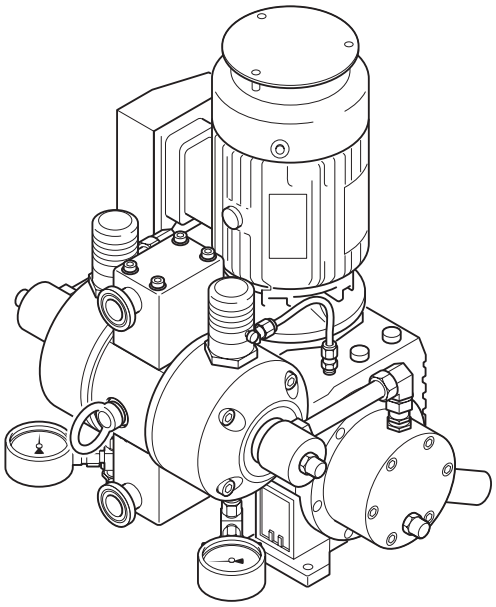
TACMINA

Smooth flow Pump

TPL Series

OPERATION MANUAL

Please read this OPERATION MANUAL carefully before use.
Operating the pump incorrectly in disregard of these instructions may lead to death, injury and/or cause property damage.



The illustration shows TPL □ ME.

Models in the series

TPL1ME(N)-008/014/
018/028
TPL2ME(N)-028/032/
040/056/
080/095
TPL1MWE(N)-008/014/
018/028
TPL2MWE(N)-028/032/
040/056/

- TACMINA accepts no liability whatsoever for any damage caused by malfunction of this product and other damage caused by use of this product.
- For details on using the inverter and other components, refer to the respective manuals.
- In this manual, the explanations of motors are based on TACMINA-standard motors. If you have selected a motor that is not a standard product or if you have purchased the pump and motor separately, refer to the operation manual of the motor being used. Also check whether the motor has the appropriate explosion-proof specifications.
- If the pump you bought conforms to special specifications not described in this manual, use the pump according to the details of the separate meetings, drawings, and approval documents.
- Additional information on this product and manuals in other languages may be found on our website.

To ensure safety

In order to ensure that the pump is operated safely, the important points to be understood and heeded by the user have been categorized as shown below in this instruction manual. This is important safety-related information and, as such, all instructions given must be followed without exception.

⚠ WARNING

• Wherever this appears in the manual, it indicates that death or serious injury may result if the action accompanied by this display is ignored and operation is performed improperly.

⚠ CAUTION

• Wherever this appears in the manual, it indicates that injury and/or property damage may result if the action accompanied by this display is ignored and operation is performed improperly.

NOTICE

• Wherever this appears in the manual, it indicates an action that must be taken without fail if the performance and service life of the pump or its constituent parts are to be maintained.

REMARKS

• This indicates additional instructions.

Operating conditions

⚠ WARNING

• When the pump is to be used in explosion-proof areas or in locations with an explosive or inflammable atmosphere, specify a special-purpose motor and inverter.

⚠ CAUTION

• This pump's specifications dictate that the pump be used indoors.
• Use this pump solely to transfer solutions: Do not use it for any other purpose. Otherwise, trouble and/or malfunctions may result.
• Do not use this pump outside the range of its specifications. Doing so may give rise to electric shocks and/or malfunctioning.
• Do not use the pump outside the operating ranges below. Doing so may cause malfunctions.

	TPL□ME	TPL□MWE
Ambient temperature/humidity	15 to 30 °C*1 / 35 to 85% RH	
Temperature of liquids used	15 to 60 °C	0 to 80 °C
Viscosity of liquids used	Max. 20 mPa·s/Max. 1000 mPa·s *2	
Slurry liquids	1μm max. particle diameter (at concentrations of 10wt% or less)	

*1: During transportation and storage, the ambient temperature must be within the range of -10 to + 50 °C, and the pump must not be subjected to impact.
*2: For high-viscosity specifications

Transport, Installation, and Piping

⚠ WARNING

• Use a dedicated motor in explosion-proof areas or in explosive or combustible atmospheres.
• In explosion-proof areas or in explosive or combustible atmospheres, work such as pump transportation, installation, piping, and wiring must be carried out by individuals who have knowledge of explosion-proof structures, the construction of electrical equipment, the related laws and regulations, and the principles and functions of the pump as well as the technical skills related to handling the pump. Failure to heed this warning may result in explosions, ignition, electric shocks, or injury.
• Install the pump in a location that cannot be accessed by anyone but control personnel.
• Do not stand or move under a hoisted pump. The pump might fall, causing an accident.

⚠ CAUTION

• Take preventative measures such as a chemical drainage ditch that is capable of handling the flow of the transfer liquid. Implement the measures so that the fluid level does not rise up to the surface where the pump is installed.
• Do not subject the pump to strong impacts.
• Keep the product level while transporting it. If the product is tilted by 10° or more, it may fall over.
• If this pump has been dropped or damaged, consult your vendor or a TACMINA representative. Using a dropped or damaged pump may result in accidents and/or malfunctions.

- The installation work must be carried out by individuals who have received the required training and appropriate protective gear (e.g. helmet, gloves) must be worn.
- Do not install the pump in humid or dusty locations. Otherwise there is a risk of electric shock or malfunction.
- When a tightening valve is located on the discharge-side piping, and when there is a risk of blockage, be sure to install a relief valve on the piping immediately on the discharge side of this pump.
- If there is a chance of the fluid solidifying or freezing due to reasons such as using water-diluted solutions in areas where the temperature is low, install a heating apparatus or heat insulation. The fluid solidifying or freezing may lead to damage to the pump or surrounding equipment.
- If the diaphragm is damaged, operating oil (buffer solution for TPL □ MWE) may be mixed in the line. Install equipment for detecting damage as necessary.
- The water used for the shipment tests may remain in the liquid-end section of the pump. If the pump will transfer chemicals that harden or give off gas when they react with water, be absolutely sure to drain the water and dry off the liquid-end section prior to use.
- The discharge volume cannot be adjusted by operating valves on the discharge piping.
- The pump head is not designed to support the piping. Ensure that the pump and pipe joints will not be subjected to any excessive force that might be exerted by, for instance, the weight of the piping or the shifting of the pipe joints out of position. In particular, pulsation will occur at the suction side, so provide sufficient support to ensure that the piping does not shake.

Electrical wiring

⚠ WARNING

- If the pump is installed in a location where there is a risk of an explosive atmosphere of gas or steam (further referred to as a hazardous location), use an explosion-proof motor that is tailored to the hazardous location where the pump will be installed. If an explosion-proof motor is not used, there is a risk of explosion or ignition.
- The electrical wiring must be undertaken by a qualified electrician or other individual with the requisite electrical knowledge. Electrical work for preventing explosions must be performed for the wiring work as well. This work must be undertaken by a specialist who has the knowledge and skills relating to explosion-proof products in compliance with the technical standards governing electrical equipment, interior wiring regulations, guidelines for preventing explosions in facilities. Failure to heed this warning may result in explosions, ignition and/or electric shocks.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- Securely ground the protective earth terminal, and be absolutely sure to install an earth leakage breaker. Otherwise, you may receive electric shocks.
- Use cables with a thickness that conforms to the rated current of the motor for the electrical wiring and the earth wire.
- To prevent water from entering the terminal box, implement waterproofing by way of cable glands or other similar methods.

⚠ CAUTION

- Connect the wires after checking the supply voltage. Do not connect the wires to a power supply that is not within the rated voltage range.
- Check the motor's voltage, phases, and power supply before wiring, and then correctly wire it. If the wiring is incorrectly wired, there is a risk of malfunction.
- The rotation direction for the motor has been predetermined for this pump. Wire the motor so that it rotates in the predetermined rotation direction.

Operation and maintenance

⚠ WARNING

- Install the pump in a location that cannot be accessed by anyone but control personnel.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.
- When there is a problem (such as when smoke appears or there is a burning smell), shut down the pump immediately, and contact your vendor or a TACMINA representative. Otherwise, there is a risk of fire, electric shock, malfunction, or accident.
- Check if the valves are open before operating the pump. If you have forgotten to open a valve or foreign objects are blocking the piping on the discharge side of the pump, an excessive pressure rise that will exceed the pump's specification ranges may occur, liquid may spray out, or piping may be damaged, which is dangerous.
- During air release, chemicals spray forcefully from the tip of the piping. Return the tip of the air release piping to the tank. During this operation, secure the air release hose in position.
- When working on the liquid-end section of the pump, wear protective gear suited to the chemical concerned (such as rubber gloves, a mask, protective goggles and work overalls that are resistant to chemical).
- Before maintaining or repairing the pump, be sure to release the discharge-side pressure, drain the chemicals from the liquid-end section, and wash the pump with deionized water.

⚠ CAUTION

- **The sound pressure level may exceed 80 dB. When performing work near the pump while it is operating, wear protective gear to protect your ears.**
- **Vibrations occur during operation. If the pump stays in contact with your body for a long period of time, numbness or other symptoms may occur. Always wear protective gear.**
- **Set the relief valve pressure to a value that is 120% or less of the pump's normal operation pressure.**
- **Gear oil may spray out when you open the oil filling hole. Wait for the drive box to cool off sufficiently before you perform this work.**
- **Replace the gear oil every 4,000 hours (operation time) or 1 year (usage period), whichever is reached first.**
- **Do not mix different brands of gear oil.**

Other precautions

⚠ CAUTION

- **Do not modify or alter the pump.**
- **The materials of the parts used in this pump are written in the provided diagrams and similar documents. When it comes time to dispose of the pump, do so after first giving careful consideration to the appropriate disposal method for each material according to the laws and regulations in the area where the pump will be disposed of. Alternatively, contract the disposal of the pump to a dedicated waste disposal company.**
- **When disassembling the pump for disposal, always wear appropriate protective gear (e.g. gloves, goggles).**

Checking out the pump

Upon delivery of the pump, check out the following points.

(1) Is the pump the one that was ordered?

(2) Do the details on the pump nameplate match what was ordered?

(3) Are all the accessories present and accounted for?

Check the accessories against the list of accessories below.

(4) Was the pump damaged due to vibration or impact while it was in transit?

(5) Have any of the pump's screws come loose or come out?

Tacmina ships its pumps with painstaking care. However, if you find something wrong, contact your vendor or a Tacmina service representative.

■TPL1ME·TPL1MWE accessory parts list

Part	Quantity
Operation manual	1 copy
Operation manual and accessories *1 for motor control device	1 set
Syringe *2	1 pc
Air release tube set *2	1 set
Diaphragm installation jig (Small)	1 pc

*1: These are not provided when the motor control device is procured separately.

*2: TPL1ME·TPL1MWE-008/014 only.

■TPL2ME·TPL2MWE accessory parts list

Part	Quantity
Operation manual	1 copy
Operation manual and accessories *1 for motor control device	1 set
Retaining ring clamping jig *2	1 pc
Diaphragm installation jig (Large) *3	1 pc

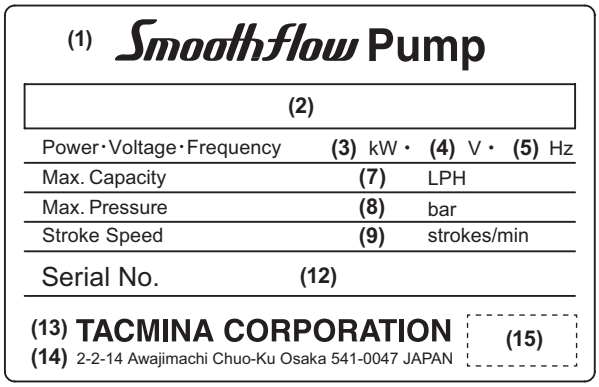
*1: These are not provided when the motor control device is procured separately.

*2: This is provided only when the high-viscosity specifications are applicable.

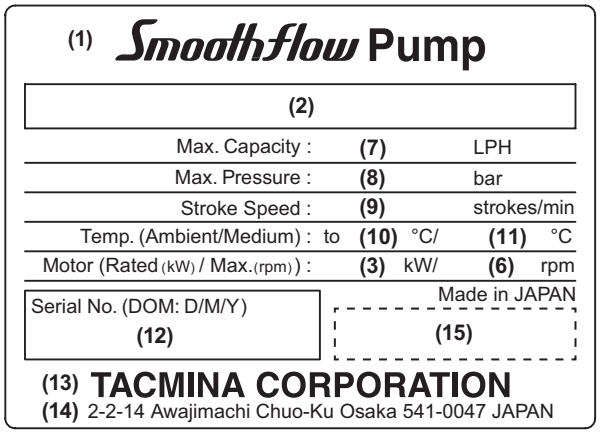
*3: Not included with TPL2ME-080/095.

■ Name plate

Products with CE marking
(65mm × 35mm)



Products with CE and ATEX markings
(60mm × 43mm)



(1) Brand Name
(2) Model Code
(3) Motor Power (kW)
(4) Motor Voltage (V)
(5) Motor Frequency (Hz)
(6) Max. Motor Speed (rpm)
(7) Max. Capacity (LPH)
(8) Max. Pressure (bar)
(9) Stroke Speed (strokes/min)
(10) Ambient Temperature (°C)
(11) Temperature of Liquid Used (°C)
(12) Serial Number
Day of Manufacture (Day/Month/Year)
(13) Manufacturer
(14) Address
(15) Marking and type of Protection
Refer to the EU Declaration of Conformity for directives that apply to this product.
Only pump parts are applied to this standard.
Please note a motor for the pump is not included.

Table of contents

Overview

The Smoothflow pumps in the TPL series convert the volumetric changes caused by the movement of the plunger through the operating oil into the reciprocating movement of the diaphragms.
As a result, they combine the advantages of diaphragm pumps which feature zero liquid leakage and complete hermetic sealing with the advantages of plunger pumps which feature high-pressure and high-accuracy injection to constitute ideal pumps with high levels of safety, reliability and durability.

■Flow of steps taken from delivery to commencement of operation

Delivery

▼

Parts checks — Page 3

▼

Installation — Pages 11 to 17

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Piping and wiring connections, pump checks — Pages 14 to 22

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Air release — Pages 55 to 56

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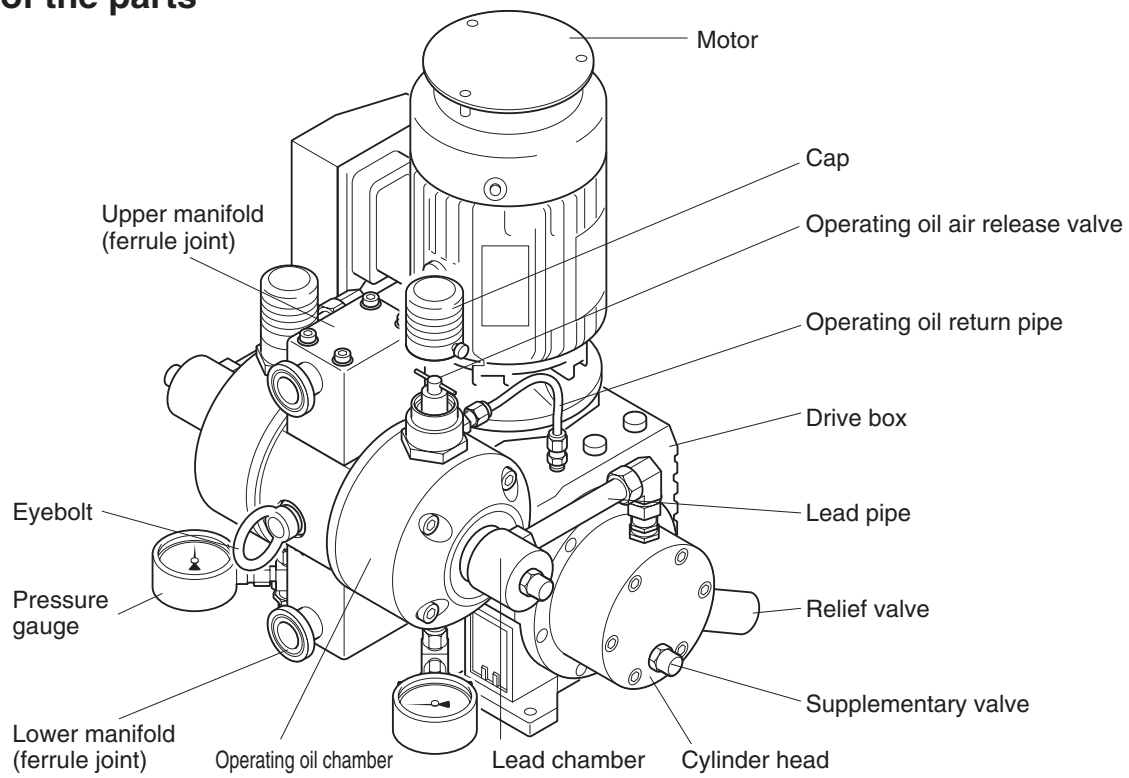
Commencement of operation

Structures

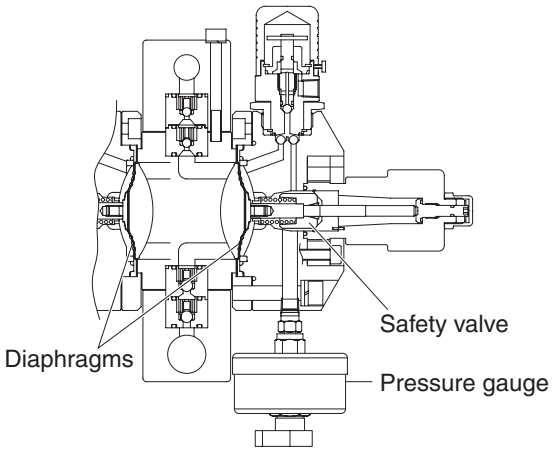
■Names of the parts



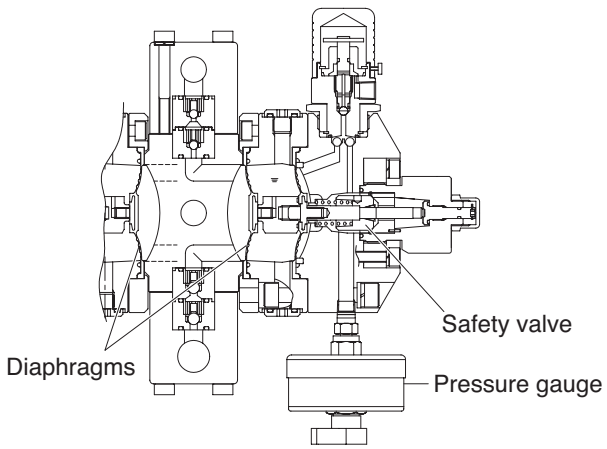
✻ To check the pump model, see the nameplate attached to the drive box.

■Pump section

TPL□ME



TPL□MWE



Principle of operation

How the liquid is pumped

(1) The rotation of the motor in Fig. 1 is decreased or increased by the worm gear speed reducer to the rotational speed which is optimally suited for the pump.

(2) The rotational movement of the motor in Fig. 1 is converted by the uniform velocity cam attached to the eccentric shaft into the reciprocating movement of the pump shaft. Linked to the reciprocating movement of the pump shaft, the plunger repeats a left-right reciprocating movement.

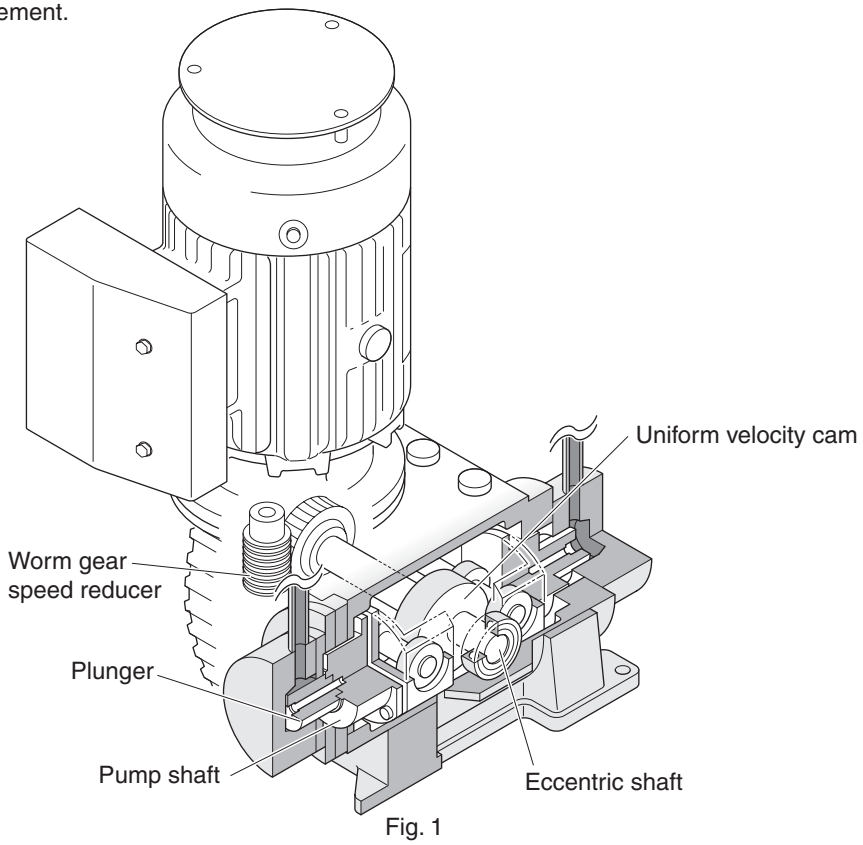


Fig. 1

(3) When the plunger (at the end of the pump shaft) in Fig. 2 moves toward the left

- The pressure inside the lead pipe on the left rises, pushing the diaphragm (left) through the operating oil toward the right. At this time, the check balls on the suction side (front side) close the flow path so that the flow path is opened on the discharge side (front side) and the chemical is discharged.
- At the same time as the actions described above are taking place, a negative pressure is created inside the lead pipe on the right, pulling the diaphragm (right) toward the right. At this time, the flow path is closed on the discharge side (back side), so that the check balls on the suction side (back side) open the flow path and the chemical is sucked in.

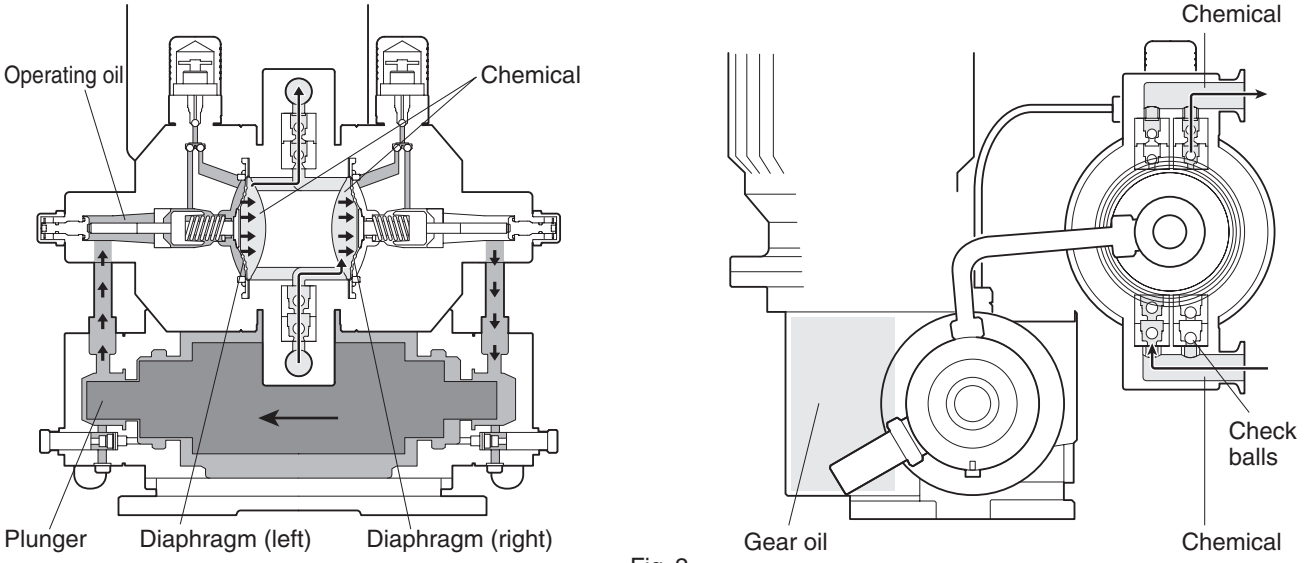


Fig. 2

Principle of operation

(4) When the plunger (at the end of the pump shaft) in Fig. 3 moves toward the right
The reverse actions to the ones described in (3) on the previous page are performed. Through a repetition of the actions described in (3) and (4), the chemical inside the left and right diaphragms is alternately sucked in and discharged.

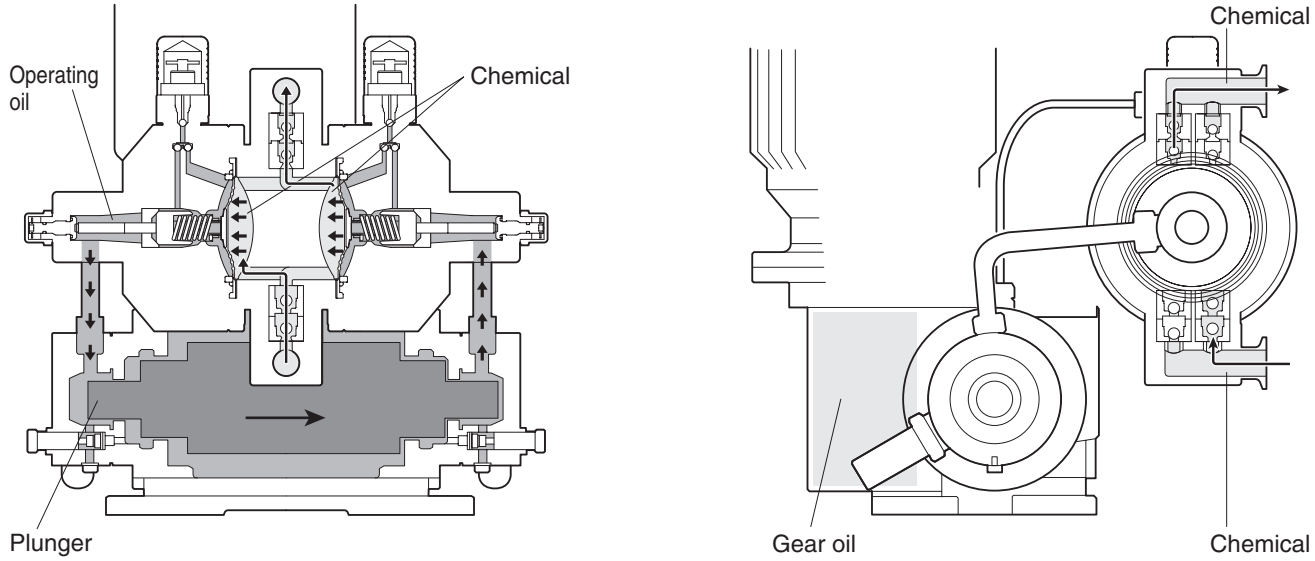
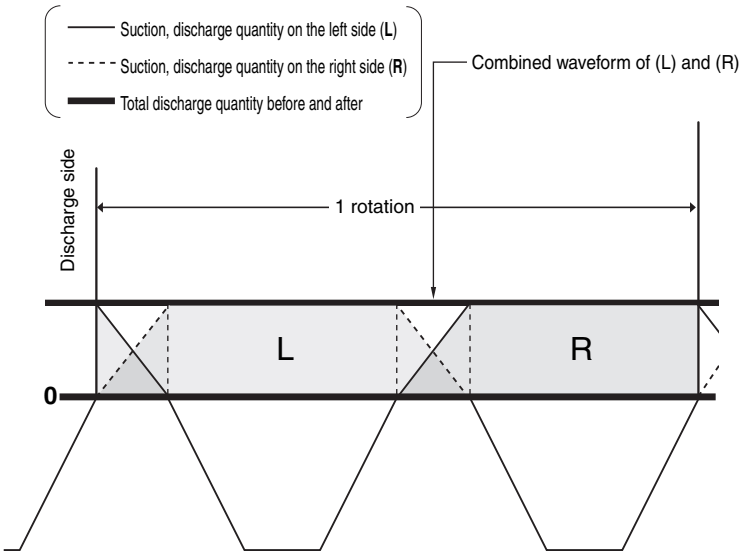


Fig. 3

By using a high-precision uniform velocity cam for the eccentric mechanism, the discharge characteristics of the pump head on the left are turned into trapezoidal waveforms resembling the shape of the letter "L." Furthermore, by staggering the operation of the pump head on the right, the combined waveforms produce a constant flow.
Pulsation occurs on the suction side.
• Do not reverse the rotational direction of the motor because doing so will give rise to significant pulsation on the discharge side.

■Discharge waveforms



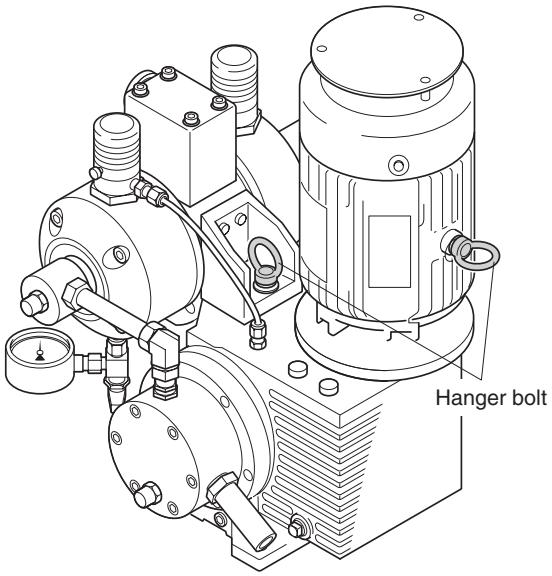
Installation

⚠ WARNING

- **Use a dedicated motor in explosion-proof areas or in explosive or combustible atmospheres.**
- **In explosion-proof areas or in explosive or combustible atmospheres, work such as pump transportation, installation, piping, and wiring must be carried out by individuals who have knowledge of explosion-proof structures, the construction of electrical equipment, the related laws and regulations, and the principles and functions of the pump as well as the technical skills related to handling the pump. Failure to heed this warning may result in explosions, ignition, electric shocks, or injury.**
- **Do not stand or move under a hoisted pump. The pump might fall, causing an accident.**
- **Install the pump in a location that cannot be accessed by anyone but control personnel.**

Lifting the pump (TPL2ME·TPL2MWE)

When hoisting the pump, use the two bolts for hoist shown in the figure below.
This pump cannot be hoisted just by using the eyebolt on the pump body. Be sure to also use the eyebolt on the motor to hoist the pump from two points.

