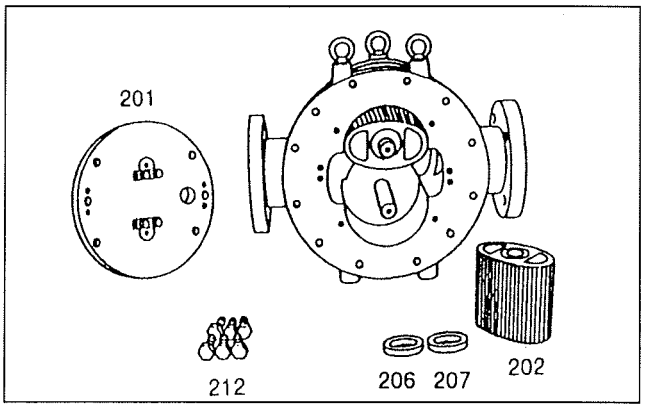


② Take off a total of twelve hex bolts (105) holding the rear cover (102) and remove the the rear cover. To do this, Screw eyebolts into screw hole in the rear cover and draw the cover horizontally. Pay attention to the possibility of a seized gasket. Residual process fluid may run from the measuring chamber. Receive it with a suitable receptacle.



③ Take off four screws (219) and remove non-turn strips (218) of the shafts.

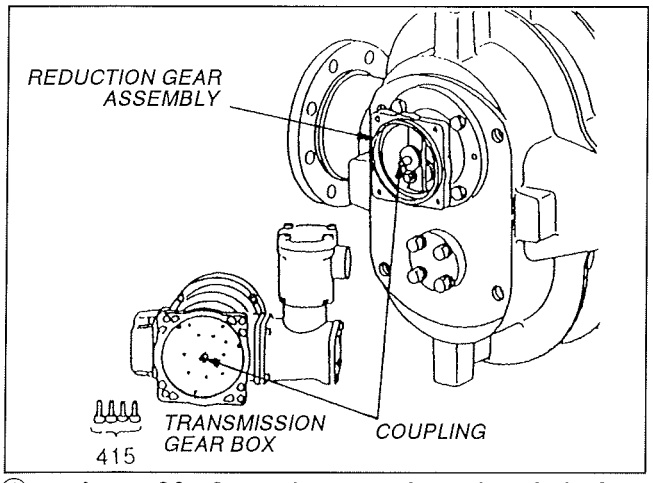
④ Remove the top cover (201): Take off six hex bolts (212) with hex wrench and Screw two of the bolts which have just been removed into two threaded holes in the top cove (201). Then, holding these bolts, separate the cover horizontally. If it is hard separate, try again while lightly tapping its flanged area with plastic mallet.



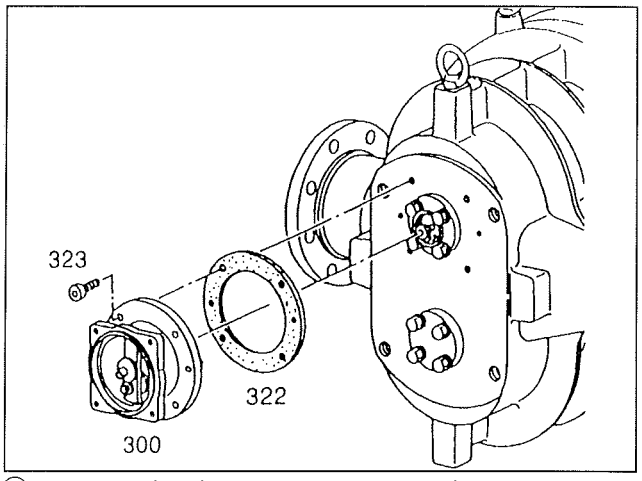
⑤ Remove Oval rotors and remove scales adhering to the inner wall of measuring changer. Use care not to damage thrust rings A and B (206, 207). It is good practice to put identification marks for correct installation. Thrust ring A (206) is larger than thrust ring B (207) in inside diameter. It is installed on the register side of the 1st rotor.