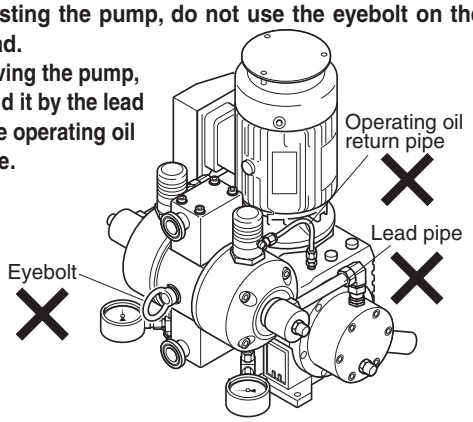


⚠ WARNING

- **Avoid entering the area underneath a pump which has been hoisted. If the pump should drop, this will result in an accident causing injury or death.**

⚠ CAUTION

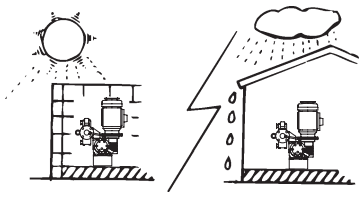
- **When hoisting the pump, do not use the eyebolt on the pump head.**
- **When moving the pump, do not hold it by the lead pipe or the operating oil return pipe.**



Installation

Installation location

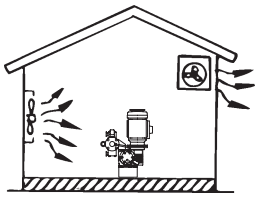
• This pump's specifications dictate that the pump be used indoors. Do not install it outdoors.



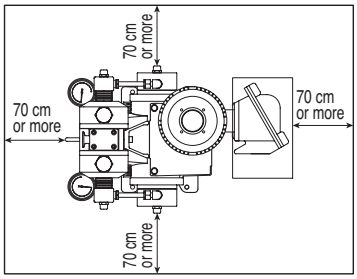
REMARKS

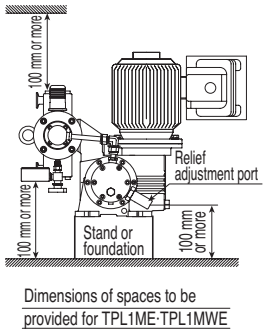
Locations which may shorten the pump's service life:
• Locations where corrosive gases are generated
• Locations with poor airing and ventilation

• Install the pump in a location where circulation is good in the summer and chemicals will not freeze in the winter.

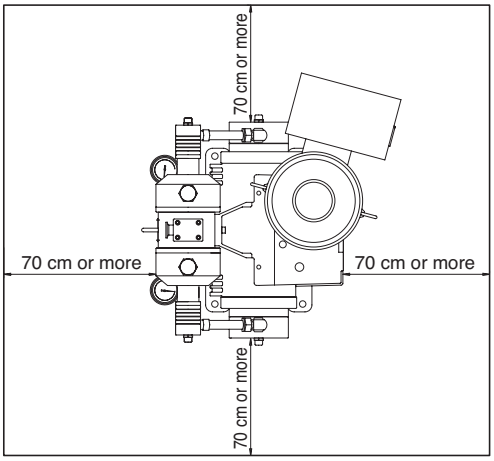


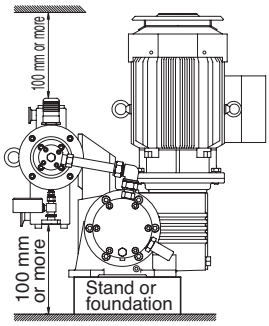
• Provide sufficient clearances around the pump so that it will be easy to perform maintenance and conduct the inspections. Enough space both to accommodate the movement distances of the tools and to make it possible for the personnel to carry out their work must be provided at the pump's installation location. (It will be easier to undertake the work if the pump is mounted on a stand of about 100 mm.)





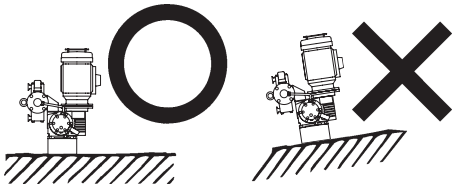
Dimensions of spaces to be provided for TPL1ME·TPL1MWE





Dimensions of spaces to be provided for TPL2ME·TPL2MWE

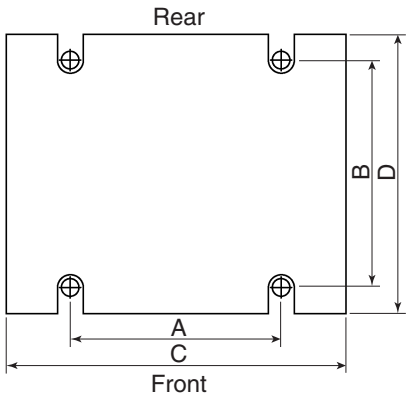
• Install the pump horizontally and secure it so it does not shake. If the pump is installed on an angle, discharge may be poor or impossible.
If the pump is placed on a cart or a surface with casters underneath, for instance, vibration may cause pulsation and/or fluctuations in the flow rate.



• Install the pump so it is lower than the surface of liquid in the tank (forced suction piping).
• When the pump is used for liquids which may coagulate due to variations in the temperature, the liquids may coagulate in the pump head and inside the pipes, causing damage to the pump and its surroundings. In cases like this, be absolutely sure to install a heating appliance or heat insulators.

Installation

Pump installation dimensions



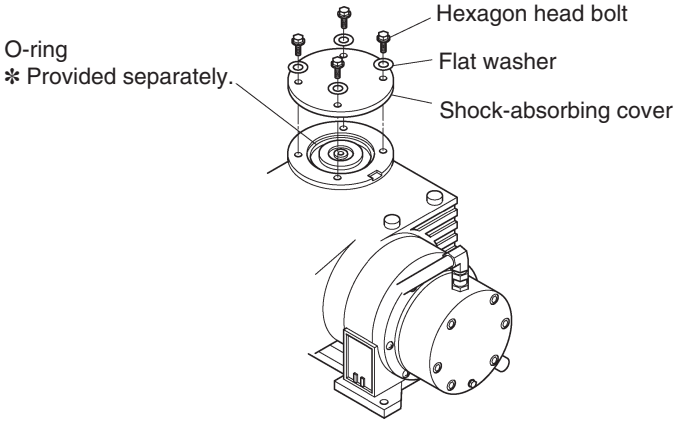
Model	Mounting pitches		Base dimensions	
	A	B	C	D
TPL1ME· TPL1MWE	214	122	238	172
TPL2ME· TPL2MWE	320	190	354	230

Installing the motor (only when the pump comes without a motor)

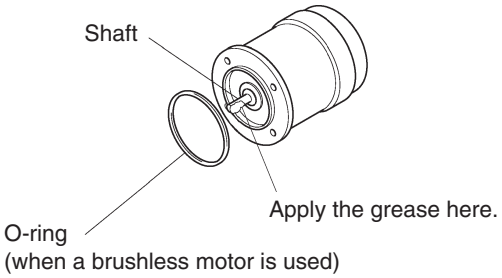
Select a 4P vertical-type flange motor which has the same output as a standard motor.
Follow the directions below if the user is to install the motor.

✻ The O-ring is packed separately. Do not forget to install it.

(1) Loosen the hexagon head bolts (M8 or M10), and remove the shock-absorbing cover.

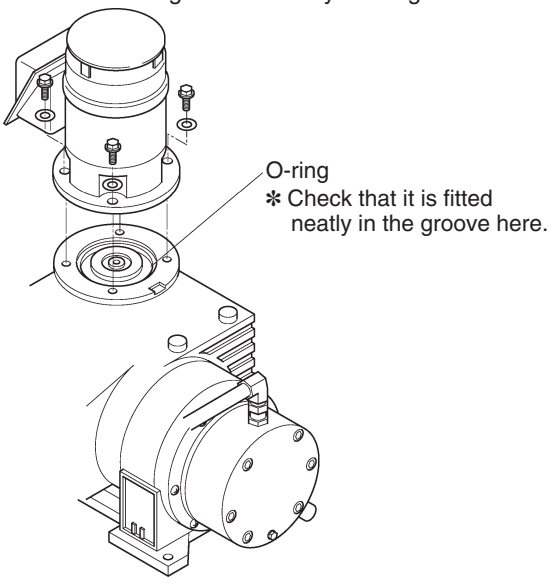


(2) Apply the grease packed in the motor insertion hole to the shaft on the motor side.



(3) Mount the motor on the drive box, and secure it using the hexagon head bolts and flat washers which were removed in step (1).

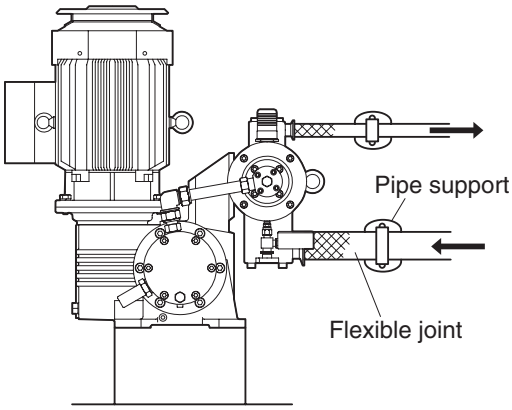
✻ Check that the O-ring is fitted neatly in the groove.



Piping

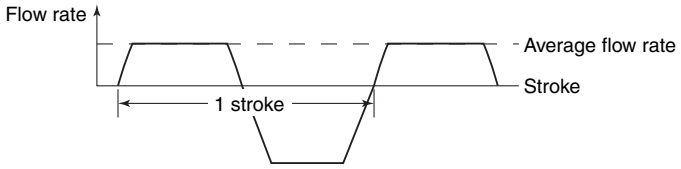
Joining the pipes to the pump

- As a general rule, use pipes whose diameter is equal to or greater than the standard bore diameter.
- Provide sufficient support for the pipe on the suction side since this is where pulsation occurs.
- Make sure that the pump and pipe joints will not be subjected to any excessive force which might be exerted by, for instance, the weight of the piping or the shifting of the pipe joints out of position. Use of flexible joints is recommended in order to protect the pump and the pipe joints.



■Concerning pulsation

The instantaneous flow rate during pulsation of the suction side pipe is approximately twice the average flow rate. This will be equivalent to 6 liters/minute, for instance, for a reciprocating pump whose flow rate is 3 liters/minute.



- If, when the discharge side pipe of the pump is configured using a flexible pipe (such as a tube), the pipe sustains a shock such as one administered by a blow, an inertial force will act on the flow, possibly causing pulsation and fluctuations in the flow rate. If a flexible pipe is to be installed, therefore, place the tube inside a pipe (such a steel pipe) or secure it.

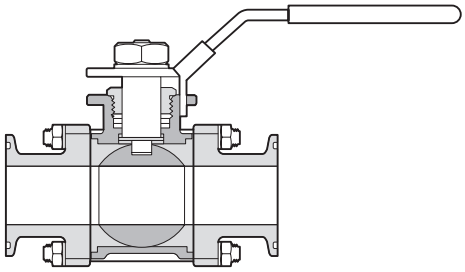
Piping lengths

- The length to which a pipe can be extended differs depending on the viscosity and specific gravity of the liquid to be handled and the bore diameters of that pipe. Connect the pipes after fully factoring in the piping resistance.
- Use of an excessively long discharge side pipe will increase the pressure loss, possibly causing the pump's allowable pressure to be exceeded and overfeed (see page 73) to occur.
  When a pipe is to be lengthened, its thickness must be increased so that the pressure loss will not exceed the maximum discharge pressure of the pump.
  Check out the following items before contacting a Tacmina service representative.
  (1) Viscosity of liquid
  (2) Specific gravity of liquid
  (3) Length of pipe
  (4) Relationship between the positions of the pump and tank
- Keep the suction side pipe as short as possible, and reduce the number of bends, joints and other factors in the pipe which increase the resistance to the absolute minimum.
  Use of an excessively long suction side pipe may give rise to cavitation (see page 73) inside the pump and inside the operating oil chamber, make it no longer possible to maintain the pump's quantitative properties due to the intrusion of air inside the operating oil chamber and/or increase pulsation.

Piping

Installing the valves and shutoff valves

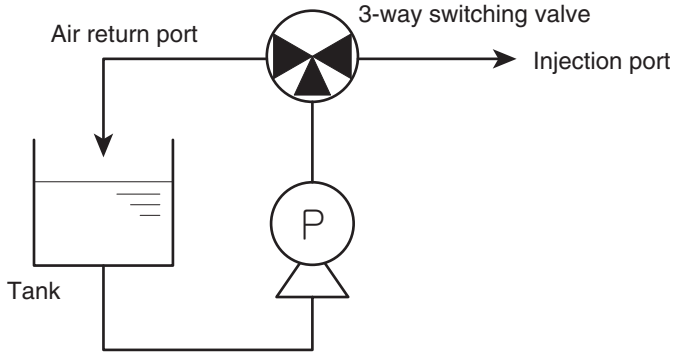
- It is a good idea to install an air release valve on the pipe right at the discharge side of the pump.
- In order to facilitate maintenance, install shutoff valves near the pump on both the suction side and discharge side.
  When a ball valve is to be used in order to avoid negative pressure inside the suction side pipe, select a full-bore type of valve such as the one shown in the figure below.



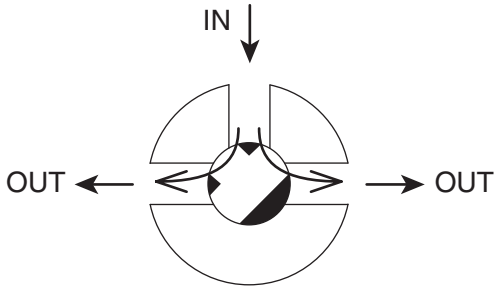
When a diaphragm valve is to be used, select one with an opening having a large surface area.

When the pump is used for a liquid which is prone to generating air bubbles (installing a 3-way valve)

- In order to release the air when pumping liquids which are prone to generating air bubbles or when starting up the pump, it is recommended that a 3-way valve be installed on the discharge side pipe of the pump as shown in the figure below. Such a valve can also be utilized to switch between the circulation line and liquid pumping line.



The L port type, T port type and other types of 3-way valves are available, and in some types the primary side may become temporarily blocked during opening and closing. If the primary side becomes blocked even for short periods of time, a level of pressure exceeding the rating may be generated, motor overloading may occur, the liquid may leak from the seals, and other problems may arise. Select a valve with the structure shown in the figure below.



Installing a pressure gauge

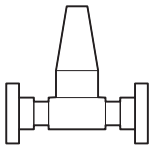
- Install a pressure gauge for measuring the discharge side pressure of the pump on the pipe right at the discharge side of the pump.

Piping

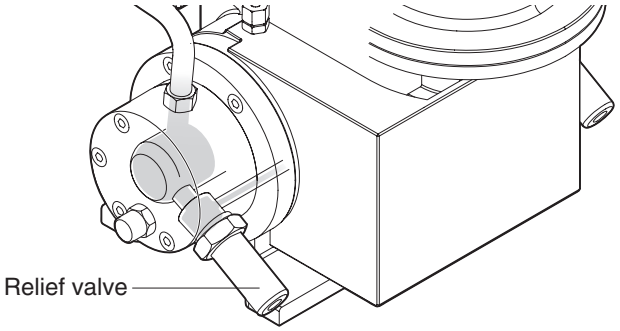
Installing the relief valve

- It is recommended that a relief valve (hereafter "pipe side relief valve"), which is capable of automatically releasing abnormal pressures in order to protect the pipe, on the discharge side pipe.
- This pump incorporates a relief valve (hereafter "pump side relief valve") which detects abnormal pressures and discharges the operating oil to the drive box to prevent the pump from being damaged. This pump side relief valve is activated if the pump is started up while the pipe remains blocked. When it is activated, the pressure inside the pump will be released but this may destroy the pipe.
  This is the reason why the pipe side relief valve should be installed on the discharge side pipe. Adjust the pressure set for this valve to 120% or so of the normal pressure.
  When pump side relief valve has been activated, proceed with the job of air release (see "Air release" on page 55).

Pipe side relief valve



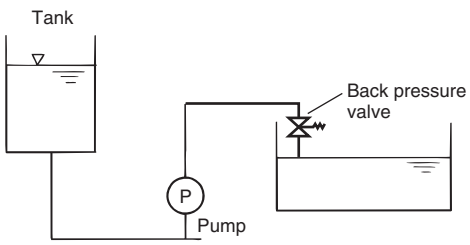
Pump side relief valve



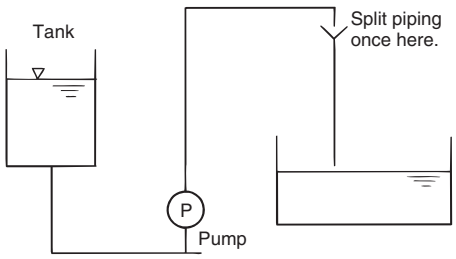
When pumping a liquid to a position lower than the level of the liquid in the tank

When the end of the discharge-side piping is lower than the level of the liquid in the tank, siphoning will cause the liquid to flow down naturally. To prevent this, install a back pressure valve. If you cannot install a back pressure valve, split off the piping at a location near the injection point and higher than the liquid level in the tank.

Example 1:



Example 2:



When pumping liquids containing slurry

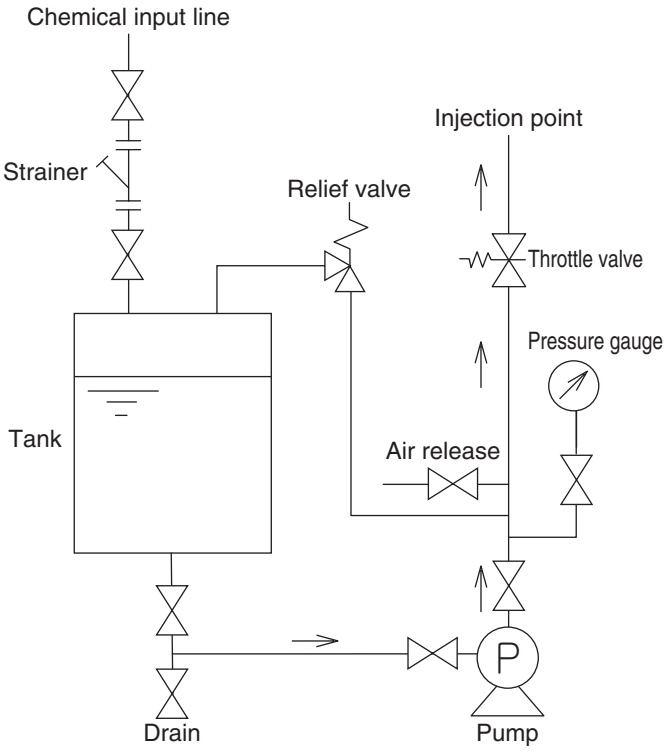
When this pump is to be used for liquids containing slurry, ensure that the following conditions are satisfied and heed the precautions for piping.
Direct all inquiries concerning the diameter, concentration and specific gravity of the kinds of slurry which can be pumped to a Tacmina service representative.

- Use pipes with as small a diameter and as high a flow rate inside the pipes as possible given the pressure loss.
- Provide a cleaning water (city water or other type of pressure water) line in the suction side pipe. Before shutting down the pump, allow the cleaning water to pass through the pump and pipes to remove the slurry.
- Avoid using the back pressure valve. If slurry adheres to the seal parts of the valve, the valve will cease to function.
  If siphoning effect (see page 73) or overfeed (see page 73) is a possibility, prevent these phenomena using a riser (to create a difference in the head).
- Provide a drain at the rise part of the pipe immediately after the pump's discharge side joint.
- When a relief valve has been installed and this valve has been activated, clean it because the slurry will become trapped in the seal parts.

Piping

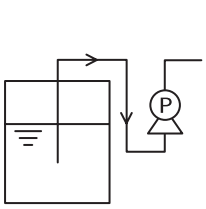
Example of recommended piping

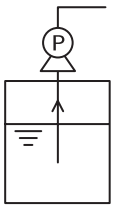
Install the pump so that it is lower than the minimum liquid level in the tank. (Pressure booster piping)
The length that the piping can be extended to differs according to the viscosity and specific gravity of the liquid and the piping diameter. Lay piping taking the piping resistance and other factors into full consideration.
Make the suction-side piping as short as possible and use piping with as few bends and joints that will cause resistance as possible.



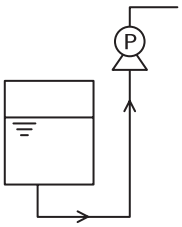
Examples of unsatisfactory piping

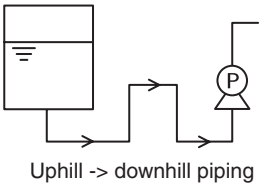
Do not connect the pipes as in the examples shown below. Doing so will cause the discharge to be unstable or disable the discharge.



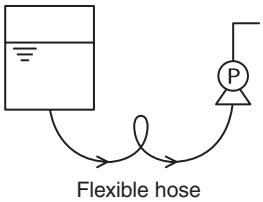


Suction piping

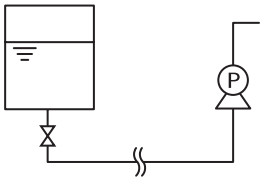




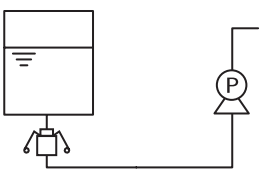
Uphill -> downhill piping



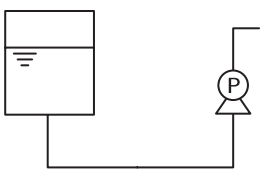
Flexible hose



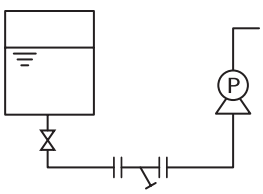
Excessively long suction side pipe



Coupler



Excessively small-diameter suction pipe



Strainer (filter) in suction side pipe

Electrical wiring

Electrical wiring

⚠ WARNING

- **If the pump is installed in a location where there is a risk of an explosive atmosphere of gas or steam (further referred to as a hazardous location), use an explosion-proof motor that is tailored to the hazardous location where the pump will be installed. If an explosion-proof motor is not used, there is a risk of explosion or ignition.**
- **The electrical wiring must be undertaken by a qualified electrician or other individual with the requisite electrical knowledge. Electrical work for preventing explosions must be performed for the wiring work as well. This work must be undertaken by a specialist who has the knowledge and skills relating to explosion-proof products in compliance with the technical standards governing electrical equipment, interior wiring regulations, guidelines for preventing explosions in facilities. Failure to heed this warning may result in explosions, ignition and/or electric shocks.**
- **Do not operate the pump with wet hands. Doing so may result in electric shocks.**
- **Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.**
- **Securely ground the protective earth terminal, and be absolutely sure to install an earth leakage breaker. Otherwise, you may receive electric shocks.**

⚠ CAUTION

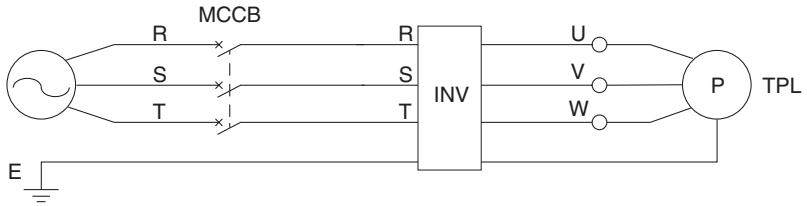
- **The grounding wire of the motor must be connected to ground in order to prevent electric shocks.**
- **The grounding wires of the controller and inverter must be connected to ground in order to reduce noise.**
- **Check the voltage, number of phases and power of the motor before connecting the motor's wires to ensure that the wires will be connected properly. Connecting the wires incorrectly will cause malfunctioning.**
- **Connect the wiring only after confirming the power supply voltage. Do not connect the pump to a power supply that is not within the regular voltage.**
- **The direction in which the motor of this pump rotates is fixed. Connect the wires in such a way that the motor will rotate in the prescribed direction.**

NOTICE

- **Install a separate circuit breaker for the pump for when the adjustments, maintenance and other such activities are performed.**
- **Use fine-quality tools and equipment for the wiring, and pay sufficient attention to ensuring safety by complying with the technical standards governing electrical equipment, interior wiring regulations, regulations specified by the power company and other applicable stipulations.**

The discharge quantity of this pump is adjusted by controlling the rotational speed of the motor. Use, for instance, an inverter or other type of motor whose rotational speed can be adjusted.
The connection size of the electrical conduit service entrance for a standard motor is G3/4. The wiring must be protected using an electrical conduit without fail.

Example of wiring



MCCB: Molded case circuit breaker
INV: Inverter

✻ For pump maintenance, install separate MCCBs for this pump.

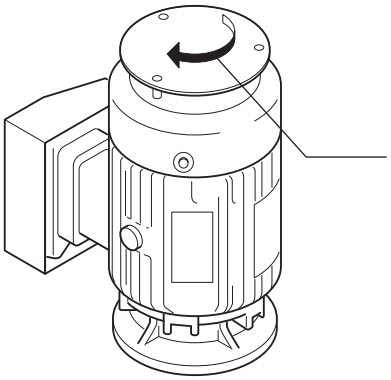
Electrical wiring

Checking the rotation direction of the motor

⚠ CAUTION

Running the motor at high speed while it is rotating in the opposite direction by mistake may give rise to significant pulsation in the discharge side pipe, causing the pipe to vibrate.

Check that the motor is running in the clockwise direction as seen from its fan cover.
If it is running in the opposite direction, change over the connections of two of the three wires.



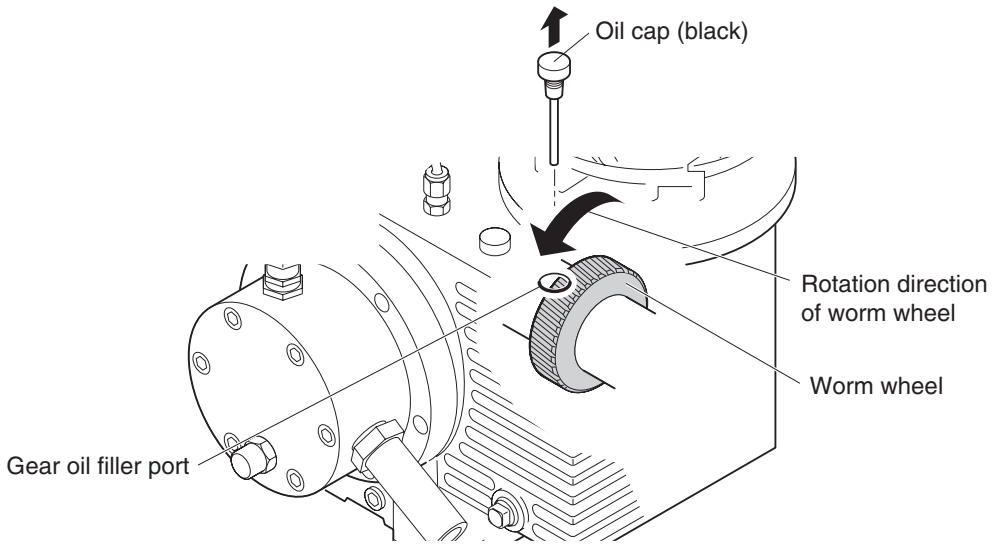
⚠ CAUTION

If a motor provided with a speed reducer or change gear is used, the pump may run in the opposite direction even when the motor fan is rotating clockwise as seen from the fan cover. With such a motor, check the rotation direction of the pump by following the check method applicable to self-cooled motors described below.

■When a self-cooled (totally enclosed) motor is used (when the rotation direction of the motor cannot be ascertained from outside)

Check the rotation direction by following the steps below.

(1) Shut down the motor, and remove the oil cap of the gear oil.
(2) Set the motor speed to the lowest number of strokes (9 strokes/min), peer through the hole in the oil cap, and check whether the worm wheel is turning from top to bottom.



(3) If the worm wheel is found to be rotating in the opposite direction, change over two of the three wires connected to the motor.
(4) After checking the rotation direction, shut down the motor, and put the oil cap back.

Operation

⚠ WARNING

- **Install the pump in a location that cannot be accessed by anyone but control personnel.**
- **Do not operate the pump with wet hands. Doing so may result in electric shocks.**
- **Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.**
- **When there is a problem (such as when smoke appears or there is a burning smell), shut down the pump immediately, and contact your vendor or a TACMINA representative. Otherwise, there is a risk of fire, electric shock, malfunction, or accident.**
- **Check if the valves are open before operating the pump. If you have forgotten to open a valve or foreign objects are blocking the piping on the discharge side of the pump, an excessive pressure rise that will exceed the pump's specification ranges may occur, liquid may spray out, or piping may be damaged, which is dangerous.**
- **During air release, transfer liquid may spray forcefully from the tip of the piping. Return the tip of the air release piping to the tank. During this operation, secure the air release hose in position.**
- **Before starting operation, be sure to check the amount of gear oil and add more if the amount is low.**

⚠ CAUTION

The pump, motor, and other components may become hot during operation. Always wear protective gear (e.g. gloves).

Before running the pump for the first time

When running the pump for the first time after installation or resuming operation after a prolonged period of shutdown, check the following points before proceed with the "routine checks."

- Check whether the conditions for the pump's operating range (such as the ambient temperature and liquid to be used) are satisfied.
- Pass a safe liquid through the pipes and check that there are no leaks or blockages. Also proceed with cleaning and flushing to ensure that no cutting chips from the piping work or other foreign matter has been left behind in the pipes.

Routine checks

Check the following routine check items before starting up operation every day.

■Before operation

Check location	Details of check conducted	Remedial action to take
Pump head Joints	Check for looseness. If the joints are loose, retighten them.	When first operating the pump after maintenance, retighten in the same manner.
Tank	Check that the amount of the liquid is sufficient.	If the liquid is not sufficient, replenish it.
Pipes	Check the pipes for disconnections and damage.	If a pipe has been disconnected or damaged, connect or repair it.
Valves *1 (suction side and discharge side)	Check that the valves are open.	If any of the valves are closed, open them.
Power supply *2	Check that the pump has been connected properly to the prescribed power supply.	If the pump is not connected properly, re-connect the pump to the prescribed power supply.
Electrical wiring *3	Check that the electrical wires have been connected properly.	If the wires are not connected properly, re-connect them properly.
Drive section	Check that the amounts of the gear oil and operating oil are appropriate. (For details, refer to "How to check the amount of gear oil" (see page 21) and "Replenishing the operating oil" (see page 59).)	If the gear oil or operating oil is insufficient, replenish it. (For details, refer to "How to check the amount of gear oil" (see page 21) and "Replenishing the operating oil" (see page 59).)
	Check that there are no operating oil or gear oil leaks.	If operating oil or gear oil is leaking, tighten up the place where it is leaking.

*1: Closed valves can cause the pressure to rise excessively, causing the liquid to gush out and the pipes to be damaged which is dangerous.
*2: Improper connection of the power supply can cause motor damage.
*3: Incorrect wiring can cause short-circuiting and power leaks.

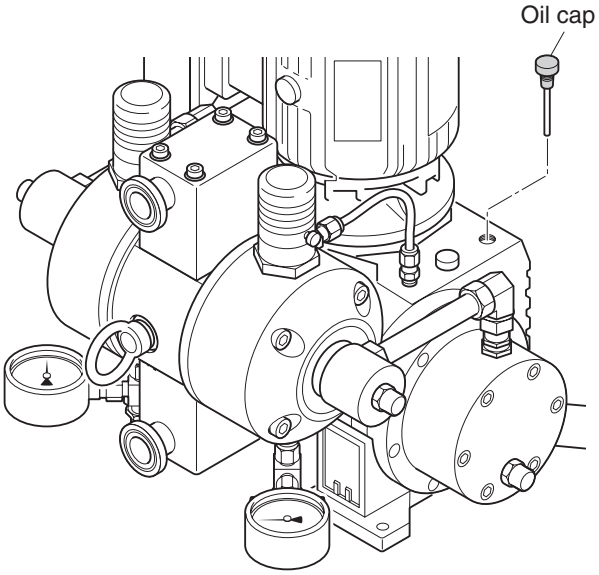
Operation

■During operation

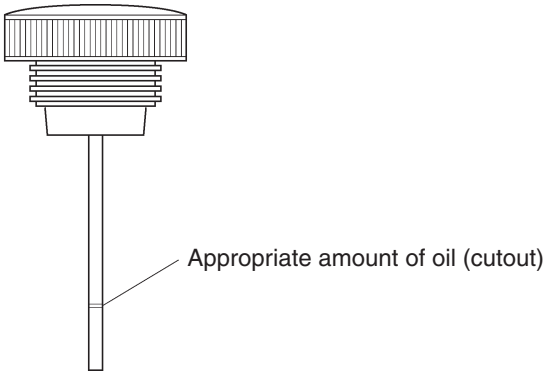
Check location	Details of check conducted	Remedial action to take
Motor	Check whether the motor is rotating in the correct direction. (For details, refer to "Checking the rotation direction of the motor" (see page 19).)	If the motor is rotating in the wrong direction, re-connect its wires.
Motor, pump	Check that no heat is being generated and that no abnormal sounds are heard.	If abnormal sounds are heard, shut down the pump, and contact a Tacmina service representative.
Joint sections	Check that no liquid is leaking.	If liquid is leaking, tighten up the place where it is leaking. If the leak persists, inspect the seals in the areas.
Discharge side pressure	Using a pressure gauge or other type of meter, check whether the pressure inside the pipes is correct.	If the pressure is abnormal, a blocked pipe or closed valve may be to blame. Inspect the pipes again.

★How to check the amount of gear oil

(1) With the pump shut down, draw out the oil supply cap/oil gauge on the top of the drive box, and wipe the gauge.



(2) Put the gauge rod back. (Tighten up the screw all the way.)
(3) Remove the rod, and check the amount of oil coating the rod.
• Check that the oil surface is at the level of the cutout on the oil cap.



(4) Put the oil supply cap back in its place.

Operation

Trial run

(1) Check the items in "Before running the pump for the first time" on page 20.
(2) Check the items in "■Before operation" under "Routine checks" on page 20.
(3) Start up the pump. (Gradually increase the motor speed from a low speed.)
(4) Check the items in "■During operation" under "Routine checks" on page 21.

●If the liquid is not sucked up during the trial run
Foreign matter may be adhering to the valve seat (the part where the check balls are sealed) on the discharge side or suction side. Follow the steps below to remove it.
(1) Turn off the power of the pump.
(2) Disconnect the joints, and clean the check balls and valve seats using pure water.
(3) Assemble the parts back into the pump head, taking care not to mistake the discharge side parts for the suction side parts (or vice versa).
(Dry out the parts thoroughly when the pump will be used for a liquid which is affected by water.)

●Points to bear in mind that pumping a liquid which solidifies or in which slurry accumulates
When the pump is to be shut down, proceed with a circulation operation using a cleaning fluid, for example, and ensure that none of the liquid that has been pumped is left behind inside the pump head, joint sections and other parts.

Adjusting the discharge quantity

NOTICE

- **Do not set the maximum rotational speed higher than 60 Hz even when an inverter or other change gear mechanism will be used.**

Unlike generally available metering pumps, the pumps in this series do not have a dial for adjusting the flow rate. They are always used at the stroke length of 100%.
The injection amount is changed by changing the rotational speed of the motor using an inverter or other mechanism.

When shutting down the pump operation for a prolonged period

Take the following steps when shutting down the pump operation for a prolonged period or when resuming operation after such a shutdown.
(1) Disassemble and clean the parts inside the pump head and joint sections, and remove all traces of the liquid that has been pumped.
(2) Place a protective cover over the pump to protect it from dust build-up and corrosion.

■When shutting down the pump

(1) Clean inside the pump head.
Pass fresh water or the cleaning fluid inside the pump head for about 30 minutes.
(2) Turn off the power completely.
(3) Place a protective cover over the pump.
Do this to protect the pump from dust build-up and from corrosive environments.

■When resuming the pump's operation

(1) Check for abnormalities including whether sediment has accumulated inside the tank and whether the liquid has become opaque.
If the quality of the liquid has deteriorated, clean inside the tank, and then replace all the existing liquid with fresh liquid.
(2) Check the check balls and valve seats inside the pump head to ensure that there is no dirt or other foreign matter on them.
(3) Open the pump valve, and then check that the pump pressure gauge indicates a positive pressure (a value greater than 0 MPa).
If the pressure is not positive, air may have entered into the operating oil chamber or the amount of operating oil in the operating oil chamber may have decreased, so release the air from the operating oil.

Maintenance

This section describes how to inspect and replace the valve seats and diaphragms which must be inspected periodically.

⚠ WARNING

- **When working on the liquid-end section of the pump, wear protective gear suited to the chemical concerned (such as rubber gloves, a mask, protective goggles and work overalls that are resistant to chemical).**
- **Take steps to ensure that the power will not be turned on during the course of work. Hang a sign on the power switch indicating that work is in progress.**
- **Before maintaining or repairing the pump, be sure to release the discharge-side pressure, drain the chemicals from the liquid-end section, and wash the pump with deionized water.**
- **Before performing maintenance, thoroughly read the operation manual and review the work details. Ensure you are in a comfortable position while working.**

Jigs and other tools used during maintenance

	Accessories		Sold separately				
	Retaining ring clamping jig	Diaphragm installation jig	Hexagonal key wrench *1	Wrench *2	Tweezers	Liquid reception tray	Oil tray
Inspecting, cleaning, and replacing the valve seats	○ (For TPL2ME·TPL2MWE high-viscosity specifications)	–	○	–	–	–	–
Inspecting and cleaning the diaphragms	–	–	○	–	–	○	–
Replacing the diaphragms	–	○ (Excluding TPL2ME-080/095)	○	○	○	○	○
Replenishing the operating oil	–	–	○	–	–	–	–
Air release	–	–	–	–	–	–	–
Pump head disassembly	–	–	○	–	–	○	–
Replacing the operating oil	–	–	○	○	○	–	○
Replacing the gear oil	–	–	–	○	–	–	○
Consumable parts replacement of lead joint	–	–	○	○	–	○	–
Setting the relief valve pressure	–	–	○	–	–	–	–

*1: Hexagonal key wrench size (A/F)

		3mm	4mm	5mm	6mm	8mm	10mm
Inspecting, cleaning, and replacing the valve seats	TPL1ME·TPL1MWE	–	–	○	–	–	–
	TPL2ME·TPL2MWE-028/032	–	–	○	○	–	–
	TPL2ME·TPL2MWE-040/056	–	–	–	○	–	–
	TPL2ME-080/095	–	–	–	○	○	–
Inspecting and cleaning the diaphragms	TPL1ME·TPL1MWE-008/014/018	–	–	–	○	–	–
	TPL1ME·TPL1MWE-028	–	–	–	–	–	○
	TPL2ME·TPL2MWE	–	–	–	–	–	○
Replacing the diaphragms	TPL1ME-008/014/018	–	–	○	○	–	–
	TPL1ME-028·TPL2ME	–	–	○	–	–	○
	TPL1MWE-008/014/018	–	–	○	○	–	–
	TPL1MWE-028·TPL2MWE	–	–	○	○	–	○
Replenishing the operating oil		○	–	–	–	–	–
Pump head disassembly	TPL1ME·TPL1MWE-008/014/018	–	–	–	○	–	–
	TPL1ME·TPL1MWE-028	–	–	–	–	–	○
	TPL2ME·TPL2MWE	–	–	–	–	–	○
Replacing the operating oil		–	–	○	○	–	–
Consumable parts replacement of lead joint	TPL1ME·TPL1MWE	–	–	–	○	–	–
	TPL2ME·TPL2MWE	–	–	–	–	–	○
Setting the relief valve pressure		–	○	○	–	–	–

Maintenance

*2: Wrench size (A/F)

		12mm	14mm	19mm	24mm	35mm	11/16"	1-1/16"	1-1/8"
Replacing the diaphragms	TPL1ME·TPL1MWE	—	○	○	—	○	○	—	—
	TPL2ME	—	○	—	—	○	—	○	○
	TPL2MWE	—	○	—	○	○	—	○	○
Replacing the operating oil		—	○	—	—	○	—	—	—
Replacing the gear oil	TPL1ME·TPL1MWE	○	—	—	—	—	—	—	—
	TPL2ME·TPL2MWE	—	○	—	—	—	—	—	—
Consumable parts replacement of lead joint	TPL1ME·TPL1MWE	—	—	○	—	—	○	—	—
	TPL2ME·TPL2MWE	—	—	—	—	—	—	○	○

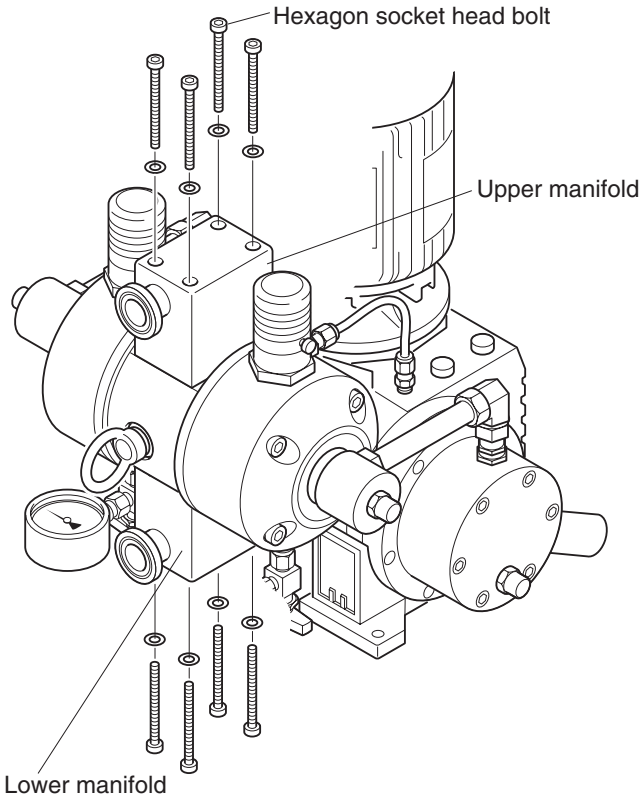
Inspecting, cleaning and replacing the valve seats

■How to remove the valve seats

(1) Remove the hexagon socket head bolts (×4) used to secure each of the manifolds.

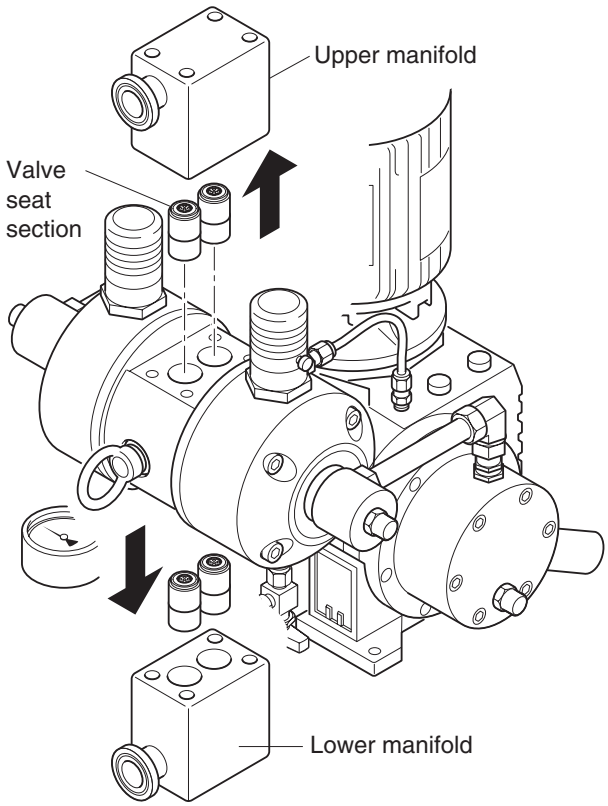
✻ Final tightening torque

Model TPL1ME·TPL1MWE-008/014/018/028 (M6): 7.8 to 8.8 N·m
Model TPL2ME·TPL2MWE-028/032 (Upper part M6): 7.8 to 8.8 N·m
(Lower part M8): 11.7 to 12.7 N·m
Model TPL2ME·TPL2MWE-040/056 (M8): 11.7 to 12.7 N·m
Model TPL2ME-080/095 (Upper part M8): 11.7 to 12.7 N·m
(Lower part M10): 15.7 to 16.7 N·m



(2) Remove the upper and lower manifolds and remove the valve seats.

✻ When removing the manifolds, take care not to drop the manifolds and the valve seat sections.



✻ The manifold used in the upper part and the manifold used in the lower part may be different.

Pump model		Manifold bore diameter	
		Upper part	Lower part
TPL1ME TPL1MWE	-008	ISO 10A	ISO 10A
	-014	ISO 10A	ISO 15A
	-018	ISO 10A	ISO 15A
	-028	ISO 15A	ISO 15A
TPL2ME TPL2MWE	-028	ISO 15A	1.0S
	-032	ISO 15A	1.0S
	-040	1.0S	1.5S
	-056	1.5S	2.0S
TPL2ME	-080	2.0S	2.5S
	-095	2.0S	2.5S

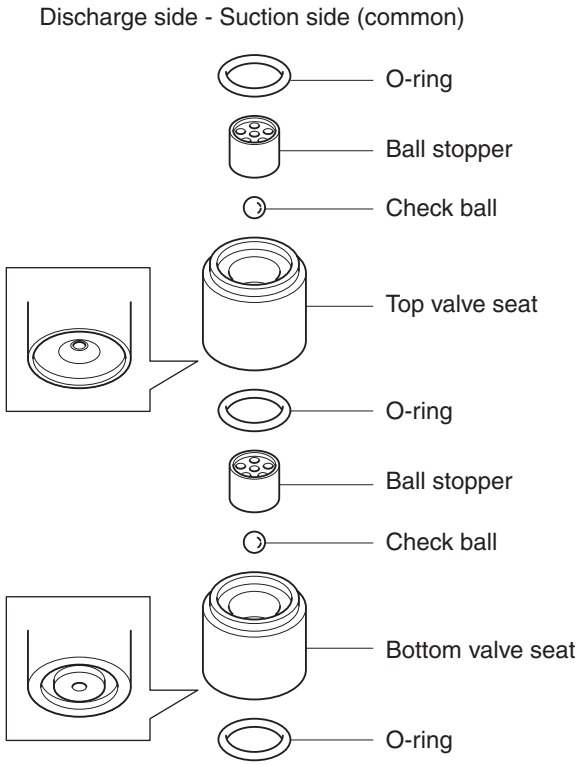
Maintenance

■How to inspect the valve seats

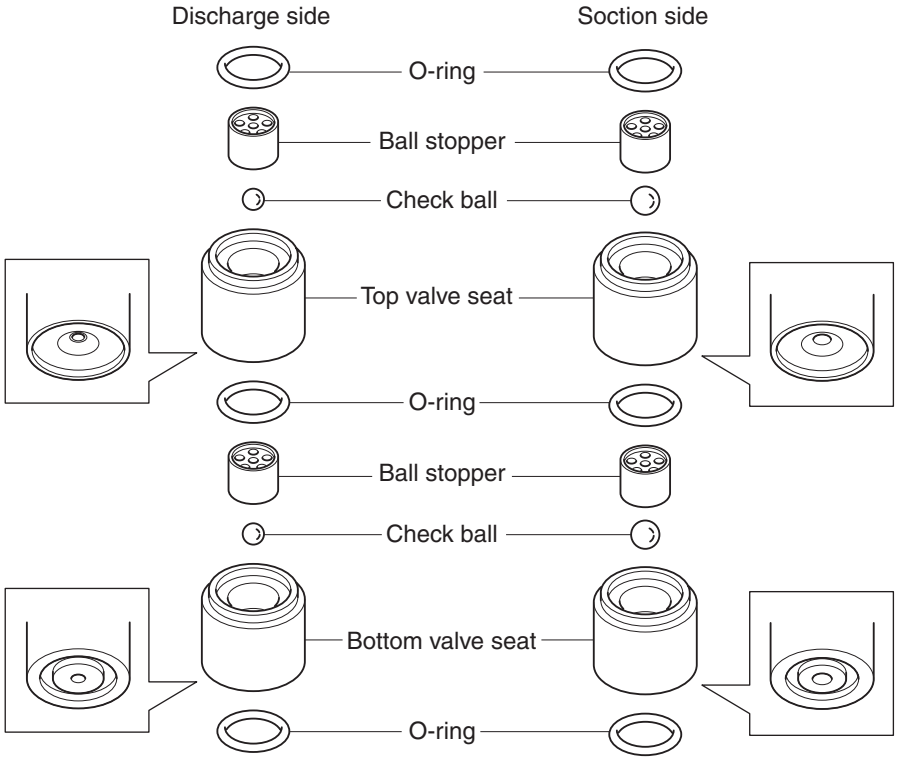
Refer to the figures below which shows the valve seat assemblies, and proceed while ensuring that all the parts are re-assembled and re-assembled correctly.

- If, during the inspection, any of the check balls or valve seat sections are found to have marks or wear, replace them with new ones.
- If a valve seat is to be replaced due to wear or other problems, be absolutely sure to replace its check ball as well at the same time.
- Assemble the valve seat assemblies on both the discharge side and suction side while taking care not to mistake the top for the bottom (and vice versa).