2. Reduction Gear Assembly, Following Magnet Assembly Inspection and Keystoned Ring Replacement

Inspecting the Reduction Gear Assembly

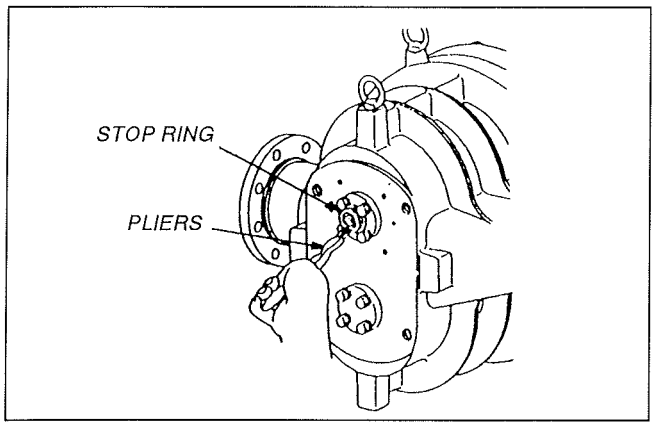


① Take off four hex socket head bolts (415) with hex key and inspect the reduction gear assembly.

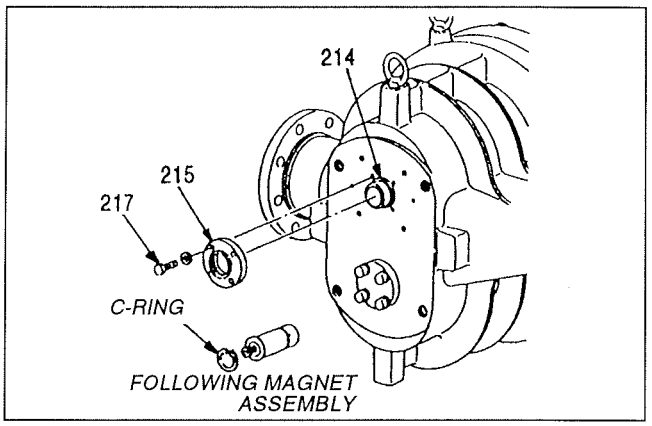


② Transmission gears are in mesh. Be careful not to damage them when you extract the assembly.

Inspecting the Magnetic Coupling (following magnet assembly)



① Remove the stop ring (C-ring) securing the following magnet holder in place, using stop ring pliers.



② By pulling the transmission gear by hand, draw the following magnet assembly out and inspect.

Keystoned Ring Replacement

If the process fluid leak persists through the keystoned ring (214), take off fitting bolts (217), remove the blind cover (215) and replace the keystoned ring.

⚠ **IMPORTANT: The keystoned rings used to seal off liquid leaks are made of Teflon and are no longer serviceable once they are disassembled. Replace with new ones without fail.**

⚠ **IMPORTANT**

(1) Score marks, scratches, high spots due to impressions, or other flaws should be reconditioned flat with oil stone or other tool.

(2) If the areas which have been in contact with rear cover forcing bolts are distorted outwardly, recondition it flat with oil stone.

⚠ **IMPORTANT:** Because the OVAL flowmeter 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, an important precaution to remember is to reduce the internal pressure of the piping assembly 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 the meter. Also exercise care to keep individual members disassembled free from grit and dust.

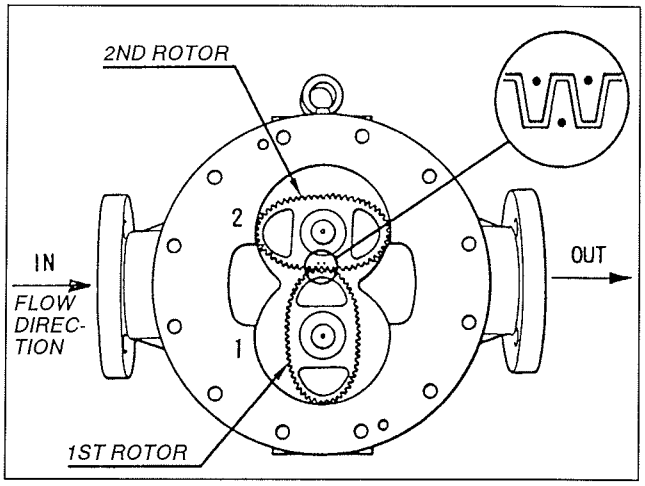
3. ASSEMBLY

The rotor installation procedure is reverse of the removal procedure. But careful attention must be paid to the following instructions:

Install the rotors with their match marks correctly aligned as shown in the inset of the figure at right. Installing the 1st and 2nd rotors the wrong way will result in dead register pointer.

① if the flow direction is from left to right as shown in the figure at right, the 1st rotor installs below the 2nd.

② If the flow direction is otherwise (from right to left), the 1st rotor installs above the 2nd.