TPL1ME·TPL1MWE-008/014

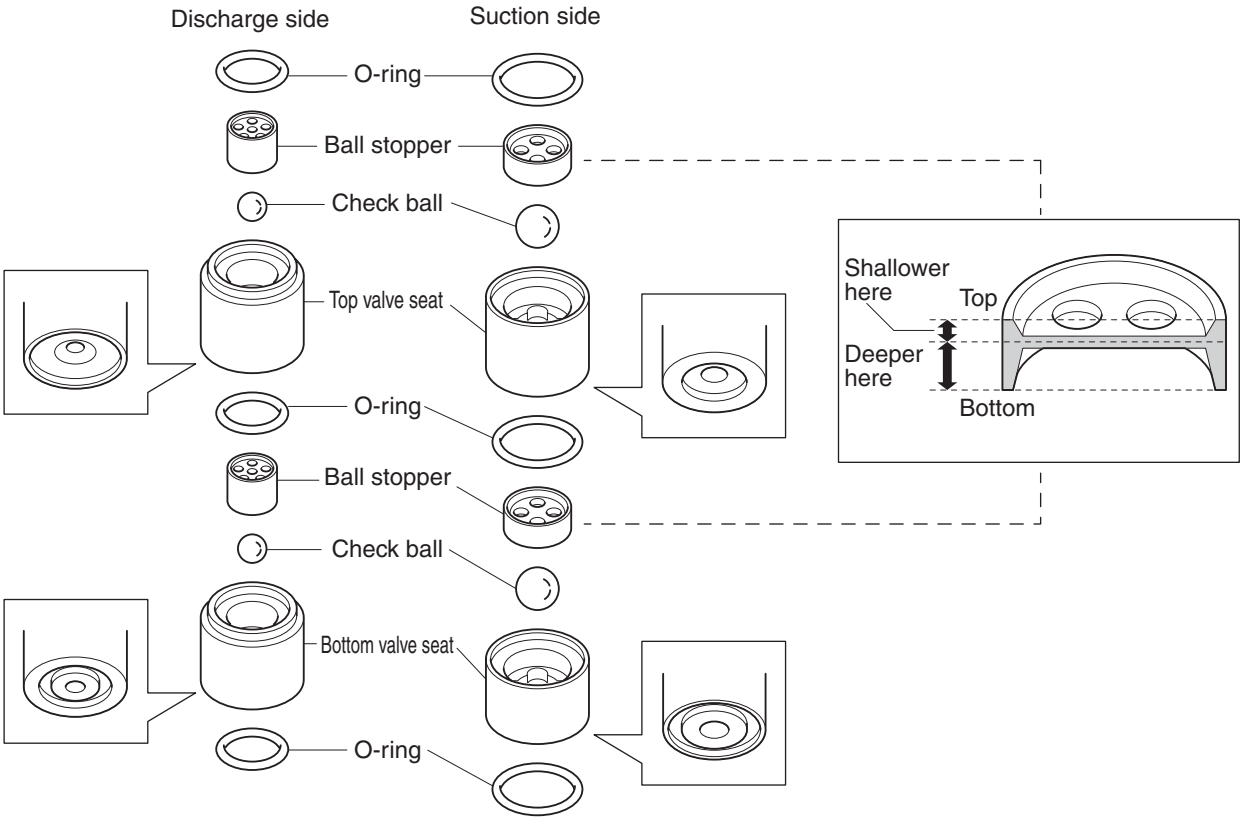


TPL1ME·TPL1MWE-018

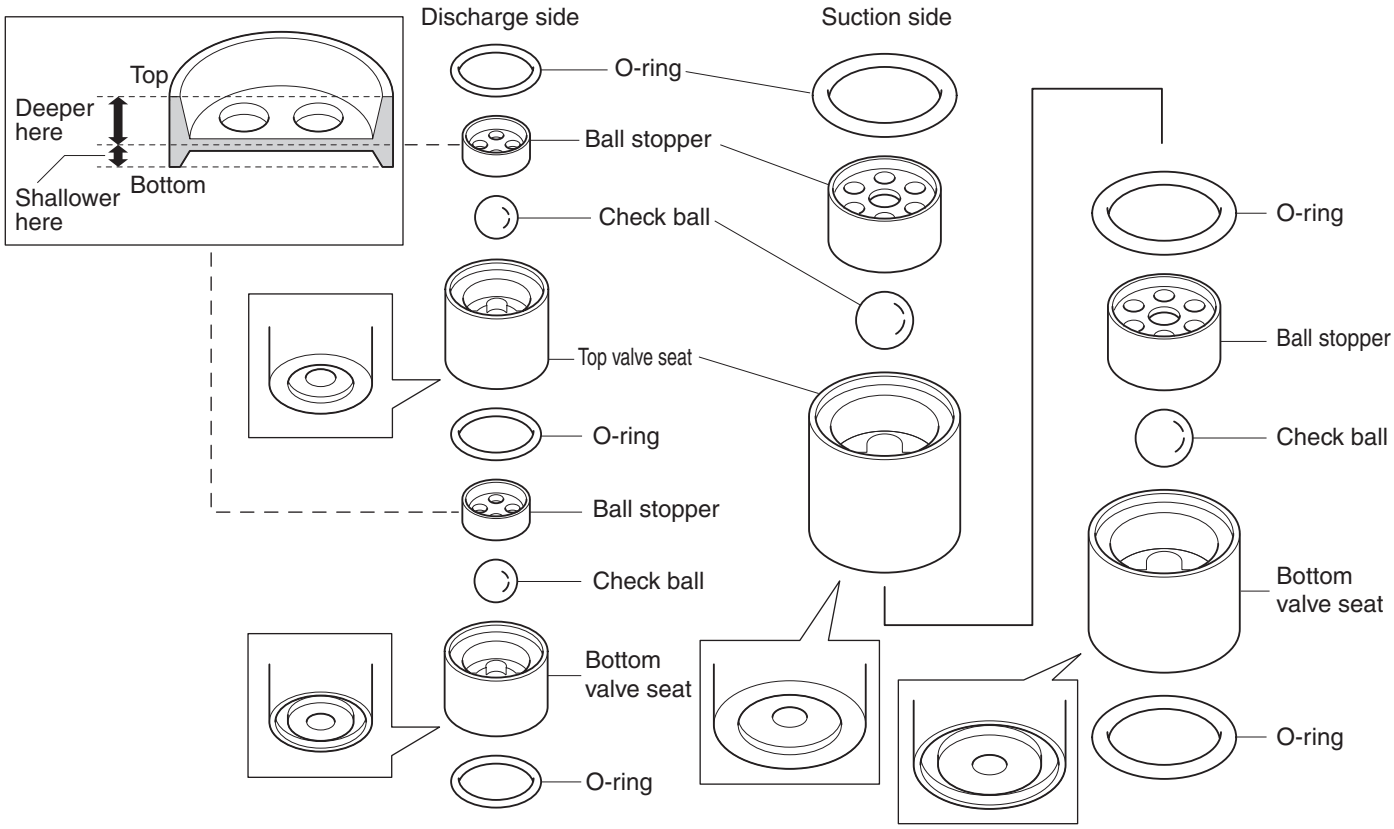


Maintenance

TPL1ME·TPL1MWE-028

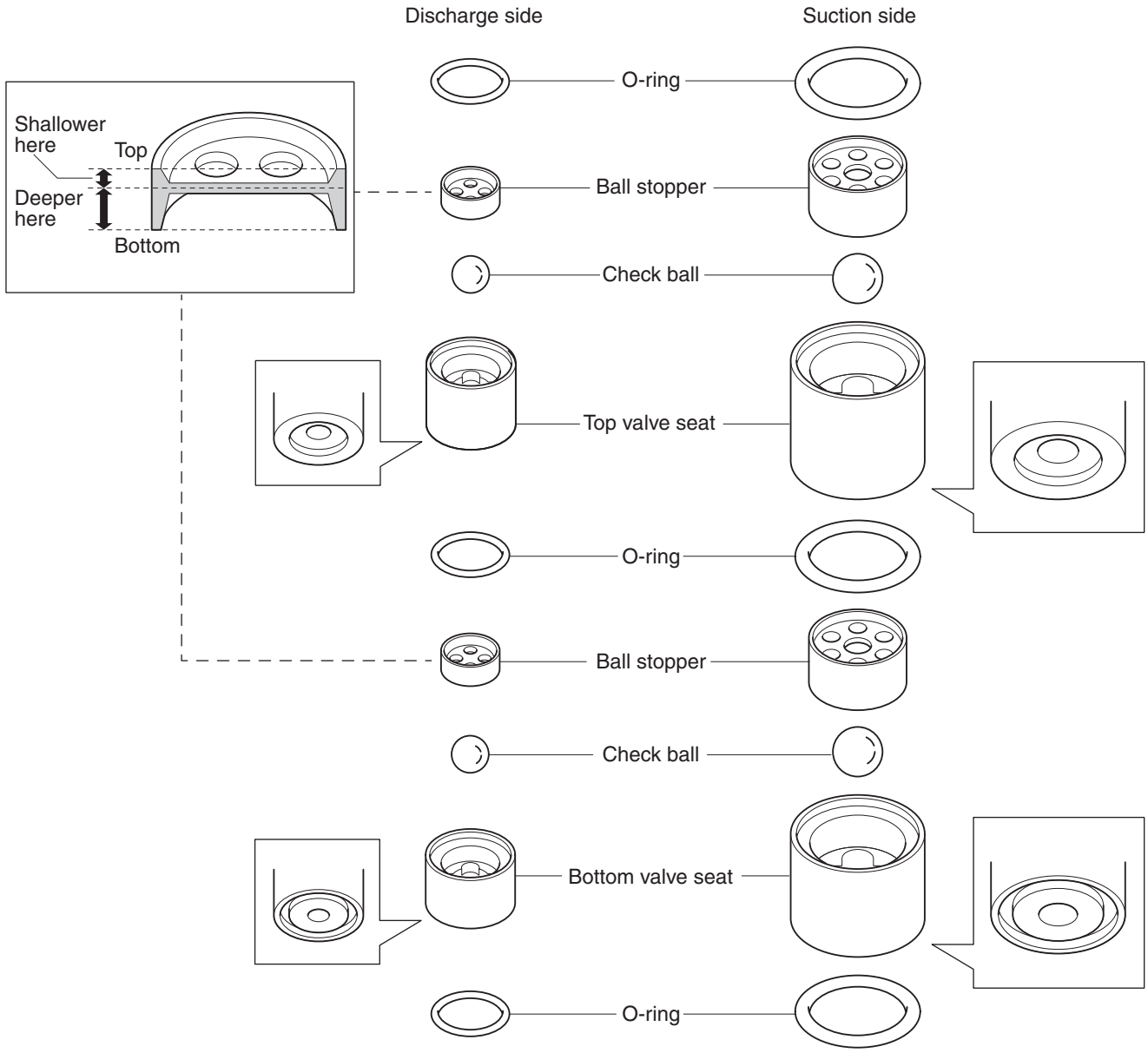


TPL2ME·TPL2MWE-028



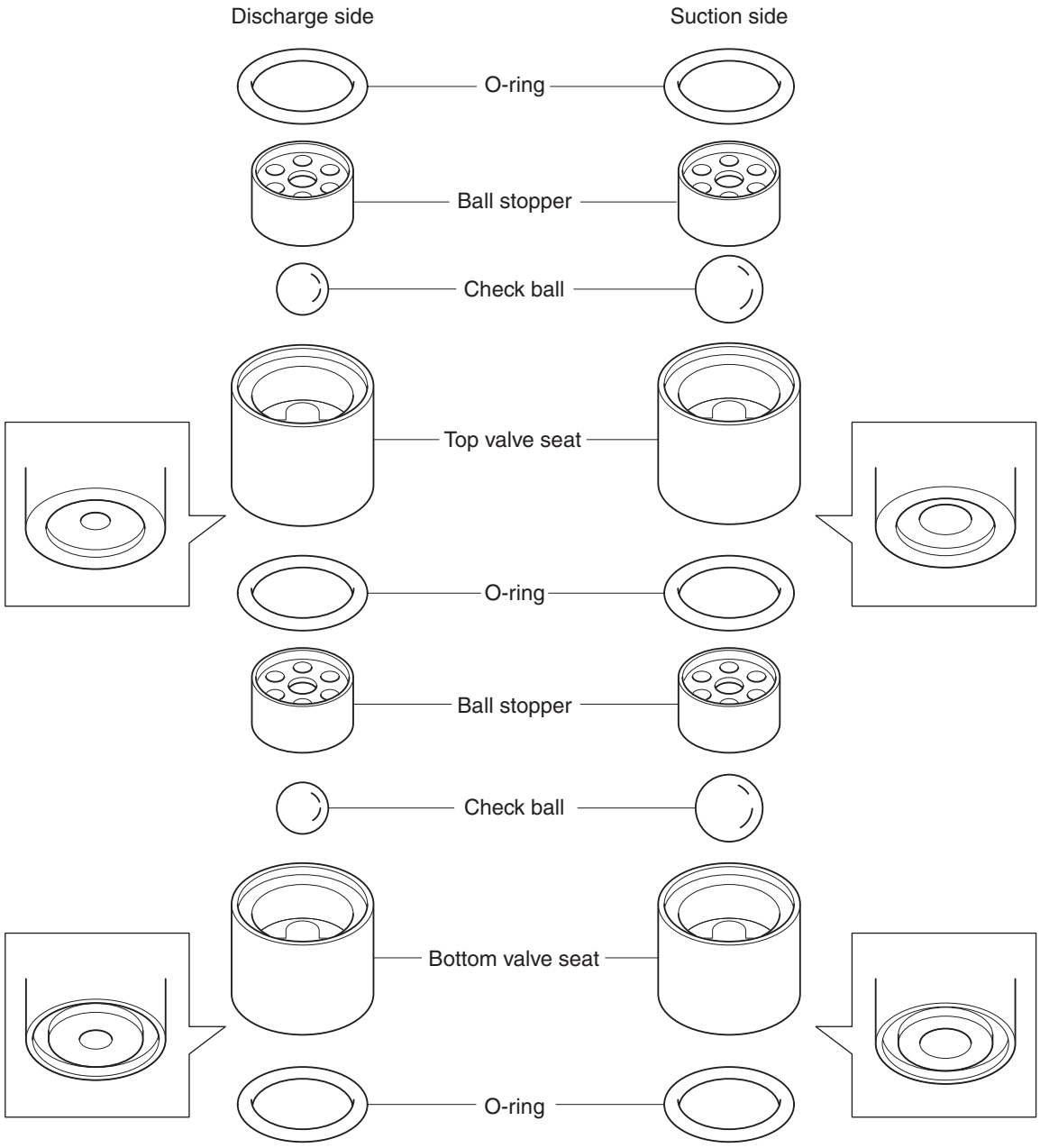
Maintenance

TPL2ME·TPL2MWE-032



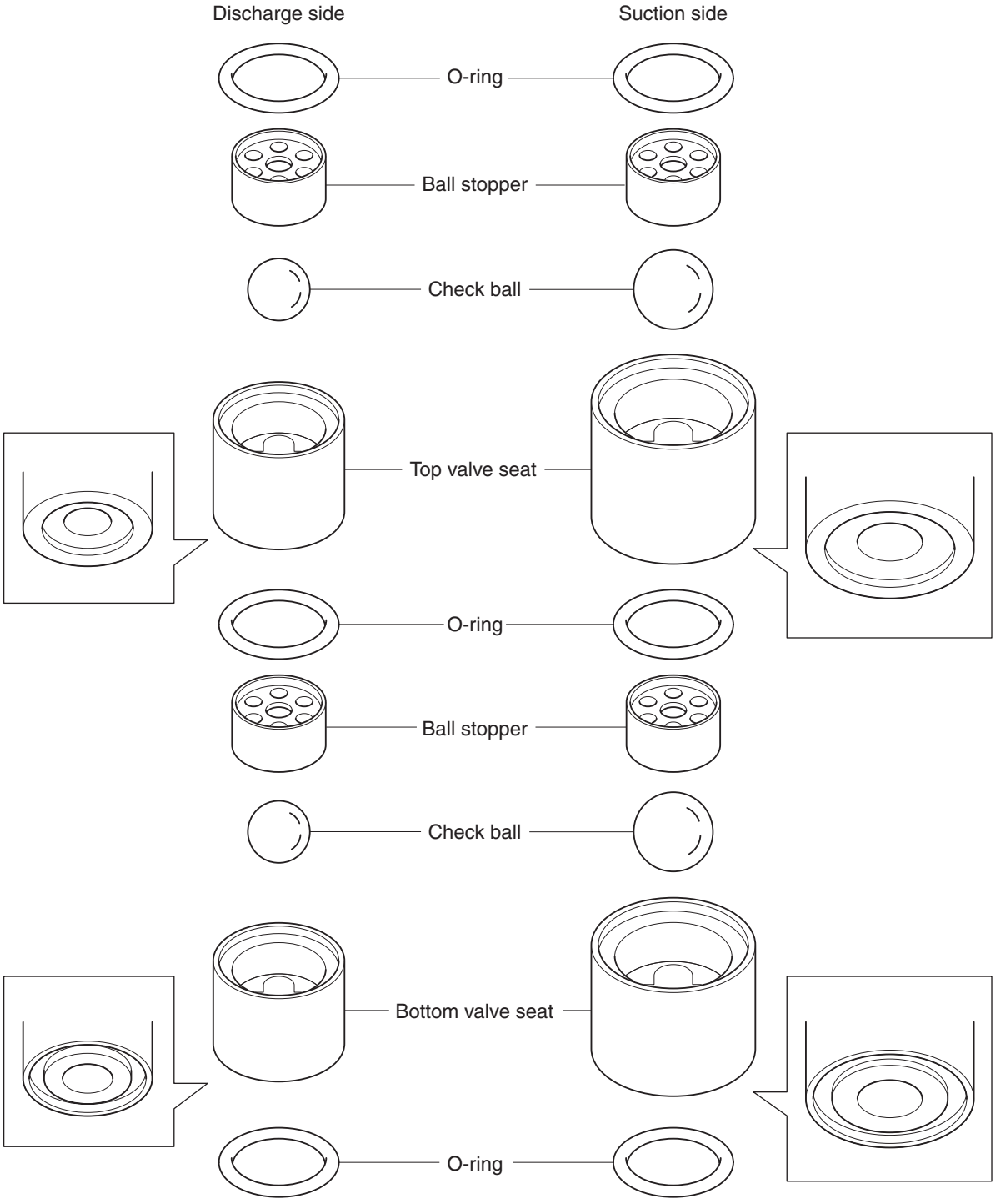
Maintenance

TPL2ME·TPL2MWE-040



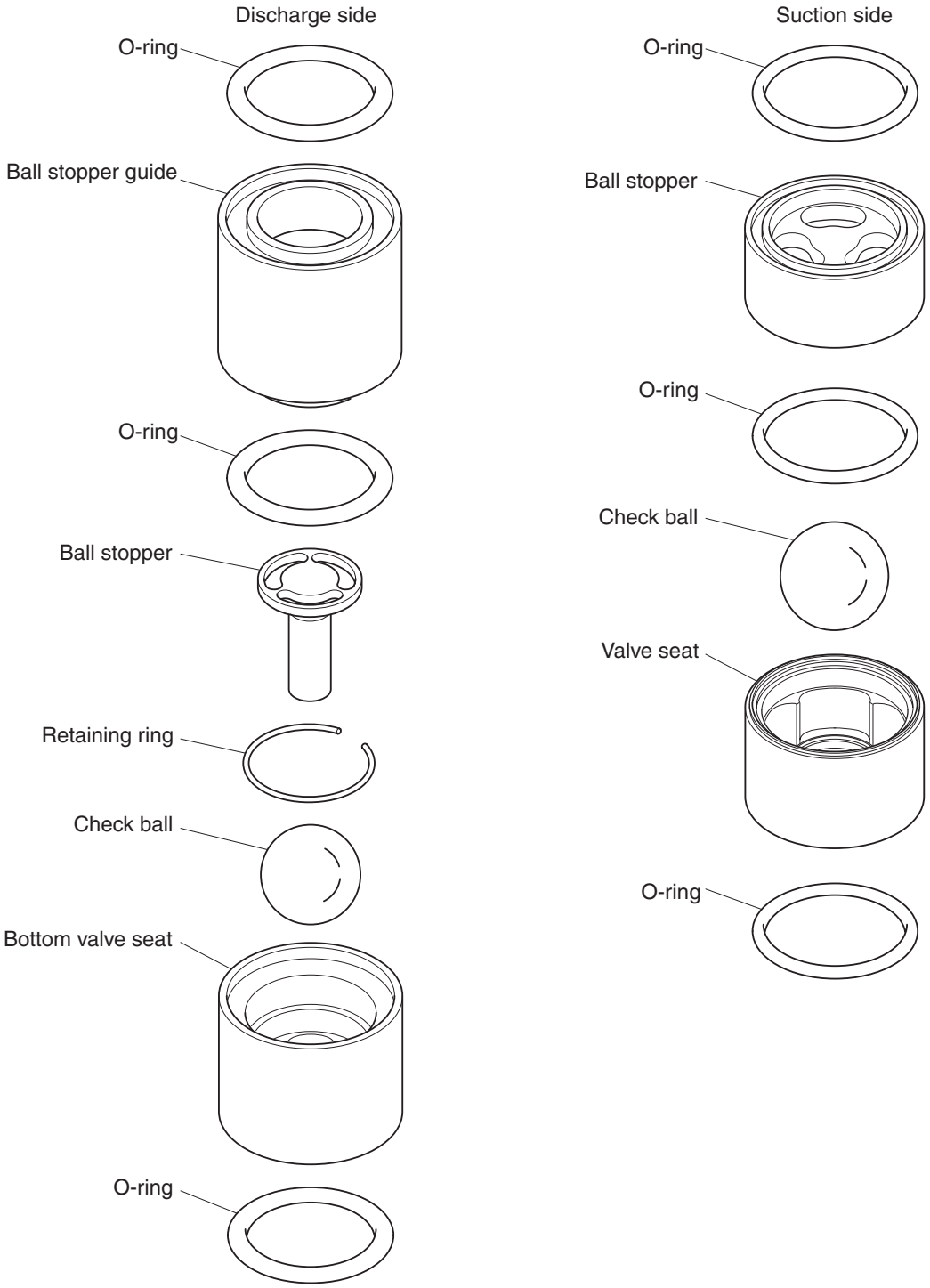
Maintenance

TPL2ME·TPL2MWE-056



Maintenance

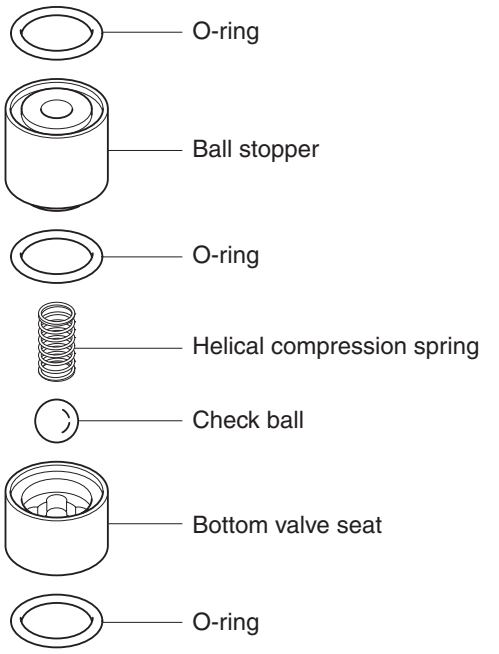
TPL2ME-080/095 ✻ The following TPL2ME-080/095 (high-viscosity type) valve seat assembly shows the helical compression spring removed from the valve seat.
See the procedure on page 37 for assembly.



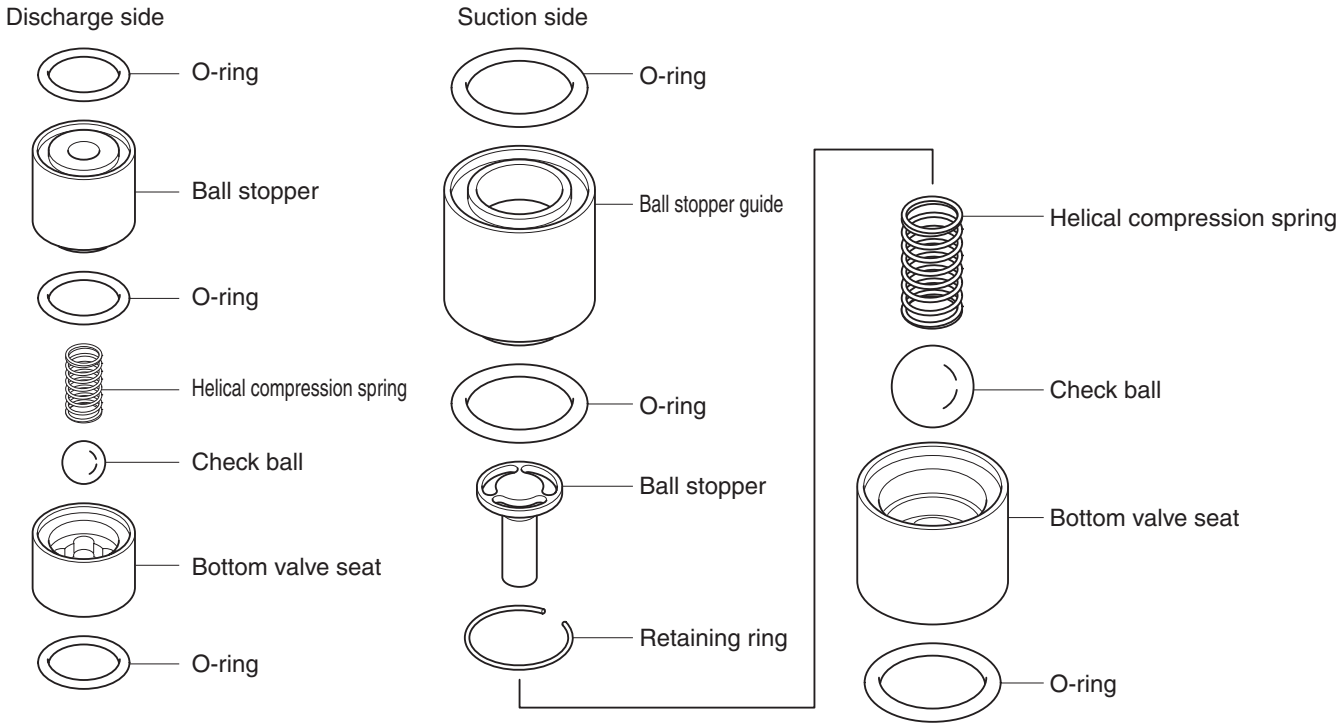
Maintenance

TPL1ME·TPL1MWE-008/014/018/028 (high viscosity) ✻ For the assembly procedure, see page 35.

Discharge side - Suction side (common)

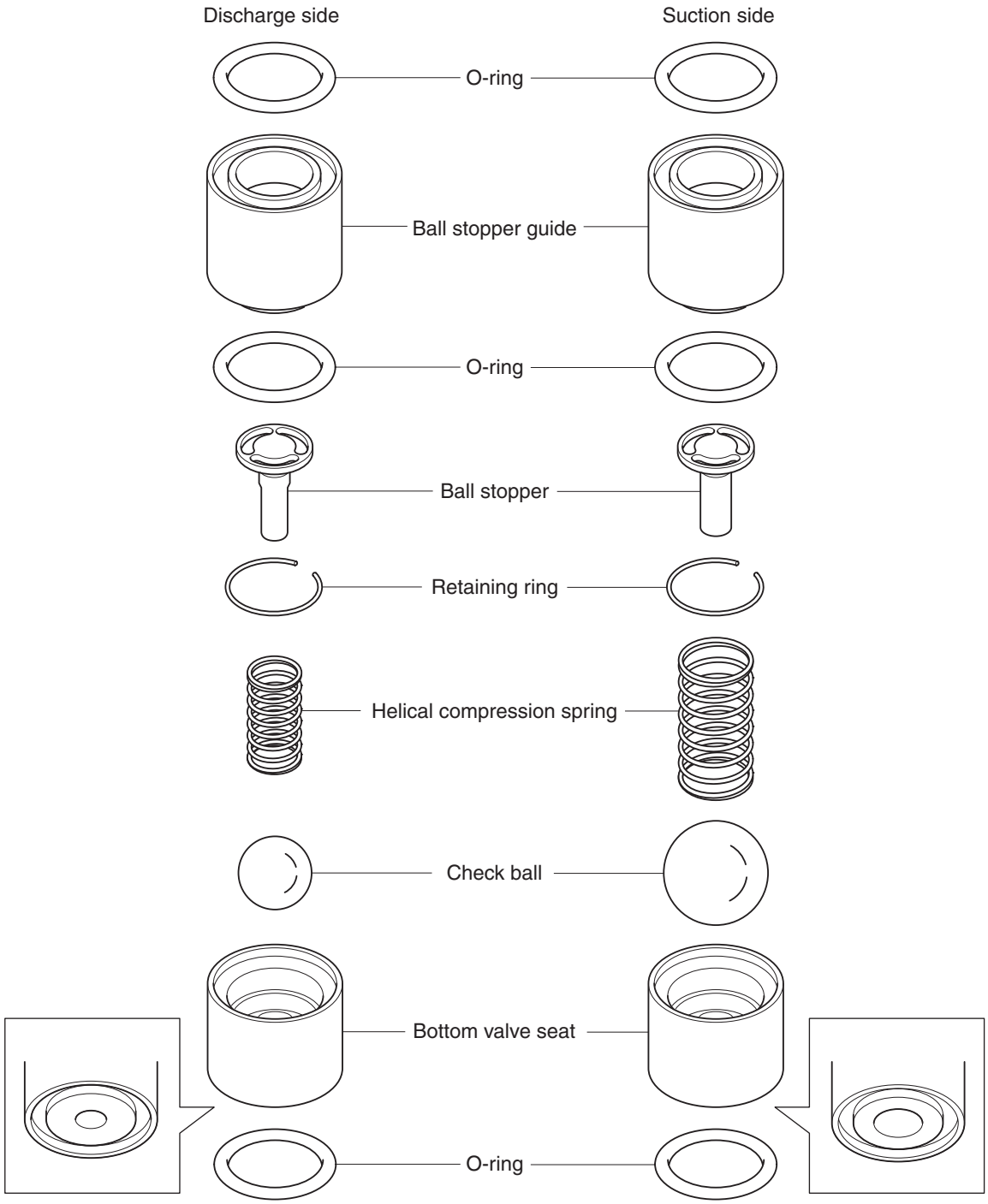


TPL2ME·TPL2MWE-028/032 (high viscosity) ✻ For the assembly procedure, see page 36.



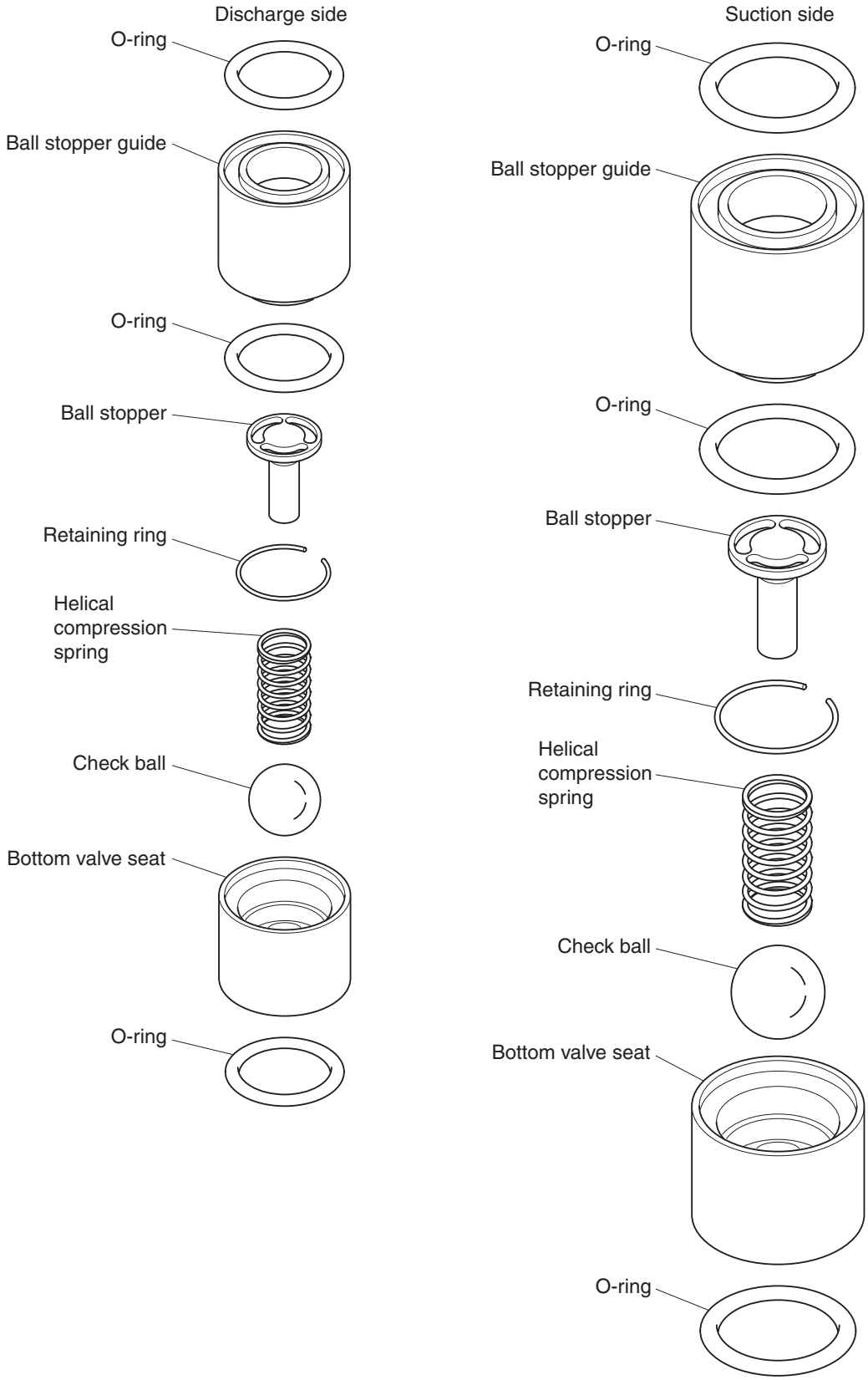
Maintenance

TPL2ME·TPL2MWE-040 (high viscosity) ✻ For the assembly procedure, see page 36.



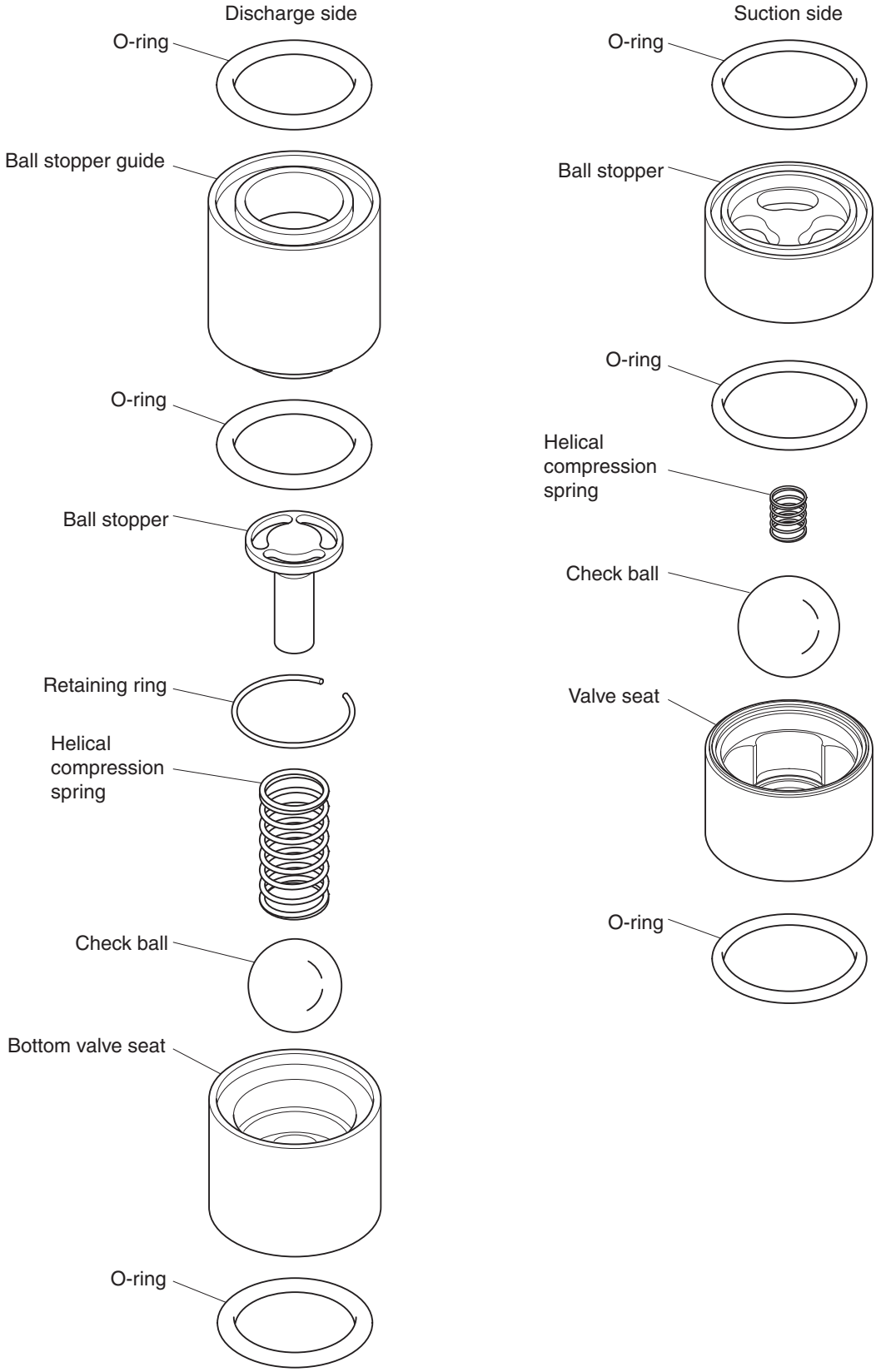
Maintenance

TPL2ME·TPL2MWE-056 (high viscosity) ✻ For the assembly procedure, see page 36.



Maintenance

TPL2ME-080/095 (high viscosity) ✻ For the assembly procedure, see page 37.



■Cleaning the valve seats

- Clean the parts at the liquid-end parts. (If any of the parts are damaged, replace or repair them.)
- Inspect the valve seat seal sections with special care, and if there is dirt or foreign matter on any of these sections, use a soft cloth or similar item to remove it. If any of the sections is worn or damaged, replace them.

Maintenance

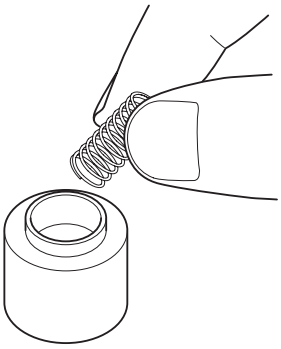
■Assembling the valve seats

Bearing in the mind the following points, assemble the valve seats following the disassembly sequence in reverse.

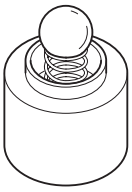
- If the pump head has also been removed, install it, and then mount the valve seats.
- Tighten up evenly the hexagon socket head bolts (×4) used to secure each of the manifolds. In addition, exercise torque control when tightening the bolts. (For details, refer to "■How to remove the valve seats" (see page 24).)
- Check the parts configuration of the valve seat sections, and ensure that all the parts are properly installed with no parts left uninstalled.
  (Bear in mind that the tops and bottoms, the installation sequence and the sizes of the check balls will differ between the discharge side and suction side depending on the model concerned. In the case of a high-viscosity type, refer to the assembly method set forth below.)

When assembling the valve seats for the TPL1ME· TPL1MWE high-viscosity type (same procedure adopted for both discharge side and suction side)

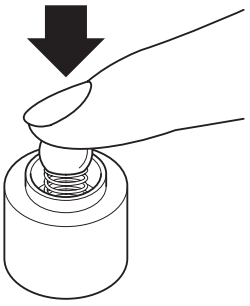
(1) Place the helical compression spring on top of the ball stopper.



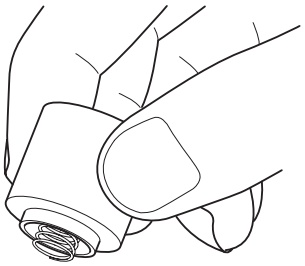
(2) Place the check ball on top of the helical compression spring.



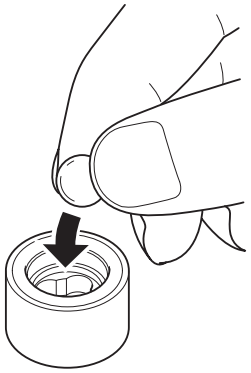
(3) Push down on the check ball so that the helical compression spring fits inside.



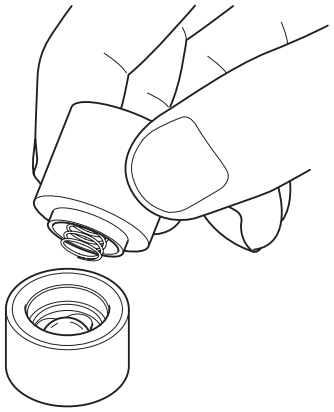
(4) Turn the valve seat upside down, and check that the helical compression spring does not fall out.

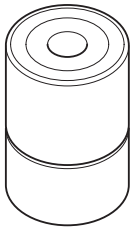


(5) Install the O-ring on the bottom valve seat.
(6) Insert the check ball into the bottom valve seat.



(7) Place the ball stopper over the bottom valve seat.



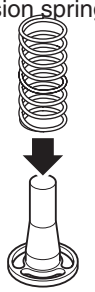


Fully assembled valve seat

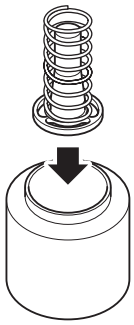
Maintenance

When assembling the valve seats for the TPL2ME· TPL2MWE-028 to 056 high-viscosity type (same procedure adopted for both discharge side and suction side)

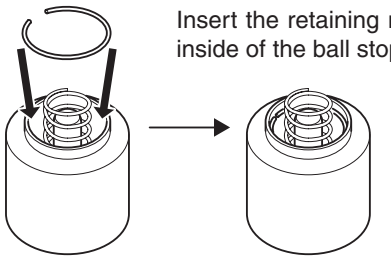
(1) Fit the helical compression spring onto the ball stopper.



(2) Insert the ball stopper into the ball stopper guide.

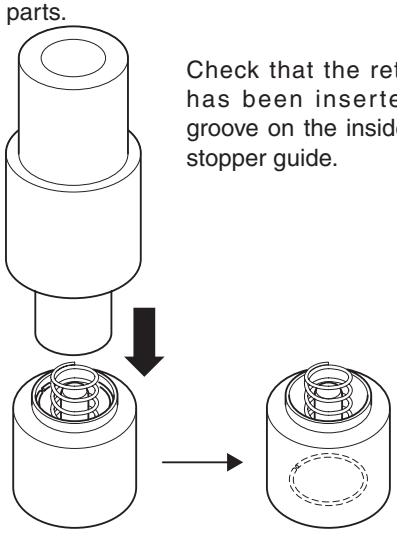


(3) Insert the retaining ring into the ball stopper guide.



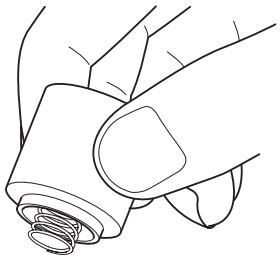
Insert the retaining ring into the inside of the ball stopper guide.

(4) Press down on the ball stopper guide using the jig for securing the retaining ring which is packed together with the other parts.

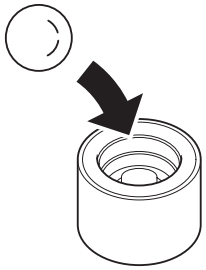


Check that the retaining ring has been inserted into the groove on the inside of the ball stopper guide.

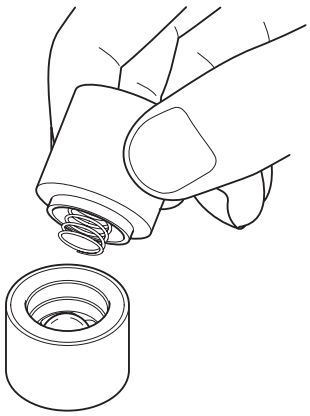
(5) Turn the valve seat upside down, and check that the helical compression spring does not fall out.

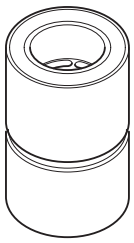


(6) Install the O-ring on the bottom valve seat.
(7) Insert the check ball into the bottom valve seat.



(8) Place the ball stopper guide over the bottom valve seat.





Fully assembled valve seat

Maintenance

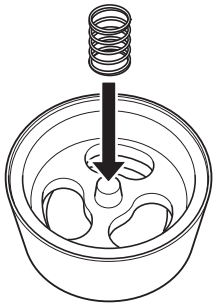
TPL2ME-080/095 high-viscosity type

Discharge side

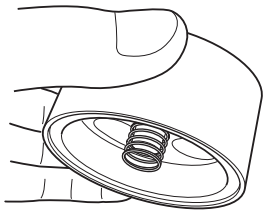
Same as for TPL2ME-028 to 056 (See page 36)

Suction side

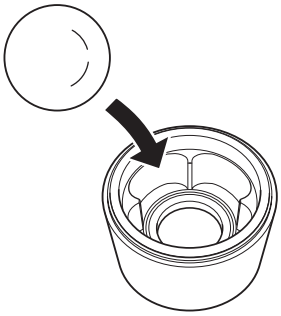
(1) Fit the helical compression spring onto the ball stopper.



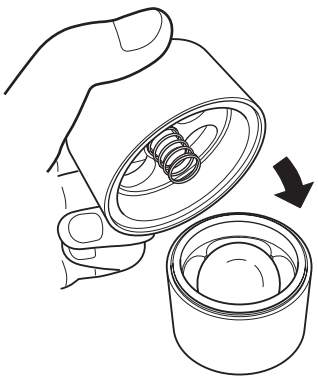
(2) Turn the valve seat upside down, and check that the helical compression spring does not fall out.



(3) Install the O-ring on the bottom valve seat.
(4) Insert the check ball into the bottom valve seat.



(5) Cover the ball stopper from above.



Maintenance

Inspecting and cleaning the diaphragms

Preparations

- Have liquid reception tray (with a capacity of 500 cc or more) ready. (This is to catch the liquid remaining inside the pump head which will flow out.)
- Tighten the shutoff valves on the discharge side and suction side.

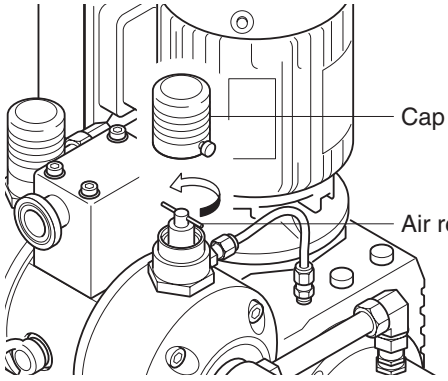
✻ The illustration shows TPL□ME.

✻ Described below is the sequence of steps taken for the diaphragm on the right as seen when the pump is viewed from the front. Take the same steps for the diaphragm on the left as well.

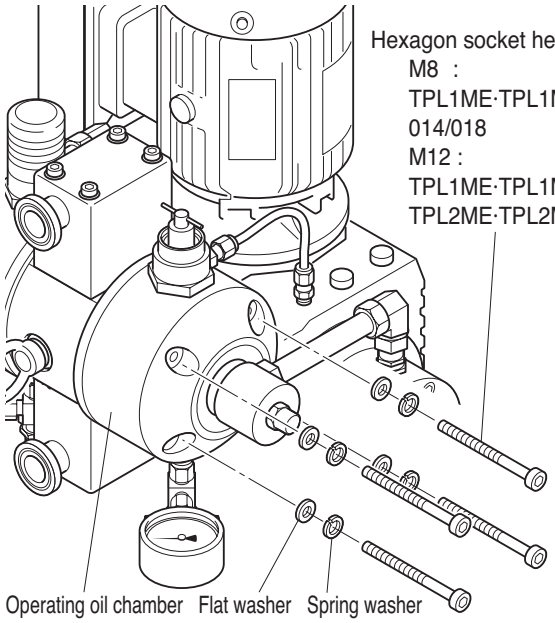
⚠ CAUTION

- **If the operating oil chamber is opened without releasing the pressure, the diaphragm may fall out.**

(1) Remove the cap, and turn the air release handle three full rotations in the counter-clockwise direction to release the pressure inside the operating oil chamber.



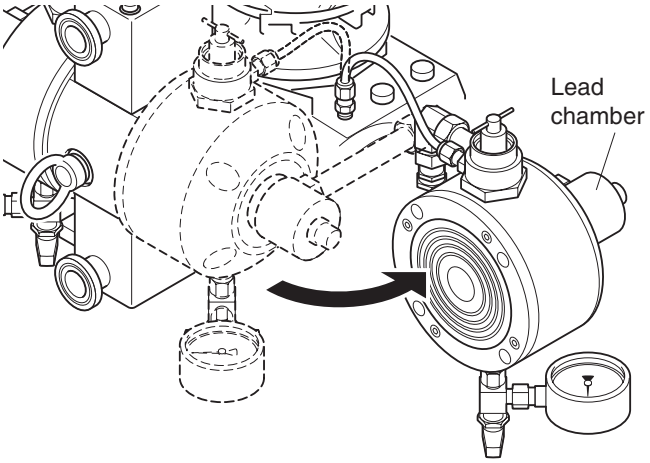
(2) Remove the four hexagon socket head bolts securing the operating oil chamber.



(3) Grasp the lead chamber, and open the operating oil chamber.

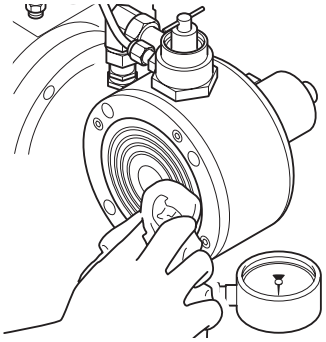
⚠ CAUTION

- **Exercise caution as the operating oil chamber may rotate around the lead pipe.**



(4) Check the diaphragm.

- If the diaphragm is dirty, wipe off the dirt gently using a soft cloth or similar item.



- If the diaphragm is bent out of shape or damaged, proceed to step (2) of "Replacing the diaphragms" on page 39, and replace the diaphragm.

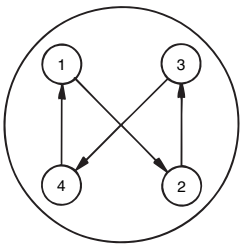
(5) Follow the steps below to reassemble the parts.

- Return the operating oil chamber to its original position, tighten the four hexagon socket head bolts with the torques given in the table below, turn the air release handle three full rotations in the clockwise direction, and install the cap.

Bolt size	Tightening torque
M8	11.7 to 12.7N·m
M12	19.6 to 20.6N·m

⚠ CAUTION

- **When securing the operating oil chamber using the hexagon socket head bolts, tighten these bolts evenly a little at a time in the sequence shown in the figure below. If, for example, the bolts are tightened in a 1 → 3 → 2 → 4 sequence, they will not be tightened evenly, possibly resulting in liquid leaking from the pump head.**



Maintenance

Replacing the diaphragms

■Removing the diaphragms (TPL□ME)

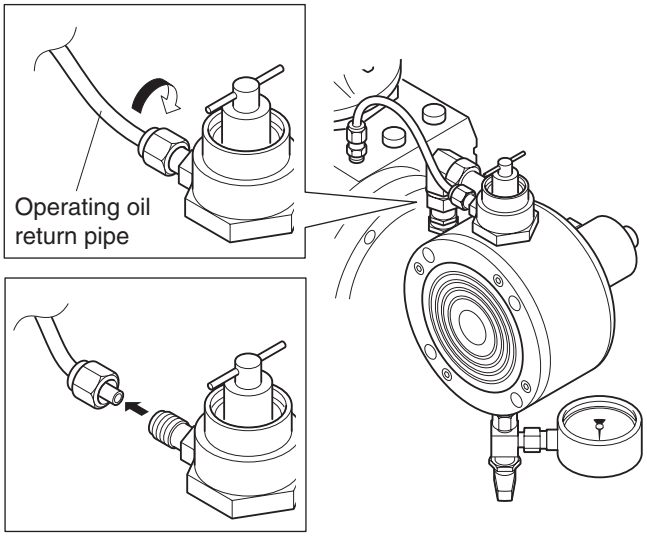
Preparations

- Ready liquid reception tray (with a capacity of 500 cc or more). (This is to catch the liquid remaining inside the pump head that will flow out.)
- Tighten the shutoff valves on the discharge side and suction side.

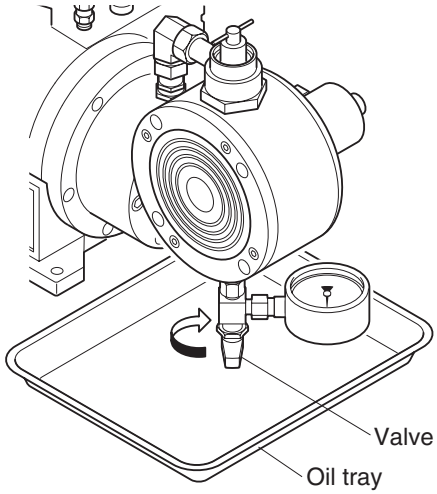
✻ Described below is the sequence of steps required for the diaphragm on the right as seen when the pump is viewed from the front. Perform the same steps for the diaphragm on the left as well.

(1) Perform steps (1) to (3) of "Inspecting and cleaning the diaphragms" on page 38 and open the operating oil chamber.

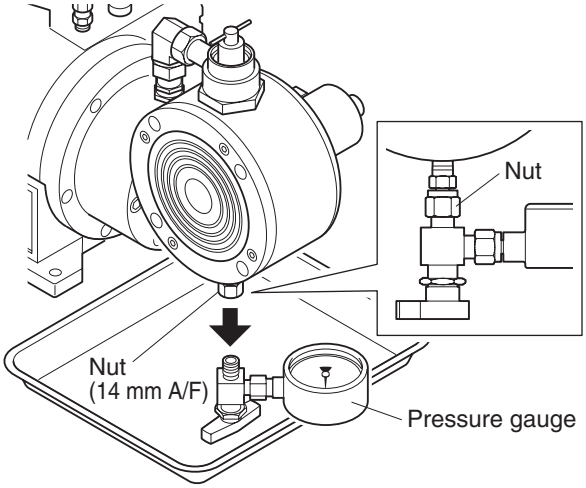
(2) Remove the return pipe.



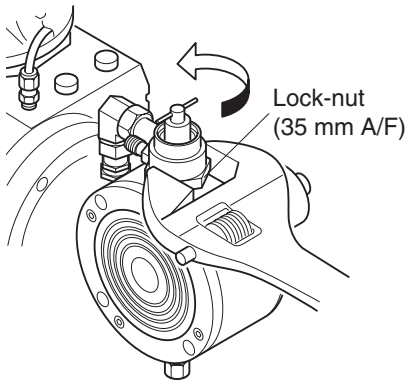
(3) Manually close the valve of the pressure gauge located on the bottom of the operating oil chamber, and place the prepared oil tray below the operating oil chamber.

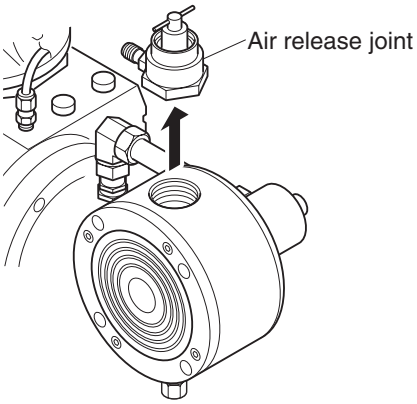


(4) Loosen the nut securing the pressure gauge, and remove the pressure gauge.



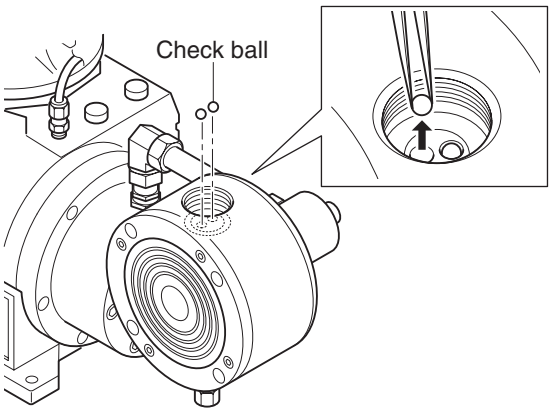
(5) Using a spanner, turn the lock-nut in the counter-clockwise direction to loosen it, then turn the lock-nut manually and remove the air release joint.



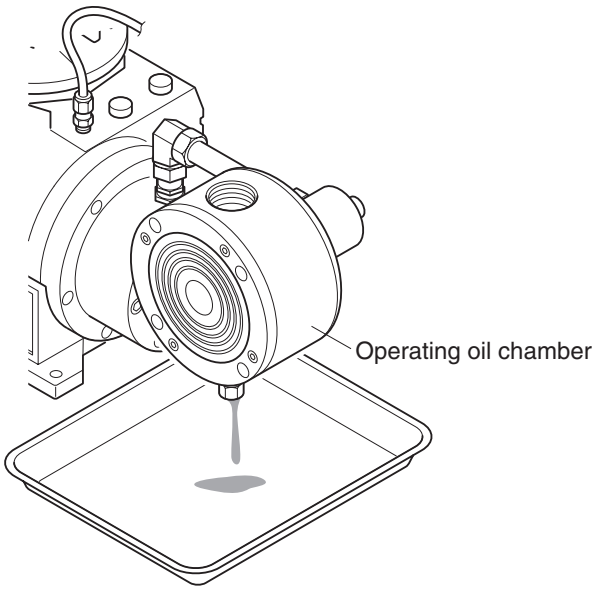


Maintenance

(6) Using tweezers or some other tool, remove the two check balls from the top of the operating oil chamber. Be careful not to scratch the seats of the check balls. (The check balls are small and roll easily, so be careful not to lose them.)

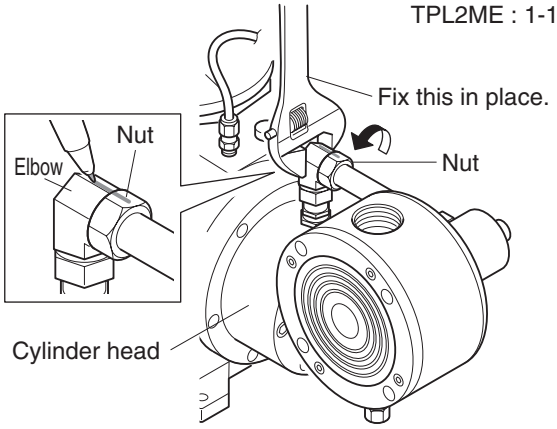


(7) Wait for the operating oil to flow out of the operating oil chamber.

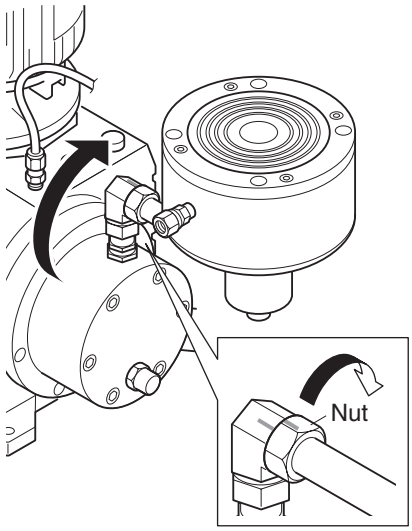


(8) [Excluding TPL2ME-080/095]
Using an ink marker or other marking instrument, mark the elbow and nut located on top of the cylinder head, and then loosen the lead pipe nut.

Fixed side TPL1ME : 11/16" A/F
TPL2ME : 1-1/16" A/F
Rotating side TPL1ME : 19 mm A/F
TPL2ME : 1-1/8" A/F



(9) [Excluding TPL2ME-080/095]
Rotate the operating oil chamber so that the diaphragm faces upward, and tighten the nut sufficiently to secure the operating oil chamber in place.

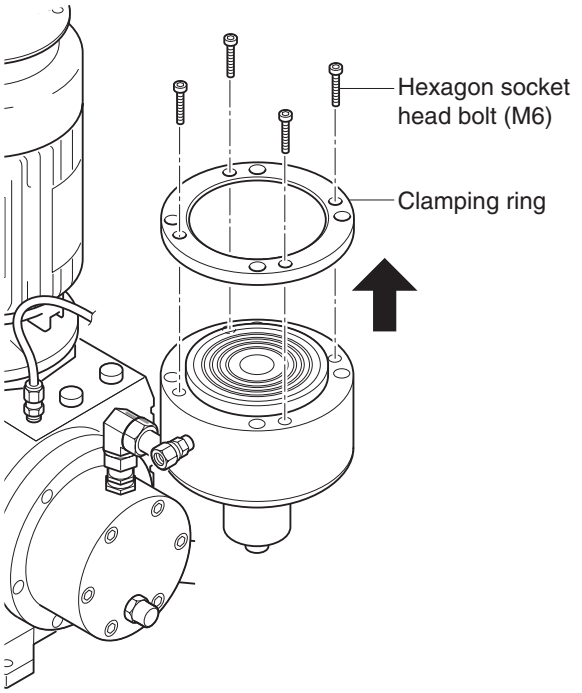


NOTE

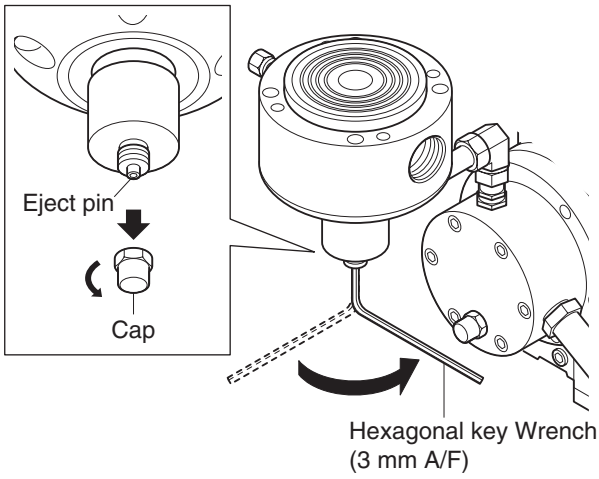
- **The direction of the operating oil chamber cannot be changed for TPL2ME-080/095. Skip steps (8) and (9) and proceed to step (10) with the diaphragm facing sideways.**

Maintenance

(10) Remove the four hexagon socket head bolts securing the clamping ring.

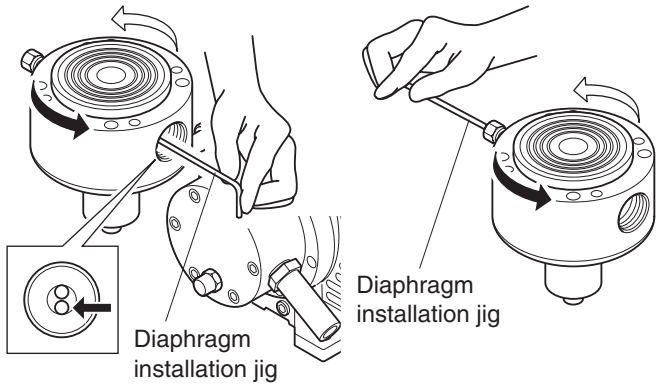


(11) Turn the lead chamber cap in the counterclockwise direction to remove it, insert the hexagonal key wrench into the eject pin in the center and turn it in the clockwise direction until it comes in contact with the retaining ring.



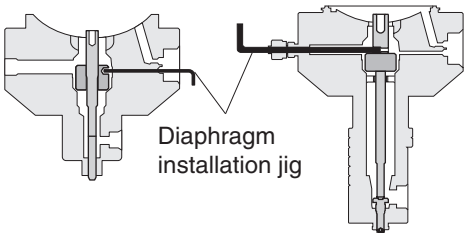
(12) [Excluding TPL2ME-080/095]
Insert the supplied diaphragm installation jig (L-shaped bar) into the operating oil chamber hole until the jig reaches the back of the chamber, and then turn the diaphragm in the counterclockwise direction while you press in on the jig.

TPL1ME TPL2ME

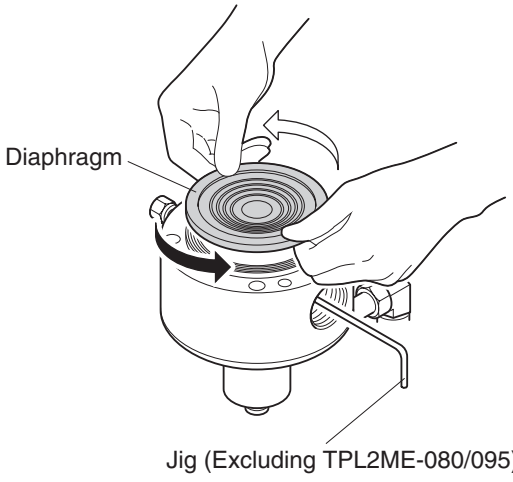


As shown in the figure below, if you insert the diaphragm installation jig into the safety valve hole, the jig stops the shaft from rotating.

TPL1ME TPL2ME



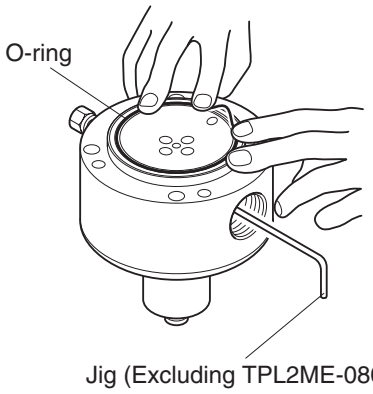
(13) Rotate the diaphragm in the counter-clockwise direction and remove it.
Leave the tool inserted.



Maintenance

■Installing the diaphragms (TPL□ME)

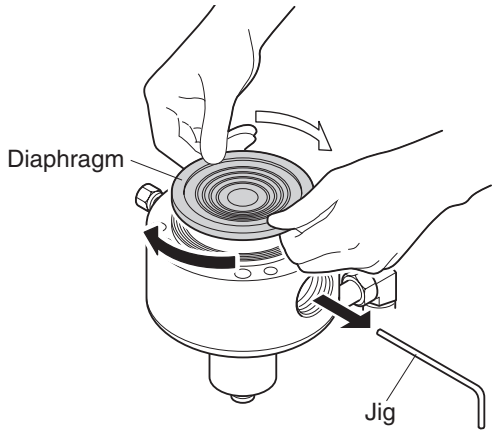
(1) Replace the O-ring with a new one.
Use only your hands to remove the O-ring, do not use tools such as screwdrivers.



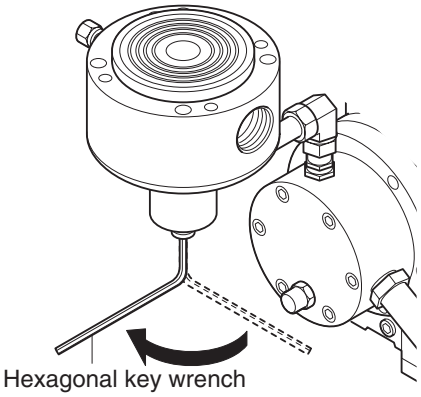
(2) Install the new diaphragm by rotating it in the clockwise direction until it stops.

(3) [TPL2ME-080/095 only]
Return the diaphragm counterclockwise 15 degrees.
✻ Do not perform this step for models other than 080/095.

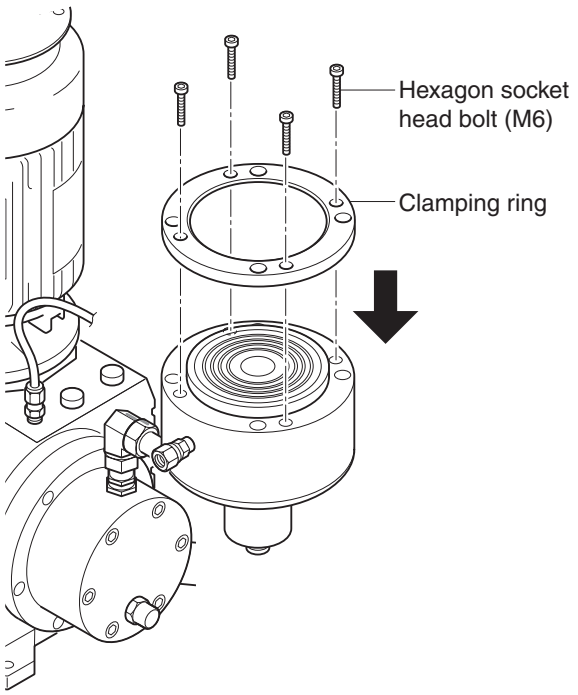
(4) [Excluding TPL2ME-080/095]
Pull out the inserted jig.



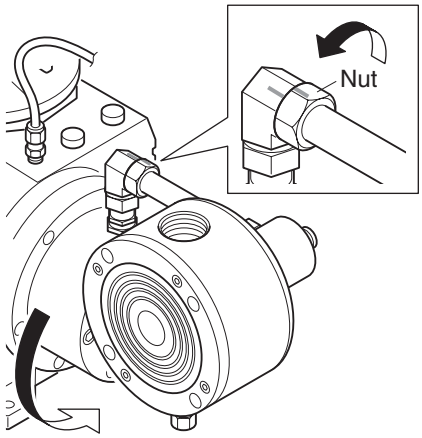
(5) Insert the hexagonal key wrench into the eject pin and turn it counterclockwise until it stops.



(6) Install the clamping ring, and secure it with the four hexagon socket head bolts. (Tightening torque: 7.8 to 8.8 N·m)

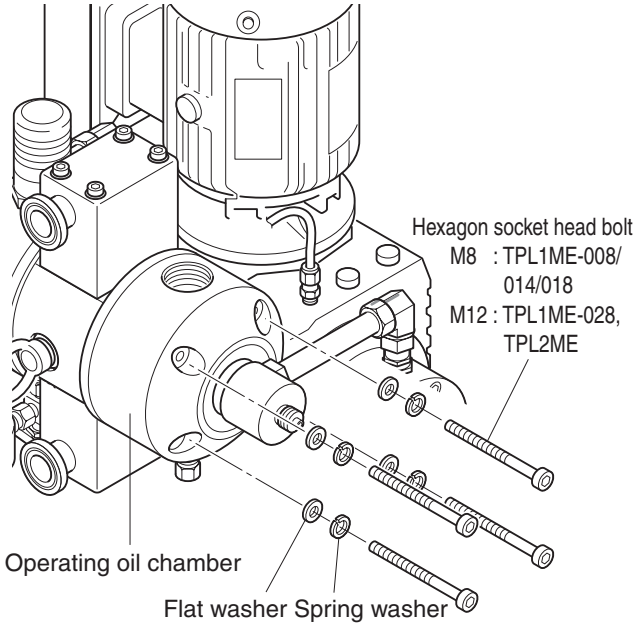


(7) [Excluding TPL2ME-080/095]
Loosen the nut of the lead pipe, and return the operating oil chamber to its original orientation.

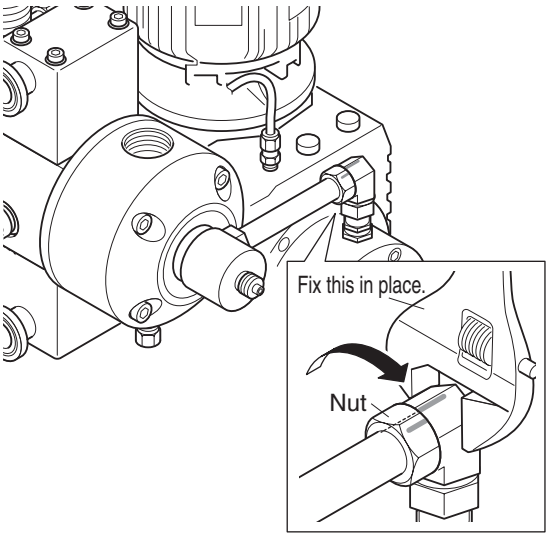


Maintenance

(8) Close the operating oil chamber, and temporarily tighten the hexagon socket head bolts.



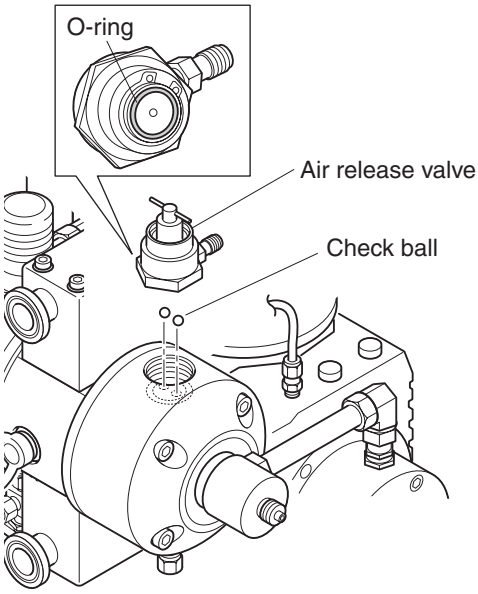
(9) [Excluding TPL2ME-080/095]
Tighten the nut to the position marked when removing the diaphragms and then tighten the nut a little further.