⚠ **NOTE: In these cases, the flow direction is as viewed from the register side.**

⚠ PRECAUTIONS AT ASSEMBLY

The assembly procedure is reverse of the removal procedure, but observe the following precautions:

① Be careful not to install the 1st rotor and the 2nd rotor the wrong way.

② Do not install the two thrust rings the wrong way.

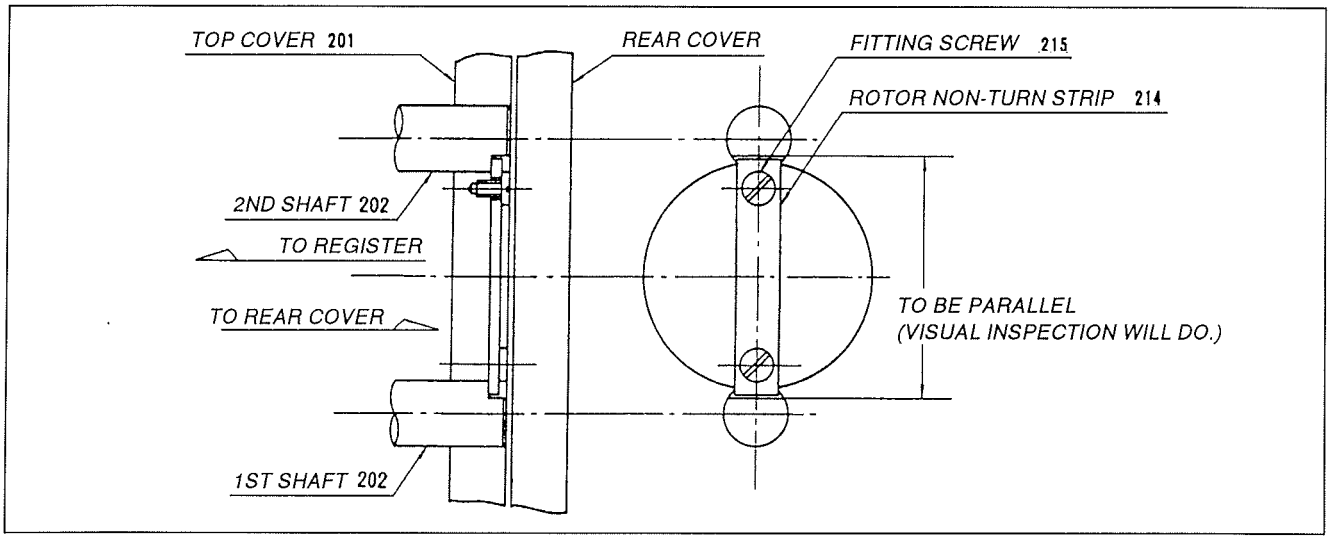
③ At installation of the assembly, use extra care not to distort shafts and other members as it involves a number of gear engagements and couplings.

④ At installation of non-turn strips, install them in close contact with notches in the rotor shafts and then tighten screws.

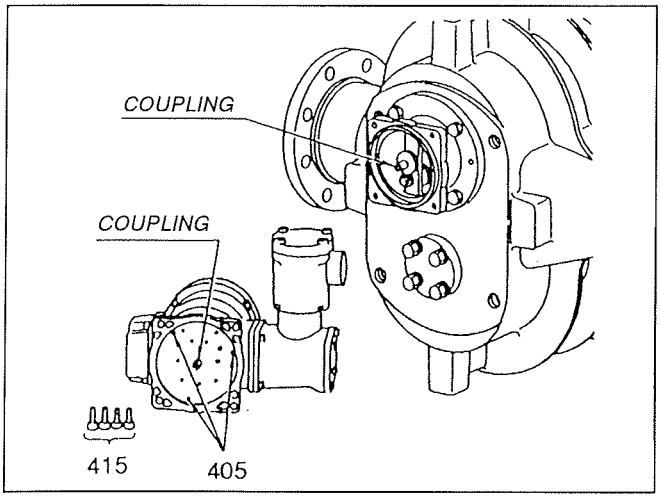
⚠ **PRECAUTIONS AT ROTOR SHAFT INSTALLATION**

① This flowmeter is designed to hold the rotor shafts with non-turn strips on the rear cover side as shown below. At assembly, therefore, ensure parallel shaft installation with respect to shaft notches (visual inspection will do).