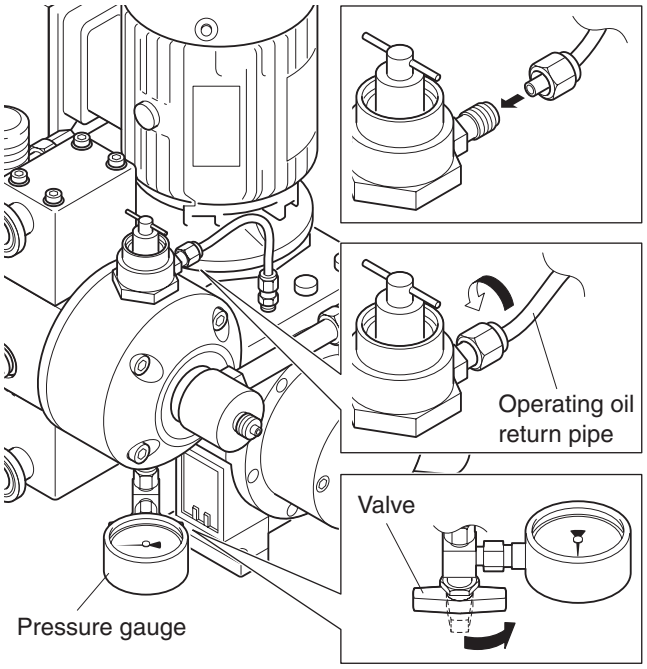
(10) Tighten the hexagon socket head bolts securing the operating oil chamber with the specified torque.

Bolt size	Tightening torque
M8	11.7 to 12.7N·m
M12	19.6 to 20.6N·m

(11) Insert the check balls, and install the air release valve. Tighten the air release valve until there is light resistance. In addition, when installing the air release valve, check that the O-ring is installed properly.



(12) Install the operating oil return pipe and the pressure gauge, and open the valve.



Maintenance

Replacing the diaphragms

■Removing the diaphragms (TPL□MWE)

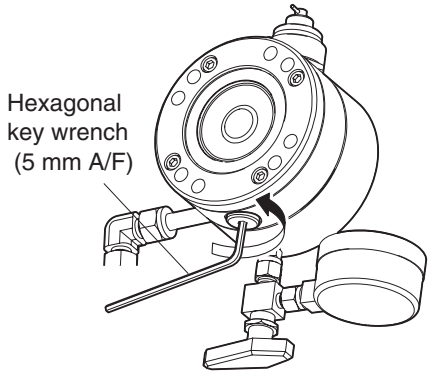
Preparations

- Have a liquid reception tray (with a capacity of 500 cc or more) available. (This is to catch the liquid remaining inside the pump head that will flow out.)
- Have a cup for buffer solution (with a capacity of 500 cc or more) available.
- Tighten the shutoff valves on the discharge side and suction side.

✻ Described below is the sequence of steps required for the diaphragm on the right as seen when the pump is viewed from the front. Perform the same steps for the diaphragm on the left as well.

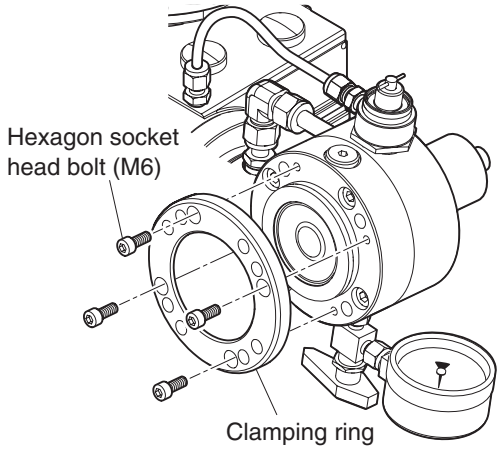
(1) Perform steps (1) to (3) in "Inspecting and cleaning the diaphragms" on page 36 to open the operating oil chamber.

(2) Remove the plug on the bottom side of the intermediate chamber and collect buffer solution with the cup.

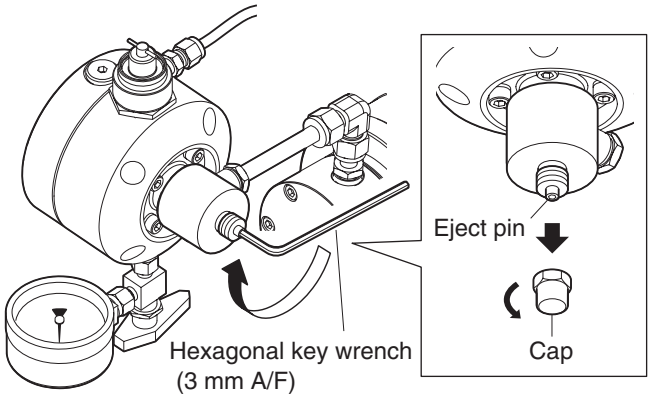


(3) Remove the hexagon socket head bolts securing the clamping ring, then remove the clamping ring.

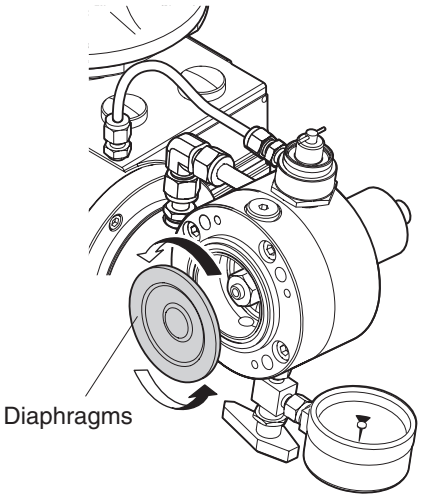
✻ Hexagon socket head bolts
4 bolts: TPL1MWE-008/014/018
8 bolts: TPL1MWE-028,
TPL2MWE-028/032/040/056



(4) Turn the lead chamber cap counterclockwise to remove it, then insert the hexagonal key wrench into the eject pin in the center and turn it clockwise until it comes in contact with the retaining ring.

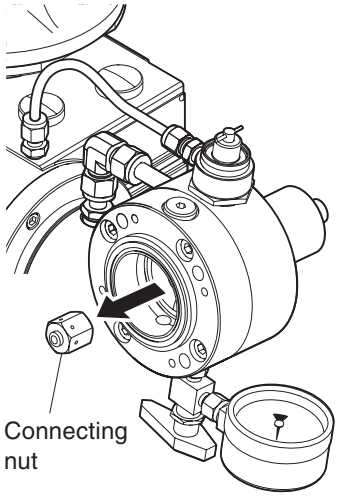


(5) Turn the diaphragm counterclockwise to remove it.



(6) Use a wrench to turn the connecting nut counterclockwise to remove it.

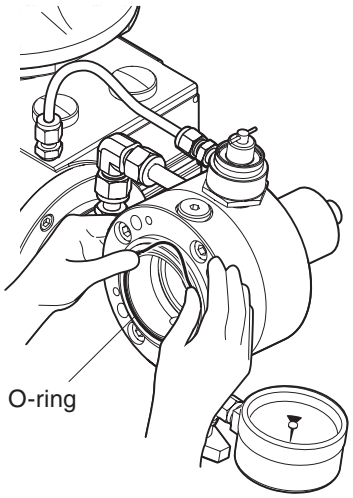
✻ Wrench size (A/F)
TPL1MWE, TPL2MWE-028/032: 19 mm
TPL2MWE-040/056: 24 mm



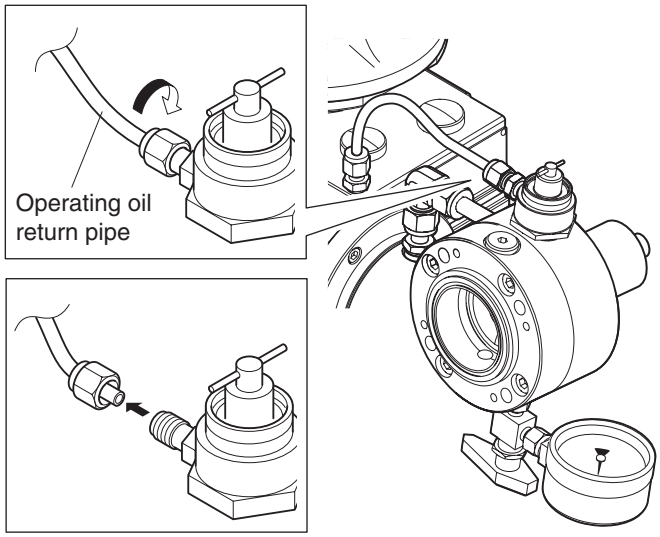
Maintenance

(7) Remove the O-ring.

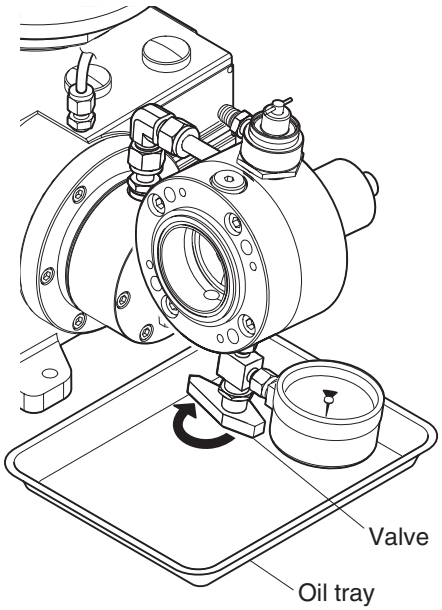
Use only your hands to remove the O-ring. Do not use tools such as screwdrivers.



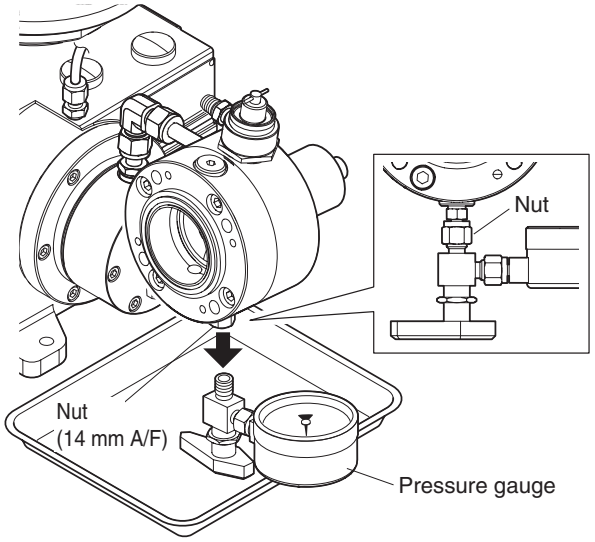
(8) Remove the return pipe.



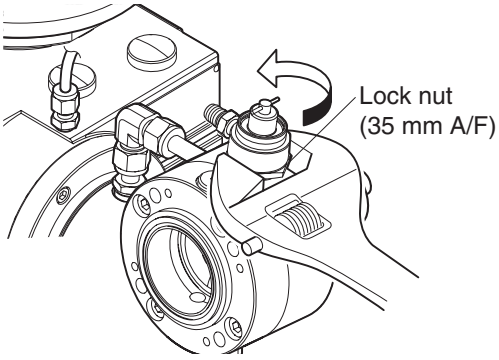
(9) Close the valve on the pressure gauge located at the bottom of the operating oil chamber, then place the oil tray.

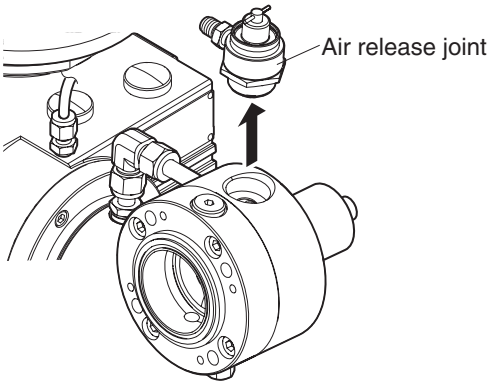


(10) Loosen the nut securing the pressure gauge, then remove the pressure gauge.

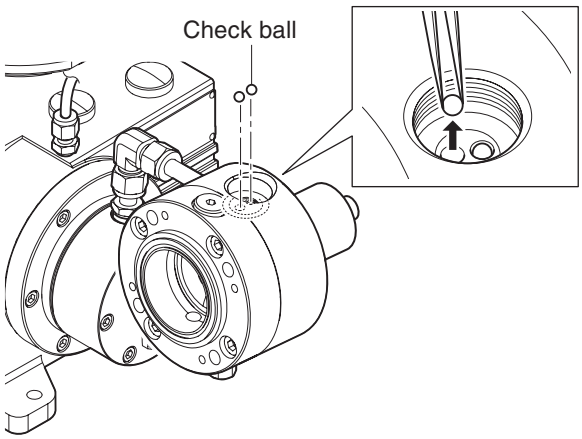


(11) Using a wrench, turn the lock nut counterclockwise to loosen it, then turn the lock nut manually to remove the air release joint.

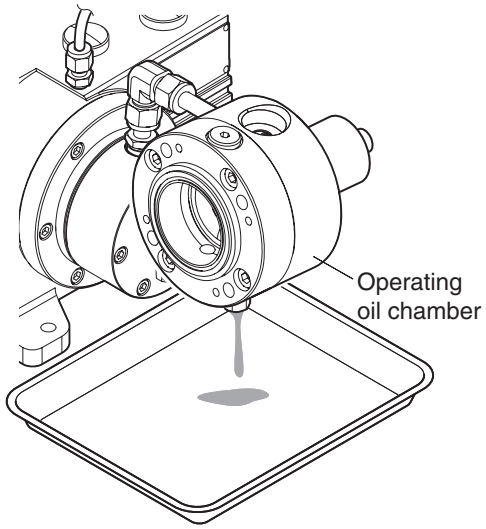




(12) Using tweezers or some other tool, remove the two check balls from the top of the operating oil chamber. Be careful not to scratch the seats of the check balls.
(The check balls are small and roll easily, so be careful not to lose them.)

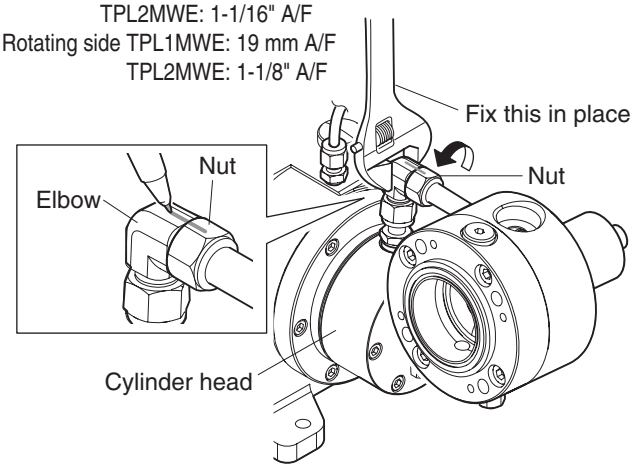


(13) Wait for the operating oil to flow out of the operating oil chamber.

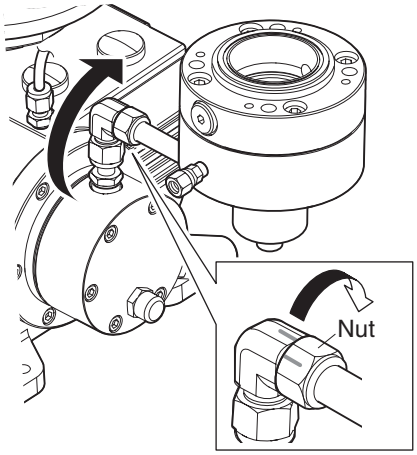


(14) Using an ink marker or other marking tool, mark the elbow and nut located on top of the cylinder head, then loosen the lead pipe nut.

Fixed side TPL1MWE: 11/16" A/F
TPL2MWE: 1-1/16" A/F
Rotating side TPL1MWE: 19 mm A/F
TPL2MWE: 1-1/8" A/F

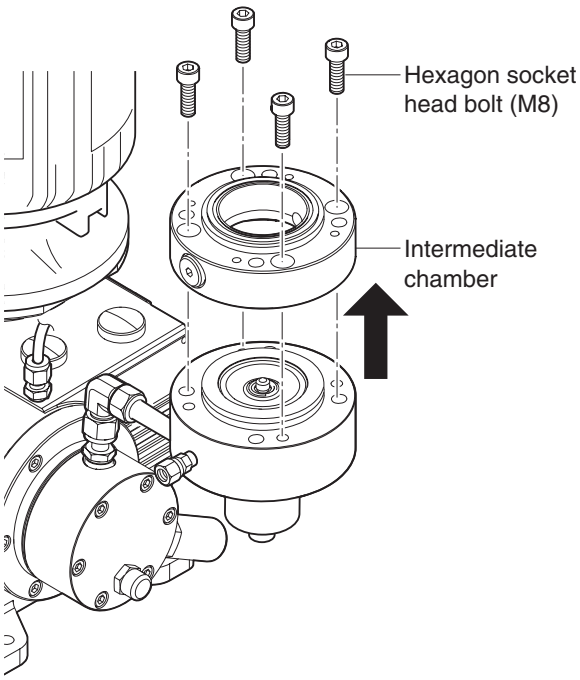


(15) Rotate the operating oil chamber so that the diaphragm faces upward, then tighten the nut sufficiently to secure the operating oil chamber in place.



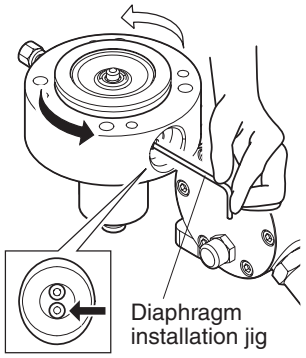
Maintenance

(16) Remove the four hexagon socket head bolts securing the intermediate chamber.

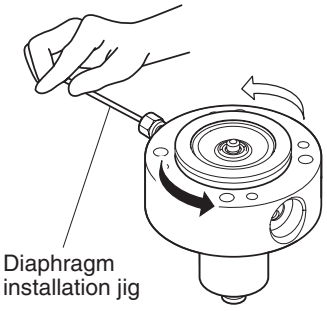


(17) Insert the supplied diaphragm installation jig (L-shaped bar) into the operating oil chamber hole until the jig reaches the back of the chamber, then turn the diaphragm counterclockwise while you press in on the jig.

TPL1MWE

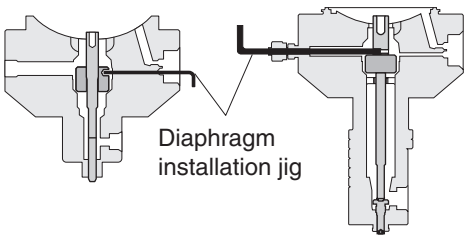


TPL2MWE

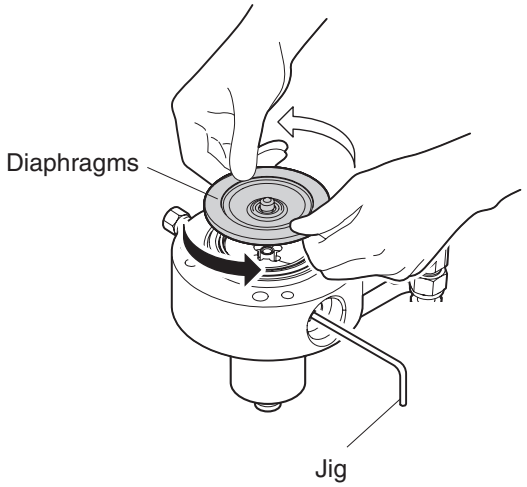


Inserting the diaphragm installation jig into the safety valve hole as shown in the figure below keeps the shaft from rotating.

TPL1MWE TPL2MWE



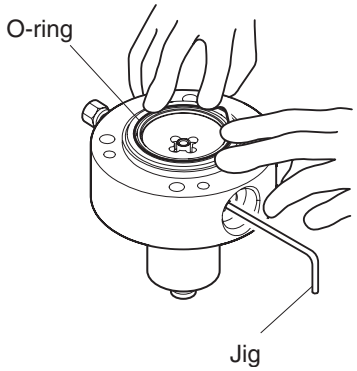
(18) Rotate the diaphragm counterclockwise to remove it. Leave the jig inserted.



Maintenance

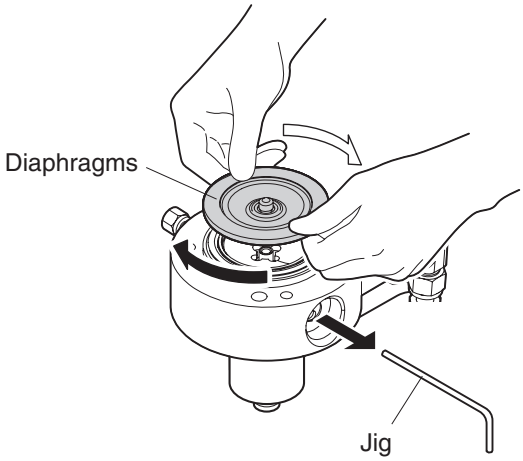
■Installing the diaphragms (TPL□MWE)

(1) Replace the O-ring with a new one.
Use only your hands to remove the O-ring. Do not use tools such as screwdrivers.

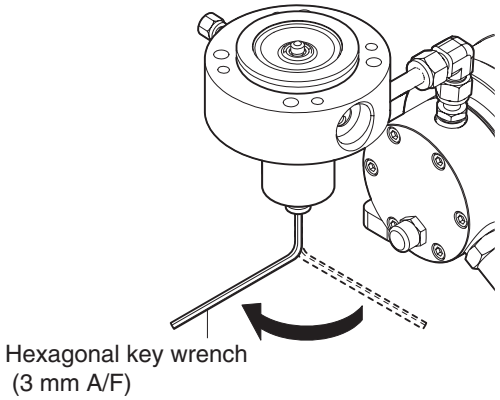


(2) Install the new diaphragm by rotating it clockwise until it stops.

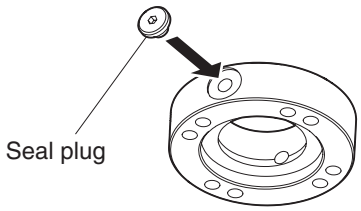
(3) Pull out the inserted jig.



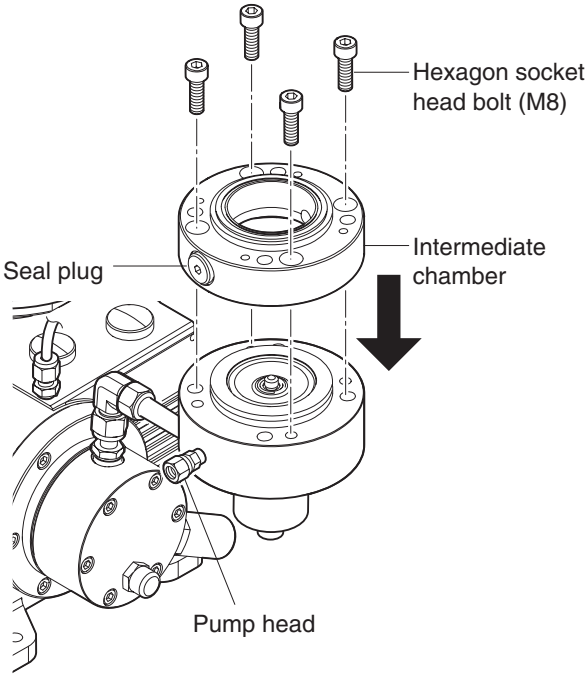
(4) Turn the hexagonal key wrench counterclockwise until it stops.



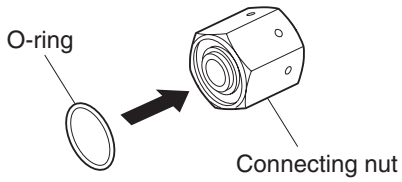
(5) Use the hexagonal key wrench to install the seal plug on the intermediate chamber.
(Tightening torque: 13.7 N·m)



(6) Secure the intermediate chamber with the four hexagon socket head bolts with the seal plug installation surface facing the bottom of the pump head. (Tightening torque: 11.7 to 12.7 N·m)

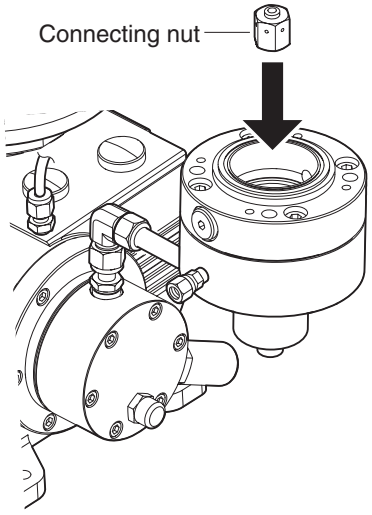


(7) Install the O-ring on the connecting nut.

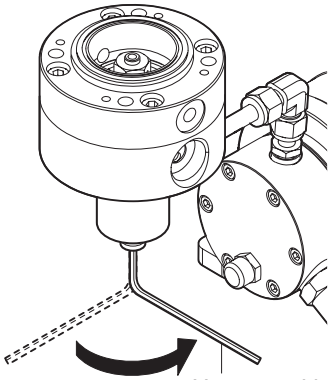


(8) Install the connecting nut.

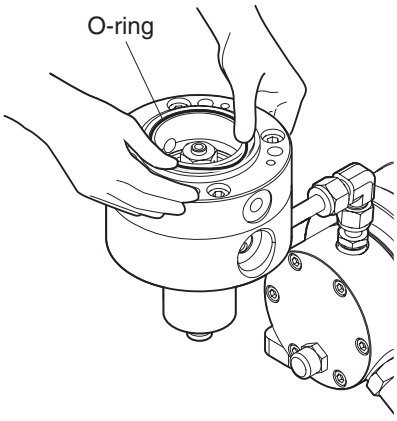
✻ Tightening torque:
TPL1MWE/TPL2ME-028/032 (19 mm A/F):
11.7 to 12.7 N·m
TPL2MWE-040/056 (24 mm A/F): 15.7 to 16.7 N·m



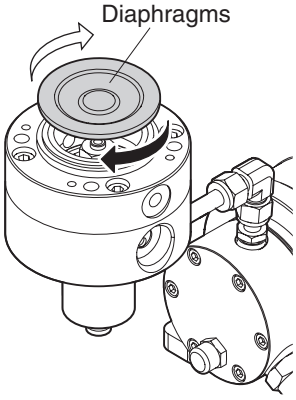
(9) Insert the hexagonal key wrench into the eject pin in the center and turn it clockwise until it comes in contact with the retaining ring.



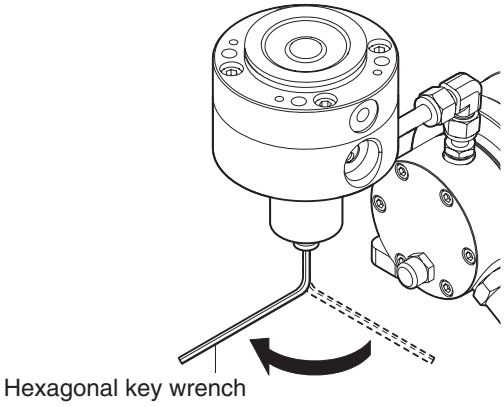
(10) Replace the O-ring with a new one.



(11) Install the new diaphragm by rotating it clockwise until it stops.

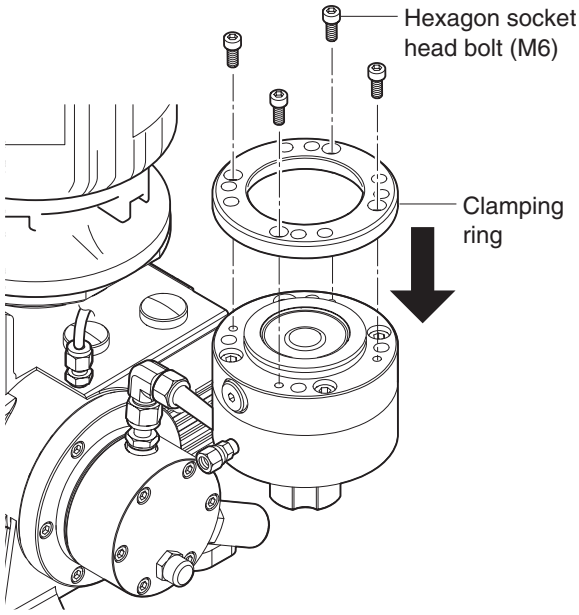


(12) Insert the hexagonal key wrench into the eject pin and turn it counterclockwise until it comes in contact with the retaining ring.



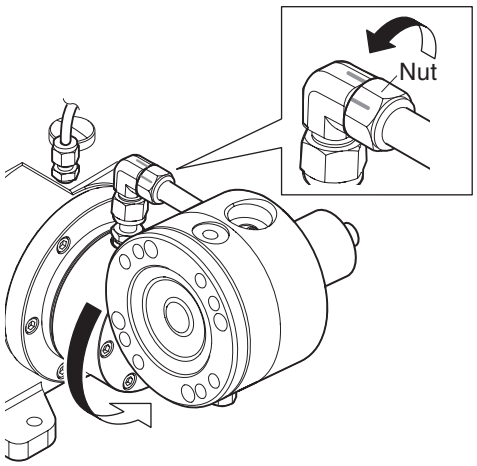
(13) Install the clamping ring and secure it with the hexagon socket head bolts.
(Tightening torque: 7.8 to 8.8 N·m)

✻ Hexagon socket head bolts
4 bolts: TPL1MWE-008/014/018
8 bolts: TPL1MWE-028,
TPL2MWE-028/032/040/056

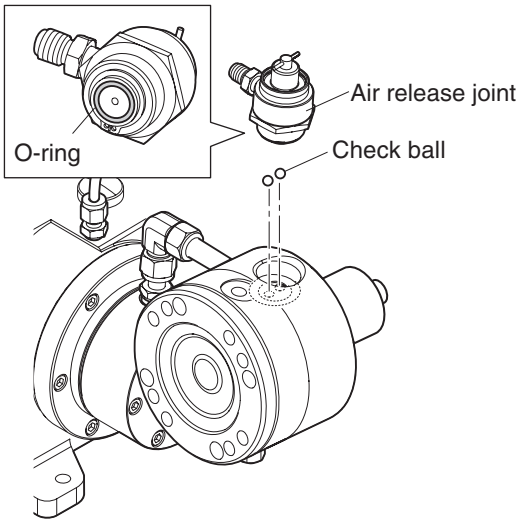


Maintenance

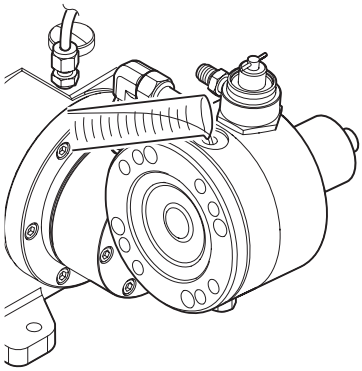
(14) Loosen the nut on the lead pipe, then return the operating oil chamber to its original orientation.