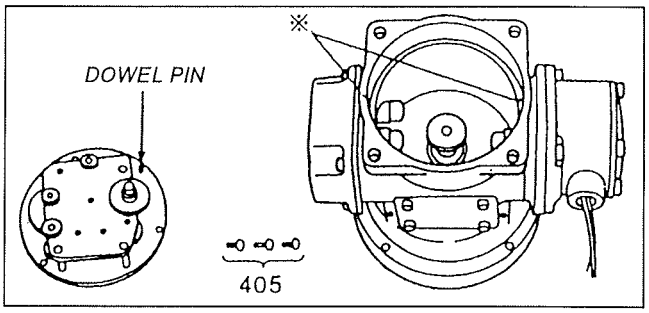
② If keystoned ring replacement is involved, force the rotor shafts (202) against the register side while installing the blind cover (212) (see figure below).



4. TRANSMISSION GEAR BOX DISASSEMBLY, INSPECTION, ASSEMBLY



① Using hex key, take off four bolts (315) securing the transmission gear box and, holding the transmission gear box complete with the register in both hand, carefully remove the transmission gear assembly or cooling tube (see ② in "HOW TO CHANGE FLOW DIRECTIONS"). Then, by turning the coupling (310) by hand, make sure of freely pointer rotation.



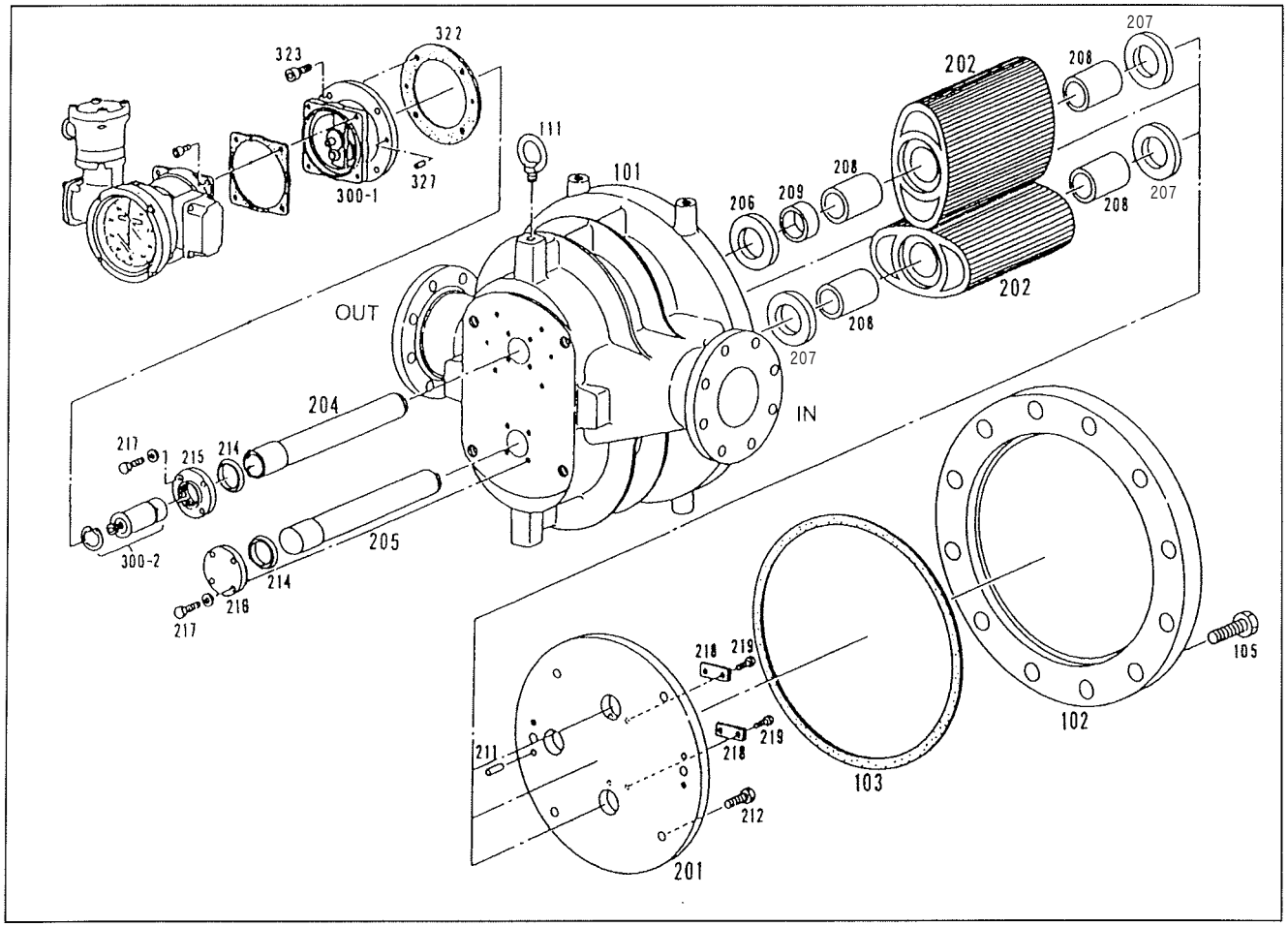
② Take off three setscrews (405) securing the transmission gear train and, holding the coupling (310) by hand, draw out the transmission gear train (408) from the transmission gear box. Inspect the assembly for condition.