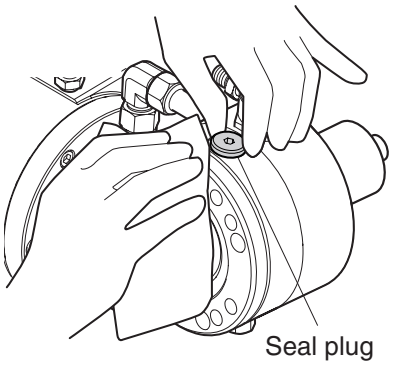
(15) Insert the check balls and air release valve.
Tighten the air release valve until there is light resistance.
In addition, when installing the air release valve, check that the O-ring is installed properly.



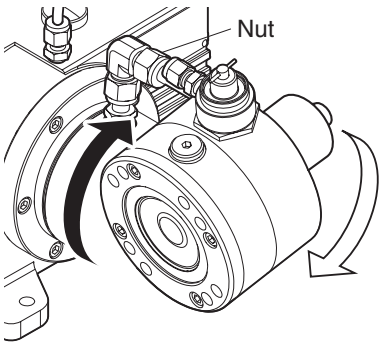
(16) Add buffer solution until it is flush with the injection port.



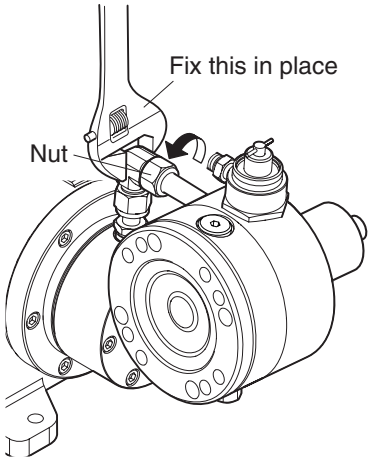
(17) Tighten the seal plug by hand to the degree that the solution does not leak.



(18) Loosen the nut on the lead pipe and shake the operating oil chamber or flick the diaphragm with your finger to remove the air adhered to the diaphragm.

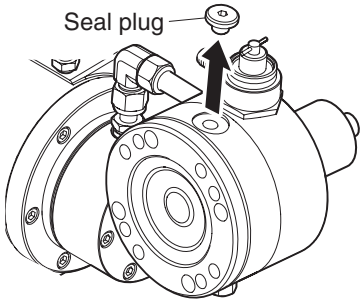


(19) Confirm that there is no air adhered to the diaphragm, then tighten the nut on the lead pipe.

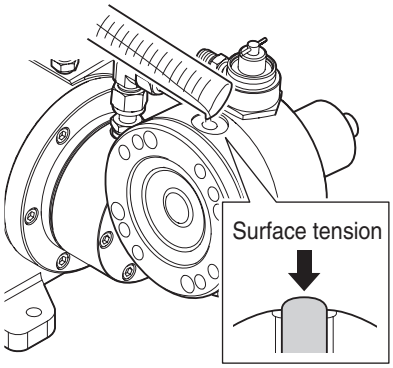


Maintenance

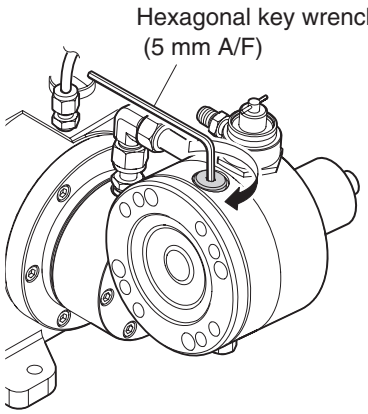
(20) Remove the seal plug.



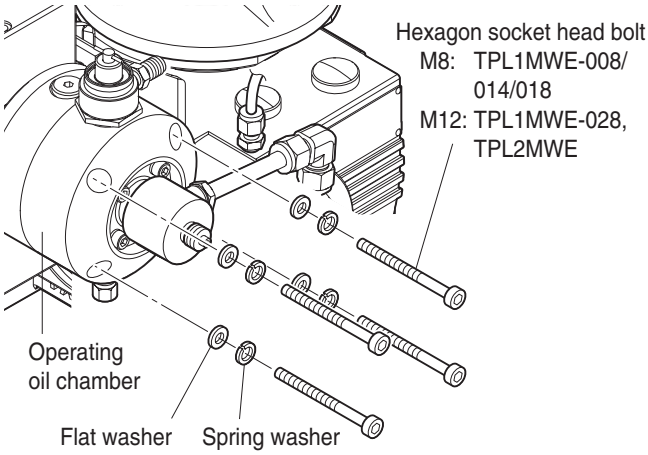
(21) Remove the seal plug. The surface of the buffer solution should be raised by the surface tension at the injection port.



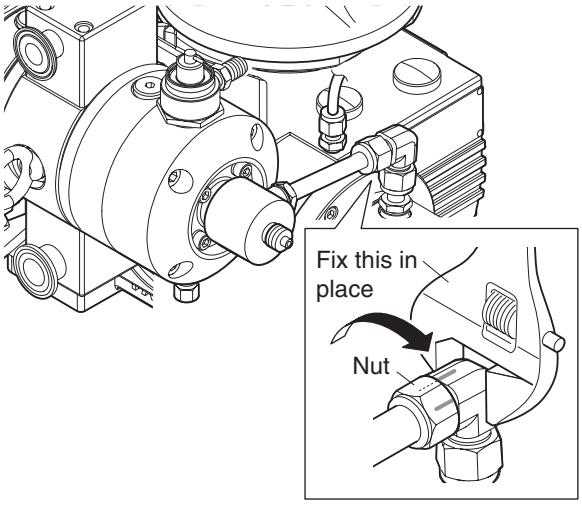
(22) Securely tighten the seal plug ensuring that no air enters. (Tightening torque: 13.7 N·m)



(23) Close the operating oil chamber, then temporarily tighten the hexagon socket head bolts.



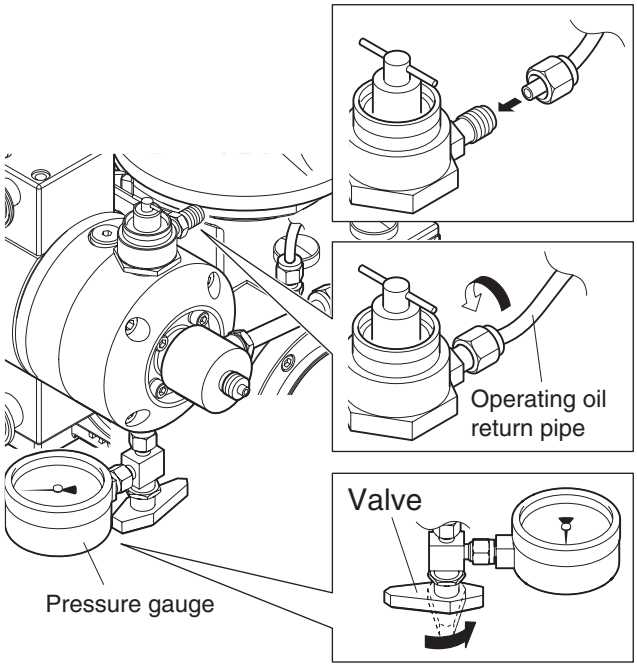
(24) Tighten the nut to the position marked when removing the diaphragms and then tighten the nut a little further.



(26) Tighten the hexagon socket head bolts securing the operating oil chamber to the specified torque.

Bolt size	Tightening torque
M8	11.7 to 12.7 Nm
M12	19.6 to 20.6Nm

(27) Install the return pipe and the pressure gauge, then open the valve.



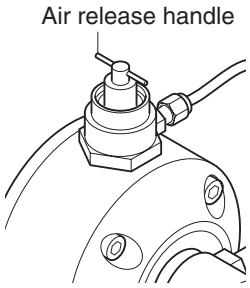
Maintenance

Replenishing the operating oil

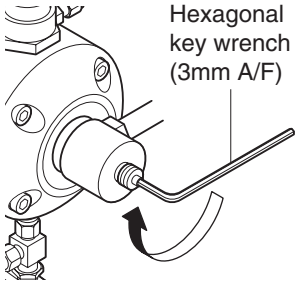
NOTICE

- **Be sure to replenish the operating oil after replacing the diaphragms.**

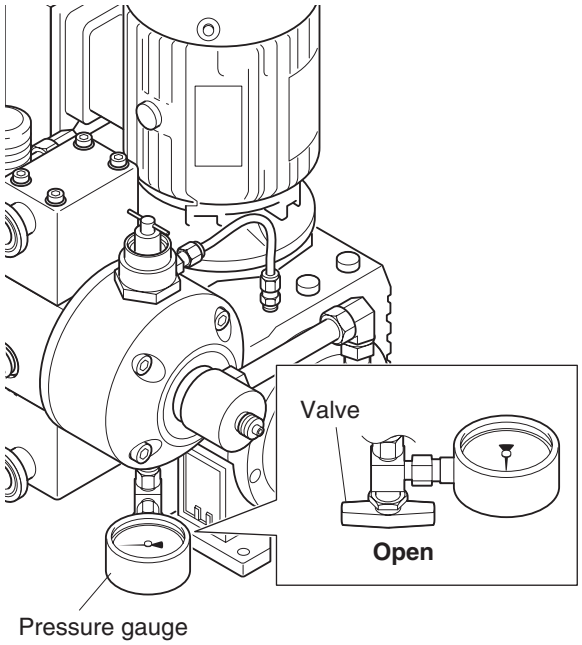
(1) Open the air release valve by turning the air release handle counterclockwise through three complete turns from the point where it is completely tightened.



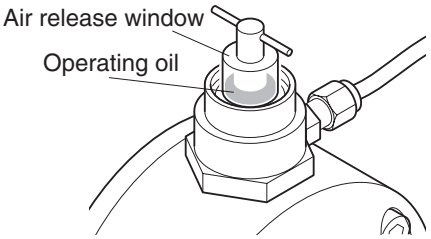
(2) Turn the eject pin in the clockwise direction until it comes in contact with the retaining ring.



(3) Check that the pressure gauge valve is open.

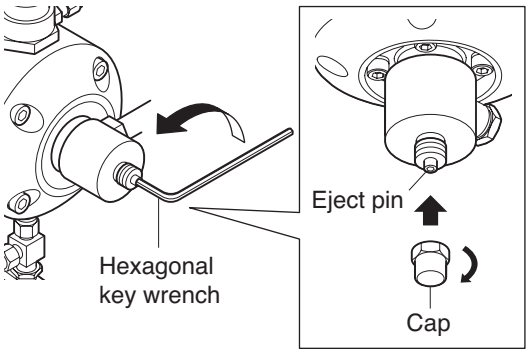


(4) Operate the pump at the frequency given in the table below.
At this time, check from the air release window in the air release joint to make sure that operating oil is discharged together with the air.
Check that there is no more air discharge after 10 minutes.



Pump model		Pump operating speed (Inverter setting frequency)
TPL1ME·TPL1MWE	008/014	30strokes/min (20Hz)
	018/028	15 to 20strokes/min (12Hz)
TPL2ME·TPL2MWE		9 to 10strokes/min (6Hz)

(5) Turn the eject pin counterclockwise until it stops, then turn the lead chamber cap clockwise to install it.

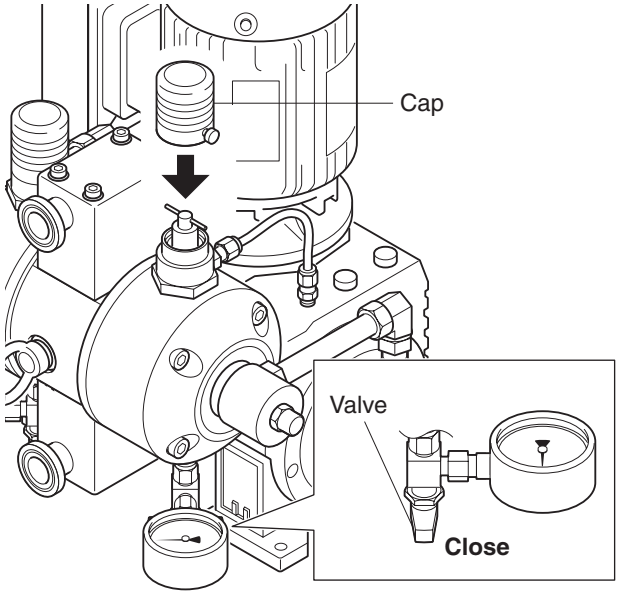


(6) Turn the air release handle to tighten the air release valve.

(7) Check that the pressure in the operating oil chamber is positive (a value greater than 0 MPa).
If the pressure is not positive, perform "Replenishing the operating oil" again from step (1).

(8) Close the valve of the pressure gauge.
✻ The pump performance will worsen if the valve is open.

(9) Tighten the cap.



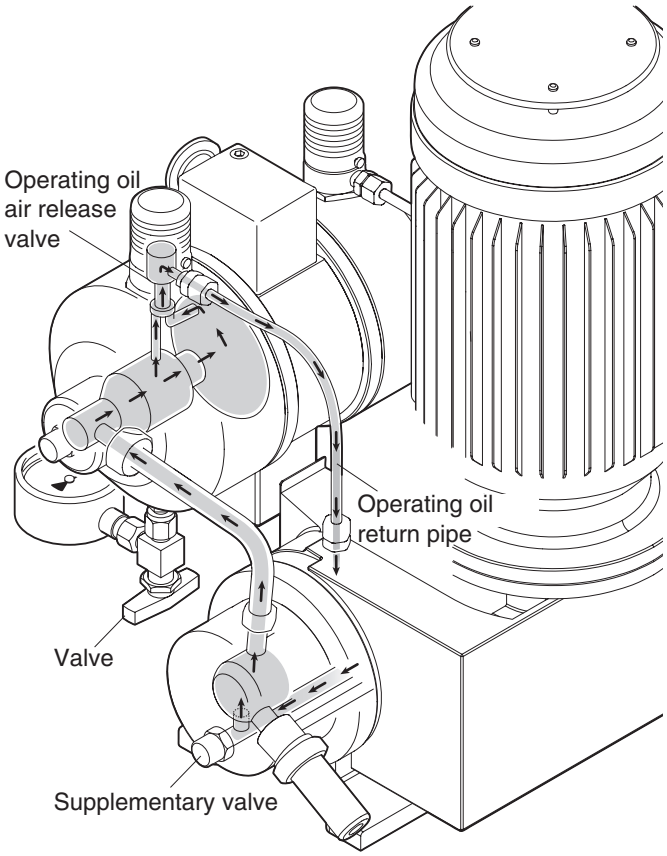
If the pump performance is poor, perform “Air release” on the following page.

Maintenance

Air release

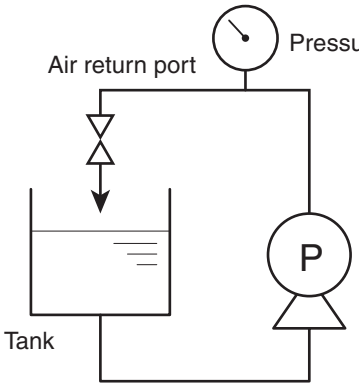
■Circulation of operating oil from the supplementary valve to the operating oil air release valve and operating oil return pipe

Air mixed into the operating oil and occurring inside the lead pipe and cylinder head is released and new operating oil is replenished by circulating the operating oil inside the drive box from the supplementary valve to the operating oil air release valve and operating oil return pipe.



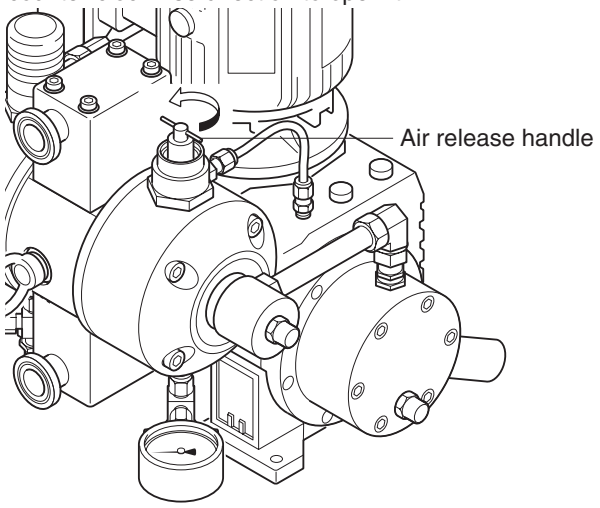
The supplementary valve is a fixed-type valve, and is set at the factory.

(1) Install the pump onto a circulation line, and fill the pump head and the pipes with a test fluid (cleaning fluid, etc.).



✻ Use a pressure gauge that has a pressure range that covers three times the maximum discharge pressure of the pump.

(2) Stop the pump.
(3) Turn the air release handle three full rotations in the counter-clockwise direction to open it.



(4) Open the valve installed on the bottom of the operating oil chamber.
(5) Operate the pump for 10 minutes at the frequency given in the table below.
✻ Look through the air release window, and check that no air is being discharged.
(6) Completely close the air release valve.
(7) Check that the pressure in the operating oil chamber is positive (a value greater than 0 MPa).
If the pressure does not rise, perform “Air release” again from step (3).
(8) Close the valve installed on the bottom of the operating oil chamber.
The operating oil is now replenished, so set the inverter to the target frequency and operate the pump.

Pump model		Pump operating speed (Inverter setting frequency)
TPL1ME·TPL1MWE	008/014	30strokes/min (20Hz)
	018/028	15 to 20strokes/min (12Hz)
TPL2ME·TPL2MWE		9 to 10strokes/min (6Hz)

Maintenance

■Supplementary procedure for air release and operating oil replenishment

When the target performance is not achieved even after performing the procedures on the previous pages, perform the following procedure.

⚠ CAUTION

- **This is not an essential procedure. Perform this procedure when the target performance is not achieved after the air release procedure.**
- **Perform the procedure as well as possible in accordance with the installation conditions.**
- **Do not perform this procedure without operating oil in the operating oil chamber.**
- **Some parts of this procedure place a load on the pump. When the target performance is not achieved even after repeating this procedure three to five times, there may be an abnormality in the pump or pipes. In this case, stop the procedure work, refer to "Troubleshooting" on page 63, and take the appropriate remedial actions.**

(1) Stop the pump for 30 minutes or longer.
Then, release the air again.

If the target performance is not obtained even after performing step (1) of the procedure

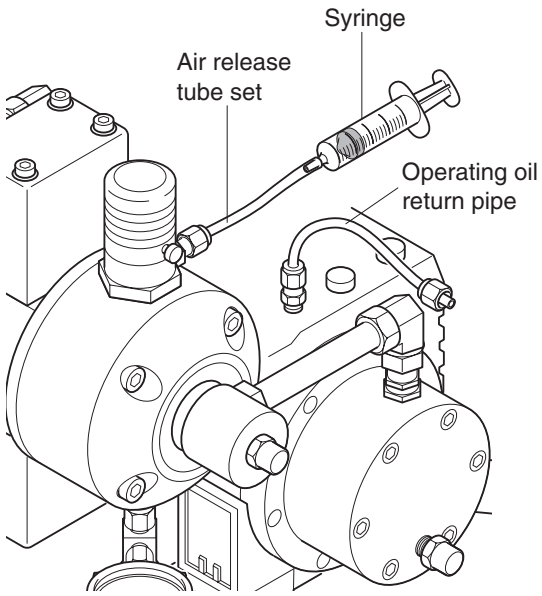
(2) Tilt the pump at an angle of 30 degrees to the left, right, front, and back for 10 seconds each.
Then, release the air again.

If the target performance is not obtained even after performing step (2) of the procedure

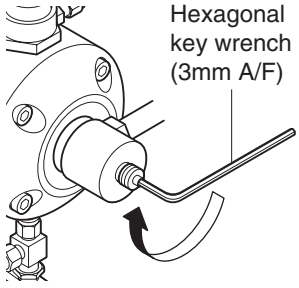
(3) Only for the TPL1ME·TPL1MWE-008/014, perform the procedure in the following paragraph under "●Air release using a syringe."

●Air release using a syringe (TPL1ME·TPL1MWE-008/014 only)

(1) Ready the supplied syringe and air release tube set.
(2) Loosen the nut attached to the air release joint, and disconnect the operating oil return pipe.
(3) Connect the supplied air release tube set and syringe to the air release joint using the nut at the tip of the tube set.



(4) Turn the eject pin in the clockwise direction until it comes in contact with the retaining ring.

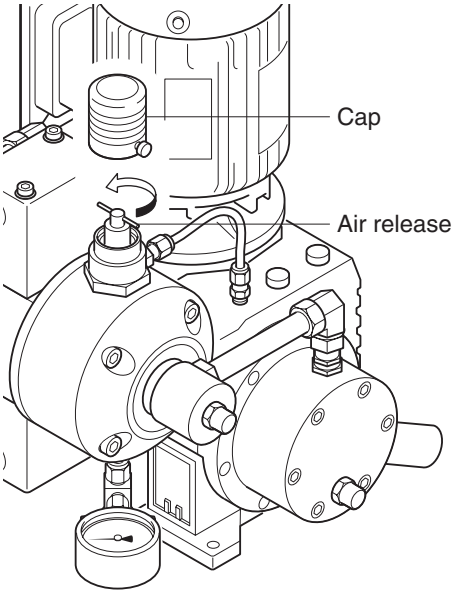


(5) Remove the cap, and then turn the air release handle counterclockwise through three complete turns.
(6) Using the syringe, suck out operating oil one or two times. Air is sucked out together with the operating oil, enabling to discharge the air inside the operating oil chamber.
(7) Turn the eject pin in the counterclockwise direction until it stops.
(8) Remove the air release tube set.
(9) Attach the operating oil return pipe.
(10) Perform the procedure under "Air release" on page 55 starting from step (4).

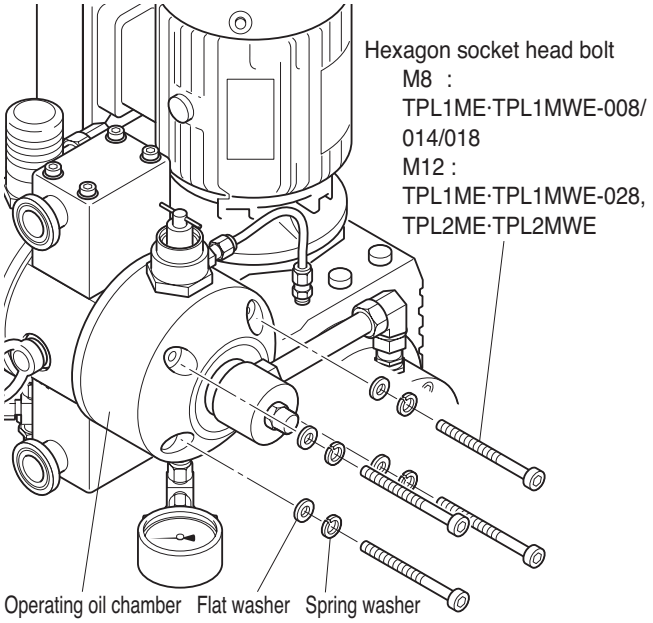
Maintenance

Pump head disassembly

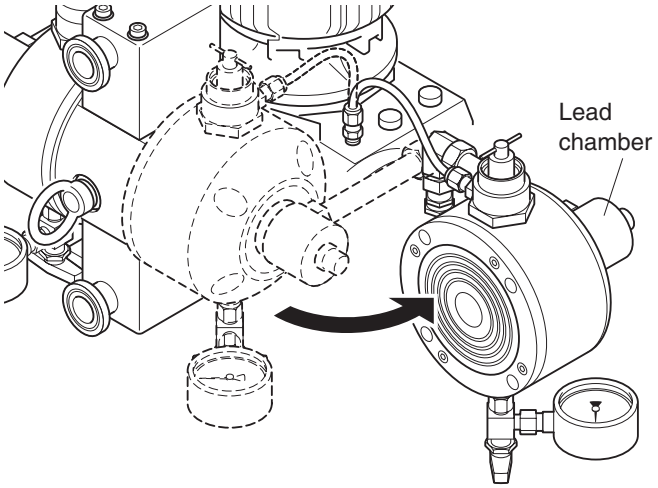
(1) Remove the cap, and turn the air release handle three full rotations in the counter-clockwise direction.



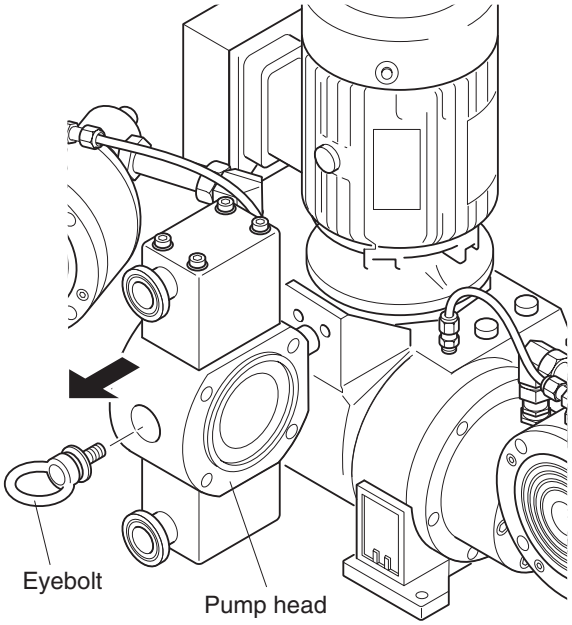
(2) Remove the four hexagon socket head bolts securing the operating oil chamber.



(3) Grasp the lead chamber, and open the operating oil chamber.



(4) Turn and remove the eyebolt.
(5) Pull out the pump head.



✻ Follow the steps in reverse to reassemble the parts.

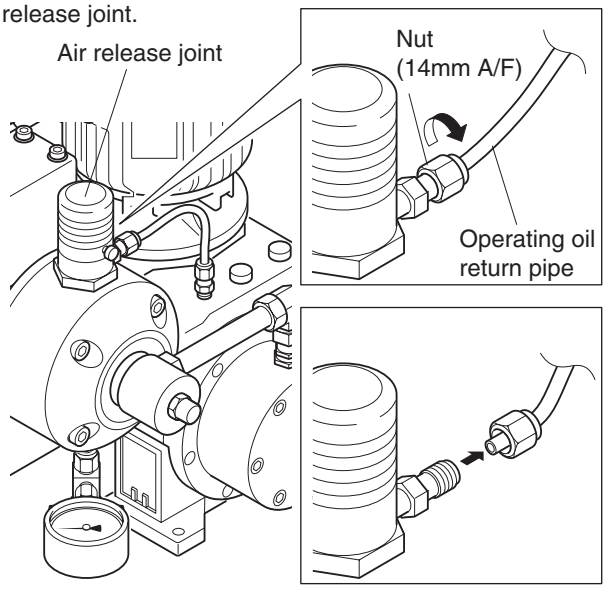
Maintenance

Replacing the operating oil

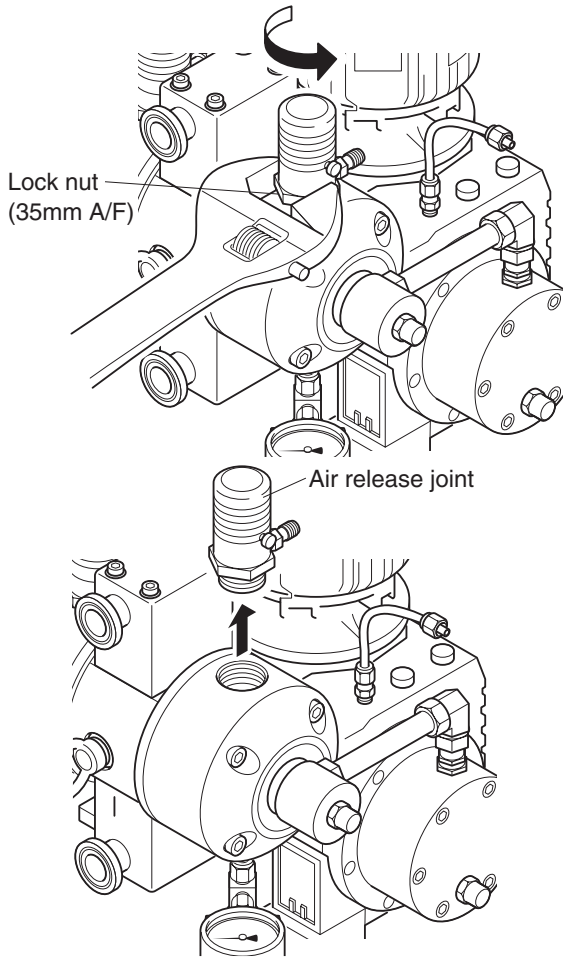
✻ Described below is the sequence of steps taken for the right side as seen when the pump is viewed from the front. Take the same steps for the left side as well.
You can also perform the steps on the right and left sides concurrently.

■Draining the operating oil

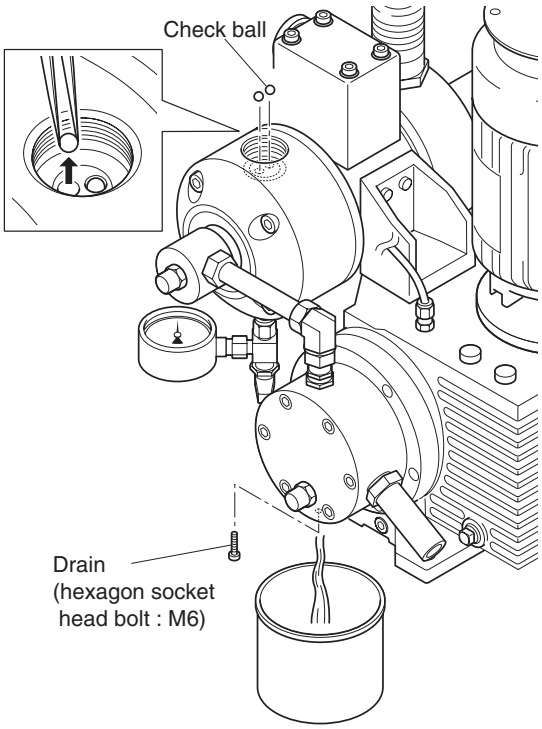
(1) Disconnect the operating oil return pipe from the air release joint.