◆ At assembly, align the locating dowel pin (marked ※) with its slot first.

■ EXPLODED VIEWS AND PARTS LISTS

● When ordering replacement parts, specify the meter model No., product No. (confirm by nameplate), instruction manual No., symbol No., part name and the quantity of parts desired.

⚠ **NOTE: If the flow direction is from right to left as viewed from the register side,the first rotor installs above the second.**



■ PARTS LIST

⟨Meter Body⟩

Sym. No.	Part Name	Q'ty	Remarks
101	Meter Body	1	
102	Rear Cover	1	
▲103	Rear Cover Gasket	1	φ 420 × φ 384 × 3t
105	Rear Cover Hex Bolt	32	10K Type M20 × 85 20K Type M24 × 95
111	Eyebolt	3	M16 × 27

⟨Magnetic Coupling Assembly⟩

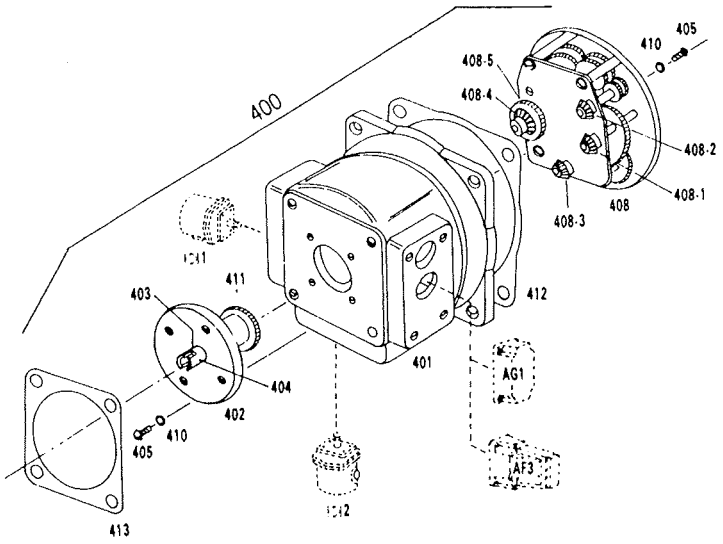
Sym. No.	Part Name	Q'ty	Remarks
300	Magnetic Coupling	1	
300-1	Reduction Gear Train	1	
300-2	Following Magnet Ass'y	1	
322	Gasket	1	Included in 300-1
323	Hex Bolt	4	Included in 300-1
327	Retaining Pin	1	Included in 300-1

▲ : Recommended replacement parts

⟨Inner Case Assembly⟩

Sym. No.	Part Name	Q'ty	Remarks
201	Top Cover	1	
202	Rotor	2	
204	1st Rotor Shaft	1	
205	2nd Rotor Shaft	1	
▲206	Thrust Ring A	1	
▲207	Thrust Ring B	3	
▲208	Rotor Bearing	4	
209	Drive Magnet	1	
210	Drive Magnet Retainer	1	
211	Locating Pin	2	
212	Top Cover Fitting Bolt	6	M12 × 35
▲214	Keystoned Ring	4	
215	Blind Cover A	1	
216	Blind Cover B	1	
217	Blind Cover Hex Bolt	8	M10 × 35
218	Shaft Non-turn Strip	2	
219	Non-turn Strip Hex Bolt	4	M8 × 12

EXPLODED VIEW OF TRANSMISSION GEAR BOX AND PARTS LIST



SYM. NO.	PART NAME	Q'TY
400	Transmission Gear Box	1 set
401	Housing, Transmission Gear Box	1
402	Bearing Retainer	1
403	Output Shaft	1
404	Coupling	1
405	Plate Holder Setscrew	7
※408	Transmission Gear Train	1 set
408-1	AG1 Input Bevel Gear	1
408-2	AG1 Output Bevel Gear	1
408-3	⊠2 Input Bevel Gear	1
408-4	⊠1 Input Bevel Gear	1
408-5	Output Gear	1
410	Washer	7
411	Gear, Output Shaft	1
412	Gasket A	1
413	Gasket B	1

※ *Varies with individual specifications. State the figures stamped on the plate at the rear when you order replacement.*

⊠ *1: Pulse generator of an engineering unit system provided (for remote total counter)*
⊠ *2: Pulse generator of nonengineering unit system provided (for remote indicator)*
AG 1: Accuracy adjustor gear unit (No. G 003 AG-1)
AF 3: Continuous accuracy adjustor unit (No. G 003 F3-1)

For details of the subassemblies above, see respective instruction manuals.

ABOUT LUBRICATION

● **Do not fail to use proper lubricants, or equivalent, shown below at disassembly and inspection.**

Lubrication Point	Fluid Temperature	Gears		Bearings		Couplings
		Plain	Bevel	Plain	Ball	
Following Magnet Assembly	−10 to +120°C	G2			L3	G2
	+120 to +260°C	G2		☆		
Transmission Gear Box	−10 to +120°C	L3	G2	L3	L3	

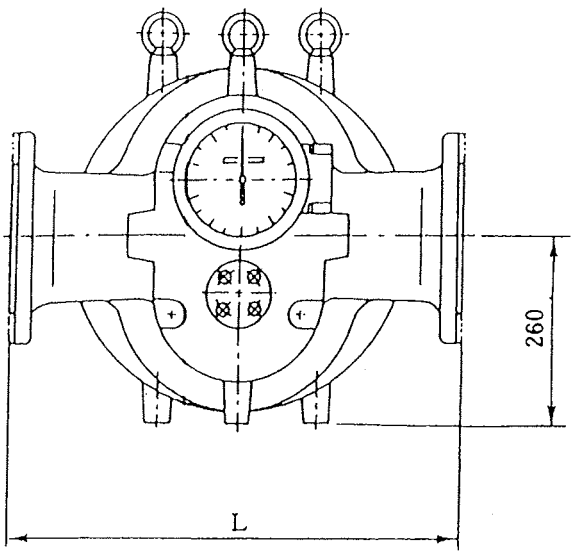
● *Lubrication Oil Specifications and Examples of Products*

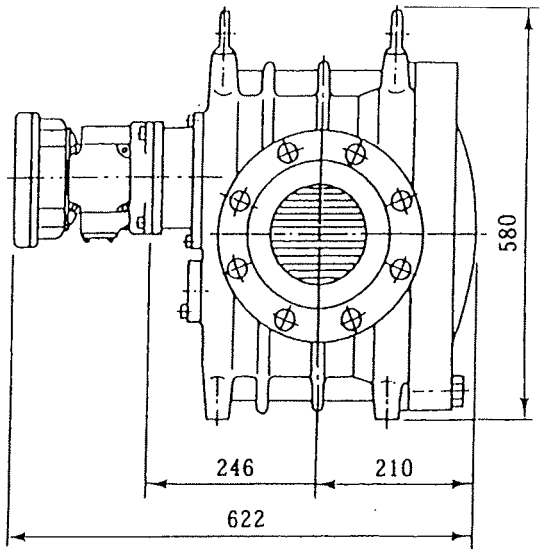
Symbol	Viscosity or Consistency	Pour Point or Drop Point	Example of Products by Trade Name
L3	36.4 cst/30°C	− 37.5°C	Nisseki Launa 40 (JX Nippon Oil & Energy Trading Corp.)
G2	300/25°C	300°C −	Moly Hi-temp Grease No.1 (Sumico Lubricant Co., Ltd.)

L: Lubricating oil G: Grease ☆: Do not lubricate plain bearings.

■ OUTLINE DIMENSIONS

- For outline dimensions and pipe connection dimensions, refer to the approval drawing.





● *FACE-TO-FACE DIMENSIONS (L)*

DIMENSIONS IN MILLIMETERS

NOMINAL DIA. mm	*METER BODY MATERIAL* / *FLANGE RATING*	C 1	C 2
100 (4″)	JIS 5K · FF	636	—
	JIS10K · RF	640	—
	JIS20K · RF	—	652
	ASME 150 · RF	652	652
150 (6″)	JIS 5K · FF	632	—
	JIS10K · RF	640	—
	JIS20K · RF	—	652
	ASME 150 · RF	647	647

2019.07 Revised
2019.02 Revised △
1996.12. Released
B-313-2-E (2)