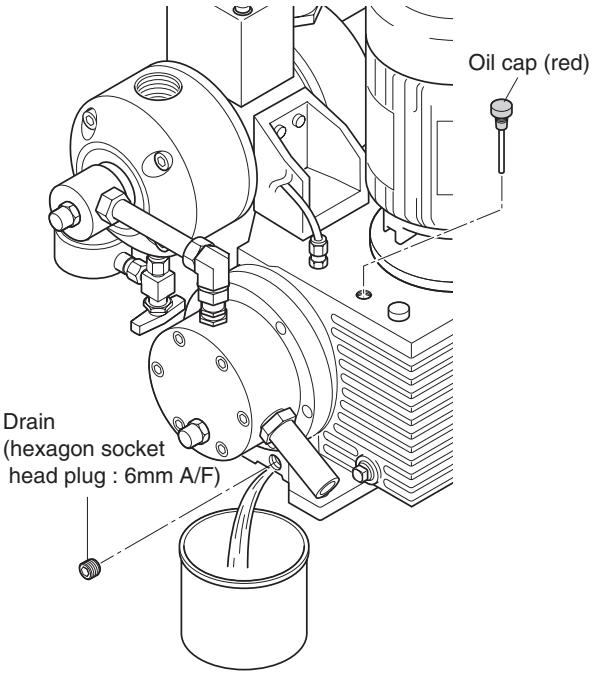
(2) Using a spanner, turn the lock nut in the counter-clockwise direction to loosen it, then turn the lock nut manually and remove the air release joint.



(3) Remove the drain (hexagon socket head bolt) located on the bottom of the cylinder head, and then use tweezers or some other tool to remove the two check balls from the top of the operating oil chamber. Be careful not to scratch the check balls at this time.
(Ready an oil tray beforehand to receive the operating oil.)



(4) Remove the red oil cap and the drain (hexagon socket head plug) located on the bottom of the drive box.
The operating oil drains from inside of the operating oil chamber.

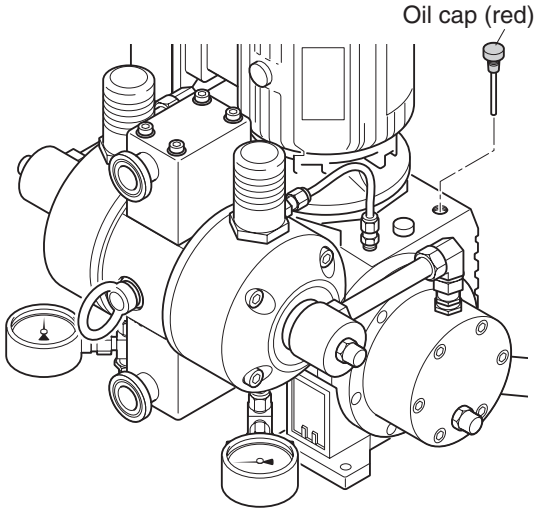


(5) Tighten the two drains removed in steps (3) and (4), and reinstall the air release joint.
(6) Reinstall the check balls removed in step (3).
(7) Return the air release joint, which was removed in step (2).
(8) Attach the operating oil return pipe.

Maintenance

■Filling with operating oil

(1) Fill with the specified amount of operating oil, then tighten the oil cap.



●Recommended brand

Manufacturer name	Product name
Idemitsu Kosan Co., Ltd.	Daphne Super Hydro A22

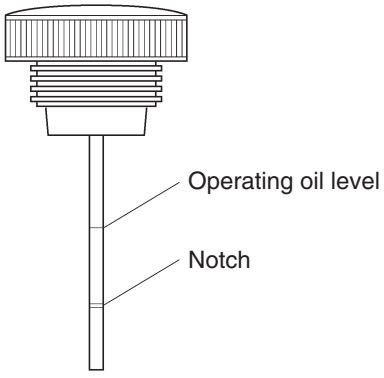
Contact a Tacmina service representative when using other than the recommended brand of oil.

●Operating oil filling amount

Pump model	Filling amount
TPL1ME·TPL1MWE-008/014/018	800 to 850mL
TPL1ME·TPL1MWE-028*	1200mL
TPL2ME·TPL2MWE	3000 to 3200mL

* Follow the procedure below, and add operating oil in two parts.
  ❶Add 900 ml of operating oil.
  ❷Perform “Replenishing the operating oil” on page 53.
  ❸Add 300 ml of operating oil.
  ❹Perform “Air release” on page 55.

• Check that the oil surface level is above the notch in the oil cap.

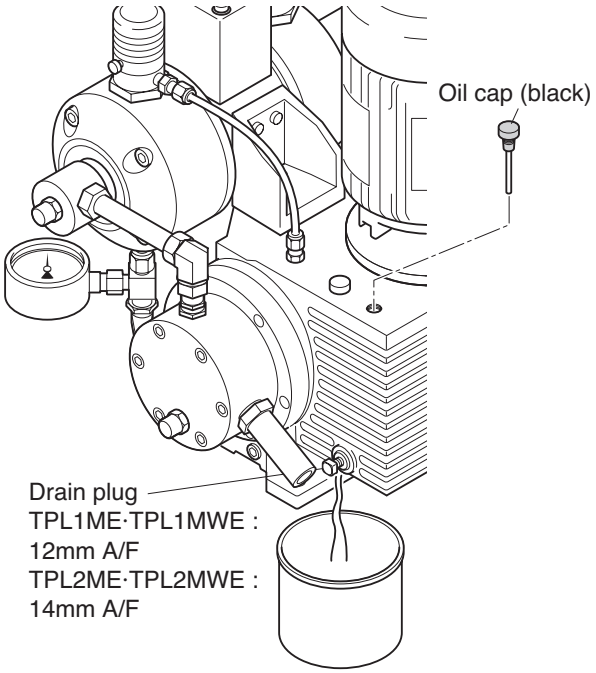


✻ After filling with operating oil, go to the procedure following “Replenishing the operating oil” on page 53, and perform “Air release.”

Replacing the gear oil

■Draining the gear oil

(1) Remove the black oil cap and the drain plug located on the bottom of the drive box.
(Ready an oil tray beforehand to receive the gear oil.)

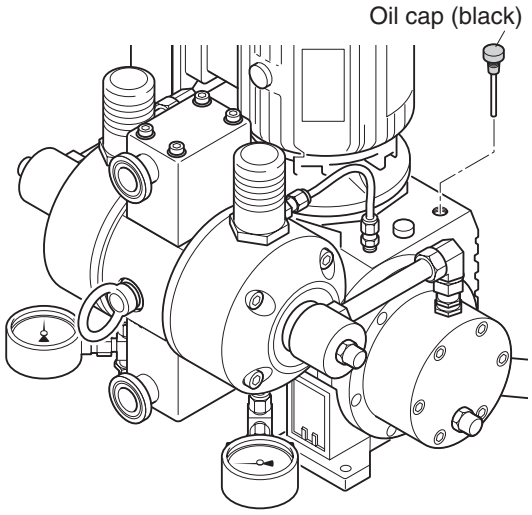


(2) Tighten the drain plug removed in step (1).

✻ The proper torque when tightening the drain plug is as follows.
TPL1ME·TPL1MWE :16N·m
TPL2ME·TPL2MWE :19.5N·m
Do not use excessive force, as this may damage the drive box.

■Filling with gear oil

(1) Check that the drain plug is securely closed.
(2) Fill with the specified amount of gear oil, then tighten the oil cap.



Maintenance

●Recommended brand

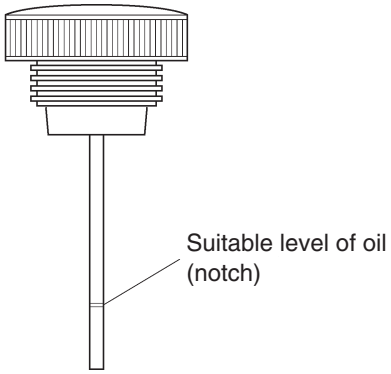
Manufacturer name	Product name
NOK Klüber Co., Ltd.	SYNTHESO HT 320

Contact a Tacmina service representative when using other than the recommended brand of oil.

●Gear oil filling amount

Pump model	Filling amount
TPL1ME·TPL1MWE	250mL
TPL2ME·TPL2MWE	800mL

• Check that the oil surface level is above the notch in the oil cap.

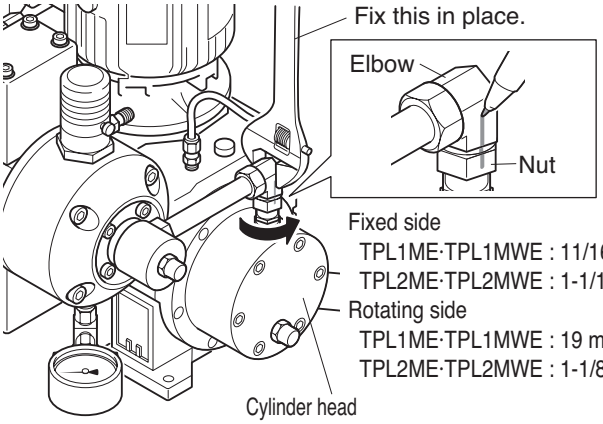


Consumable parts replacement of lead joint

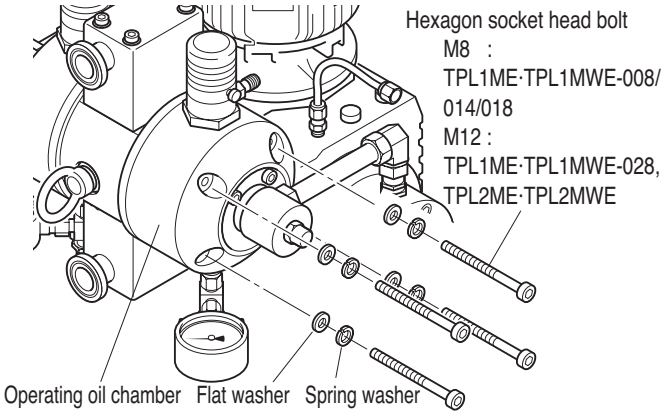
✻ Described below is the sequence of steps taken for the lead joint on the right as seen when the pump is viewed from the front.
Take the same steps for the lead joint on the left as well.

(1) Perform steps (1) to (4) of "■Draining the operating oil" on page 58, and drain the operating oil from the operating oil chamber.

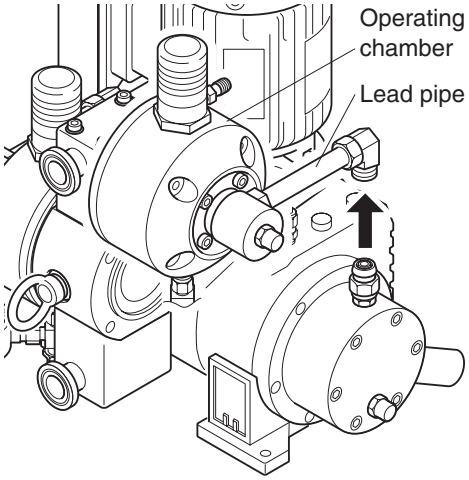
(2) Using an ink marker or other marking instrument, mark the elbow and nut located on top of the cylinder head, and then loosen the nut.



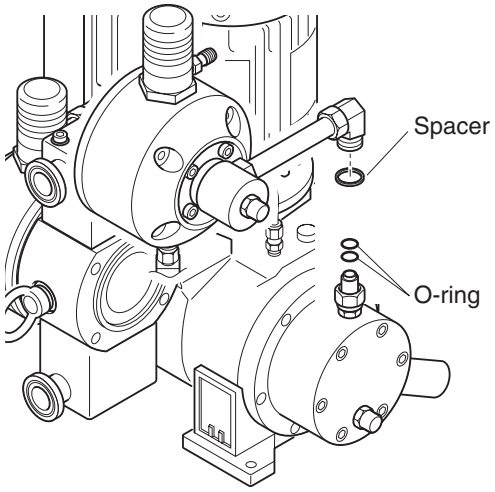
(3) While holding the operating oil chamber in place, remove the four hexagon socket head bolts securing the operating oil chamber.



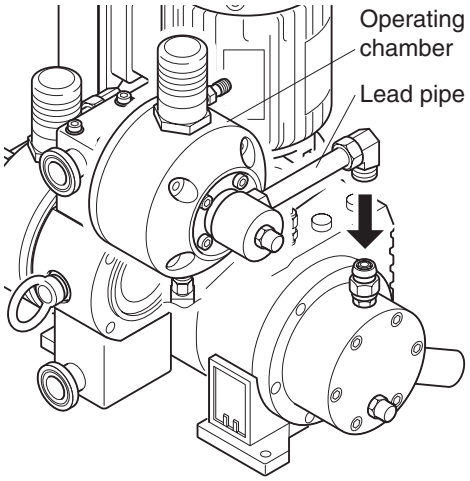
(4) Remove the nut loosened in step (2), and then remove the operating oil chamber and lead pipe assembly.



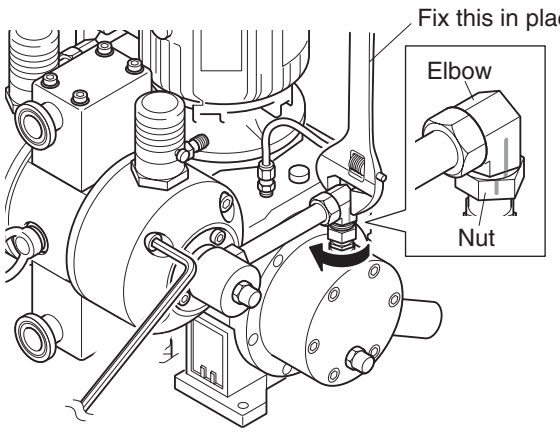
(5) Remove the spacer, and replace the O-rings.



(6) Insert the operating oil chamber and lead pipe assembly onto the lead joint, and temporarily tighten the nut of the elbow.



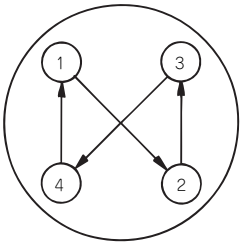
(7) Temporarily secure the operating oil chamber to the pump head using the four hexagon socket head bolts.
(8) Tighten the nut temporarily tightened in step (6) to the position marked in step (2), and then tighten the nut further.
(9) Tighten the four hexagon socket head bolts temporarily tightened in step (7) with the torques given in the table below.



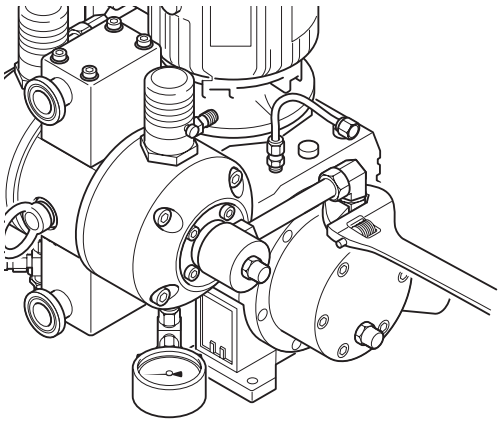
Bolt size	Tightening torque
M8	11.7 to 12.7N·m
M12	19.6 to 20.6N·m

⚠ CAUTION

When securing the operating oil chamber using the hexagon socket head bolts, tighten the bolts evenly a little at a time in the order shown in the figure below. For example, when tightened in the order of 1 → 3 → 2 → 4, the bolts may not tighten evenly, possibly resulting in oil leakage from the pump head.



(10) Check that the joint attached to the cylinder head is not loose, and then install the lead joint.
When the lead joint cannot be properly connected, finely adjust the positions of the lead pipe and the securing ring.



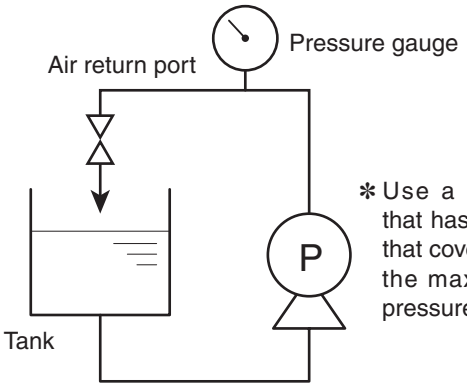
Maintenance

Setting the relief valve pressure

■Relief valve

When an abnormally high pressure results because, for instance, the user has forgotten to open the valve on the discharge side pipe, operating oil is discharged from the relief valve into the drive box, causing the pressure to be released.

(1) Install the pump onto a circulation line, and fill the pump head and the pipes with a test fluid (cleaning fluid, etc.).

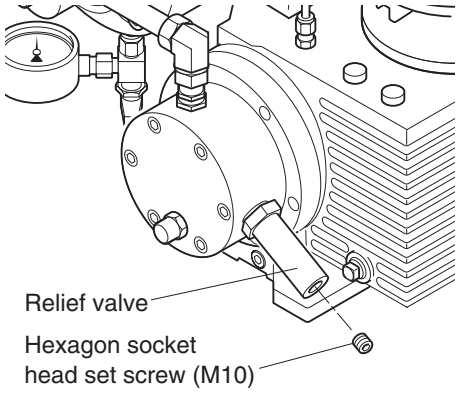


✻ Use a pressure gauge that has a pressure range that covers three times the maximum discharge pressure of the pump.

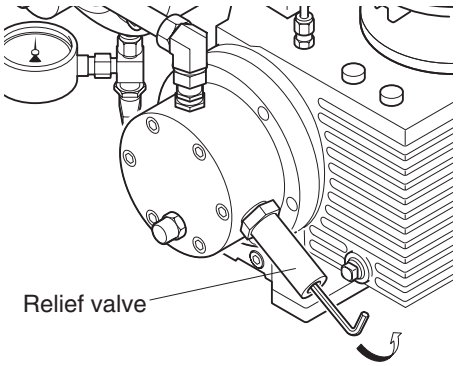
(2) Turn the relief valve that you are adjusting and the air release handle on the opposite side counterclockwise through three complete turns.

(3) Close the valve on the pump discharge side pipe.

(4) Remove the hexagon socket head set screw used to lock the relief valve.



(5) Loosen and then remove the hexagon socket head bolt (M5) inside the relief valve.



(6) Operate the pump at a speed of 10 strokes/min.

(7) Gradually tighten the hexagon socket head bolt (M5) inside the relief valve.
When you tighten the bolt, the pressure will rise. Tighten the bolt until the following pressures are reached.

Discharge pressure	Pressure set for the relief valve
Less than 1 MPa	150 to 160% of the pressure during normal operation
1 MPa or more	120 to 150% of the pressure during normal operation

✻ If you exceed the target pressure, loosen the hexagon socket head bolt (M5), and then open the valve on the discharge side to set the indicated value of the pressure gauge to "0."
Then, close the valve on the discharge side and perform step (7) again.

(8) Fully tighten the hexagon socket head set screw used to lock the relief valve.

✻ Perform steps (2) to (8) for the opposite side as well.

⚠ CAUTION

- **The setting pressures on the right and left sides should be balanced to within ±10% of each other.**
- **Be sure to open the discharge side valve after finishing the adjustment.**

Troubleshooting

If one of the situations or symptoms described below is applicable to the problem at hand, ignore the priority sequence, and take the remedial action.

Problem	Problem area	Detailed situation or symptoms	Priority sequence	Causes	
Pulsation occurs. Discharge quantity is low.	Pump	—	A1	- There is some air inside the operating oil chamber.	
		Vibration is greater for the discharge side pipe than for the suction side.	A1	- The motor is rotating in the reverse direction.	
		Pulsation does not occur at the start of operation, but it does occur after several hours.	A2	- There is some air inside the operating oil chamber.	
			A2	- One or more of the valve seats are dirty or clogged.	
		There is no back pressure at the discharge side, and the valve seat movements are not stable.	A2	- A back pressure valve has not been installed. Note: A back pressure valve is not necessarily required.	
		—	B1	- The liquid has a high viscosity.	
			B1	- Air bubbles have formed on the inside of the pump head.	
		A strange sound (the sound of pressure being relieved) can be heard from the pump.	B1	- The discharge pressure is too high.	
			B1	- One or more of the valve seats are dirty or clogged.	
			B1	- One or more of the valve seats have not been assembled properly.	
		—	B2	- Gas lock in the pump.	
		Liquid is leaking from the manifold.	C1	- The manifold has not been secured properly.	
			C1	- An O-ring is worn down or defective.	
		Liquid is leaking from the pump head.	C1	- The operating oil chamber has not been secured properly.	
			C1	- The air release joint has not been tightened properly.	
		A strange sound (the sound of pressure being relieved) can be heard from the pump.	C1	- The supplementary valve has not been set correctly.	
		—	C1	- There is some air inside the intermediate chamber (W type).	
		Liquid is leaking from the seal plug of the intermediate chamber.	C1	- The seal plug is not secured in place properly.	
			C2	- The seal plug O-ring is worn out or defective.	
		—	C2	- The frequency setting exceeds (or has exceeded) 60 Hz.	
		A strange sound (the sound of pressure being relieved) can be heard from the pump.	C2	- Diaphragm deterioration	
		Operating oil, buffer solution, or other fluid is mixed in with the pumped liquid.	C3	- Diaphragm damage	
		Operating oil is leaking from the lead joint.	D	- Defective seal of lead joint	
		Operating oil is leaking from the supplementary valve.	D	- Defective seal of supplementary valve	
		—	E	- One or more of the valve seats are worn.	
			E	- One or more of the seal parts is worn.	
		Abnormal sounds are heard from the pump.	F	- One or more of the drive parts are worn or damaged.	

*1: When the discharge quantity on one side or both sides is virtually nil--a condition referred to as "gas lock"--perform a circulation operation without applying the back pressure.

✻: Priority sequence: If the causes of the problem are unknown, take the remedial action by following the priority sequence.
Priority sequence: A (1 → 2) → B (1 → 2) → C (1 → 2) → D → E → F

	Remedial action	Details and references
	Proceed with the air release job.	- See "Air release" on page 55.
	Change the wiring connections so that the motor runs in the correct direction.	- See "Checking the rotation direction of the motor" on page 19.
	Proceed with the air release job. If the problem persists, look into other causes.	- Contact a Tacmina service representative.
	Clean the valve seats.	- See "Inspecting, cleaning and replacing the valve seats" on page 24.
	Install a back pressure valve.	
	Replacing the high-viscosity valve seats.	- Contact a Tacmina service representative.
	Install a refiner (option).	- Contact a Tacmina service representative.
	Change the circulating liquid to one such as ethanol which tends not to allow air bubbles to adhere. Apply a back pressure, and continue with the circulation operation for 1 to 2 hours.	- Avoid performing operation using fresh water. - Apply a back pressure of 0.1 to 0.2 MPa or so (*1).
	Take another look at the discharge side pipe.	
	Clean the valve seats.	- See "Inspecting, cleaning and replacing the valve seats" on page 24.
	Re-assemble the valve seats. In the case of high-viscosity valve seats, check the springs.	- See "Inspecting, cleaning and replacing the valve seats" on page 24. - Take care to ensure that the valve stoppers are pointing in the correct direction.
	Release the discharge pressure, and perform a circulation operation.	
	Re-assemble the manifold.	- Re-assemble it so that the clearance between the manifold and pump head is fixed.
	Replace the O-rings.	- See "Inspecting, cleaning and replacing the valve seats" on page 24.
	Re-assemble the operating oil chamber.	- See "Inspecting and cleaning the diaphragms" on page 38.
	Shut off the air release joint.	- See "■Draining off the oil in the operating oil chamber" on page 39.
	Set the supplementary valve to its home position.	- See "■Circulating the operating oil from the supplementary valve to the operating oil air release valve and operating oil return pipe" on page 55.
	Remove the air out of the intermediate chamber, then add buffer solution.	- Perform steps (1) to (3) in "Inspecting and cleaning the diaphragms" on page 36 to open the operating oil chamber and perform steps (18) to (22) in "Installing the diaphragms (TPL□MWE)" on pages 50 to 51 to release air out of the intermediate chamber.
	Add buffer solution, then re-assemble the seal plug.	- Perform steps (1) to (3) in "Inspecting and cle aning the diaphragms" on page 36 to open the operating oil chamber and perform steps (21) to (22) in "Installing the diaphragms (TPL□MWE)" on page 51 to add buffer solution, then re-assemble the seal plug.
	Replace the O-ring.	- Perform steps (1) to (2) in "Removing the diaphragms (TPL □ MWE)" on page 44 to drain the buffer solution, then replace the seal plug O-ring.
	Reduce the frequency to below 60 Hz, and proceed with the air release job.	
	Replace the diaphragm.	- See "Replacing the diaphragms" on page 39.
	Replace the diaphragm. Clean the pipes and operating oil chamber.	- See "Replacing the diaphragms" on page 39.
	Re-tighten the lead joint.	- Contact a Tacmina service representative.
	Replace the lead joint.	- Contact a Tacmina service representative.
	Replace the O-ring of the supplementary valve.	- Contact a Tacmina service representative.
	Replace the valve seats.	- See "Inspecting, cleaning and replacing the valve seats" on page 24.
	Overhaul the pump.	- Contact a Tacmina service representative.
	Overhaul the pump.	- Contact a Tacmina service representative.

Troubleshooting

If one of the situations or symptoms described below is applicable to the problem at hand, ignore the priority sequence, and take the remedial action.

Problem	Problem area	Detailed situation or symptoms	Priority sequence	Causes	
Pulsation occurs. Discharge quantity is low.	Pipes	The discharge side pipe is vibrating.	A	- The discharge side pipe is vibrating.	
		—	A	- The suction pipe condition is unsatisfactory.	
		There is some air in the liquid inside the tank.	B	- Air has found its way into the liquid-end line.	
		Pulsation does not occur at the start of operation, but it does occur after several hours.	B	- There is some air inside the discharge pipe.	
		—	C	- Clogged filter	
		The discharge side back pressure valve is vibrating.	C	- Chattering of discharge side back pressure valve	
Air is mixed in with the discharge liquid.	Tank	Air has found its way into the tank.	A	- Air has found its way into the liquid-end line.	
	Pipes	—	B	- Air has been drawn in due to high viscosity or cavitation (see page 73).	
			B	- Air has been sucked in from the pipes.	
Cannot proceed with the air release job.	Pump	A thin stream of air continues to be discharged when the air release window is monitored.	A	- Defective seal	
			A	- Insufficient operating oil	
			A	- Damaged air release window	
		The discharge of the air cannot be verified.	B	- Trouble in another pipe or in the pump.	
		The discharge of the operating oil cannot be verified.	B	- The flow of operating oil is not visible.	
			B	- Defective seal	
		—	C	- Trouble in the pump parts	
No discharging.	Pump	The motor does not run.	A	- The power supply is connected to an inverter.	
			A	- Trouble in supply voltage	
			A	- A switch has been turned off.	
			A	- The circuit breaker has been tripped or a fuse has blown.	
			B	- Broken cord	
			B	- Defective magnetic switch	
			B	- Inverter failure	
		A strange sound (the sound of pressure being relieved) can be heard from the pump.	A	- A valve on the discharge side or suction side has been shut off.	
		Abnormal sounds are heard from the drive srction.	D	- Worn or damaged drive parts	
Liquid is leaking.	Pump	—	A	- Worn-down O-ring of liquid-end part	
				- Defective tightening of bolt sections	
				- Mistake made in valve seat assembly	

	Remedial action	Details and references
	Remove whatever is supporting the pipe.	
	Take another look at the pipe.	- See "Piping" on page 14.
	Remove the air inside the tank.	
	Tighten up or re-tighten the pipe seal sections.	
	Use a pipe construction which prevents the air from collecting.	- The pump itself may be to blame. - Contact a Tacmina service representative.
	Clean the filter.	
	Take another look at the back pressure valve setting.	- Contact a Tacmina service representative.
	Remove the air inside the tank. Prevent air from being drawn in due to the liquid dripping into the supply tank from the circulation line.	
	Reduce the frequency setting.	
	Take another look at the suction pipe.	- See "Piping" on page 14.
	Re-tighten the sections where the pipes are connected.	
	Re-tighten the pump seal parts.	
	Replace the seal parts.	- Contact a Tacmina service representative.
	Inject the specified amount of operating oil inside the drive box.	- See "■Filling with operating oil" on page 59.
	Replace the air release window.	- Contact a Tacmina service representative.
	Refer to the "pump" and "pipes" sections of Troubleshooting.	
	Disconnect the air release tube connected to the drive box side, and check whether the operating oil is flowing.	
	Re-tighten the pump seal parts. Replace the seal parts.	- Contact a Tacmina service representative.
	Overhaul the pump.	- Contact a Tacmina service representative.
	Connect the power supply to an inverter.	
	Connect the correct supply voltage.	
	Set the switch to the correct position.	
	Check out the causes and reset the circuit breaker or replace the fuse.	
	Replace the cord.	
	Replace the magnet switch.	
	Inspect and replace the inverter.	
	Release the valve.	
	Overhaul the pump.	- Contact a Tacmina service representative.
	Replace the O-ring.	
	Re-tighten the bolts.	
	Re-assemble the valve seats.	- See "Inspecting, cleaning and replacing the valve seats" on page 24.

■Model codes

TPL	1	ME	N	-	008	-	6	T	6	T	-	C	W	S	-			-	
(1)	(2)	(3)	(4)		(5)		(a)	(b)	(c)	(d)		(a)	(b)	(8)		(9)	(10)		(11)
									(6)			(7)				Models with CE marking only			

(1) Series name

TPL: high-accuracy diaphragm pump

(2) Drive section

1	0.4kW motor specifications
2	1.5 kW motor specifications

(3) Pump type

ME	Hydraulic diaphragm
MWE	Hydraulic double diaphragm

(4) Drive box surface treatment

None	Painting
N	Electroless nickel plating

(5) Plunger diameter

008	8mm
014	14mm
018	18mm
028	28mm
032	32mm
040	40mm
056	56mm
080	80mm
095	95mm

(6) Materials used for liquid-end parts

(a) Pump head

6	SUS316
X	Special

(b) Diaphragm

T	PTFE
X	Special

(c) Check balls

6	SUS316 (Standard)
X	Special

(d) O-ring

T	PTFE
X	Special

(7) Connection format

(a) Connection format

C	Ferrule
X	Special

(b) Valve structure

W	Standard
V	High viscosity
X	Special

(8) General specifications

S	Standard
X	Special

(9) Connection standard

G	Straight pipe thread
R	Taper pipe thread
D	DIN
A	ANSI
I	ISO
J	JIS
F	Fuji standard

(10) Motor

N	Without motor

(11) Standard

CA	CE and ATEX standard

✻ Products with a model code ending in X are special order products. For detailed specifications, see the diagrams or approval documents.

■Specifications and capacity tables

■Pump specifications

Model		TPL1ME·TPL1MWE				TPL2ME·TPL2MWE				TPL2ME	
		-008	-014	-018	-028	-028	-032	-040	-056	-080	-095
Max. discharge volume	L/min	0.1	0.3	0.5	1.2	2.6	3.4	5.3	10.5	20	30
	L/h	6	18	30	72	156	204	318	630	1200	1800
	US G/h	1.58	4.75	7.92	19	41.18	53.85	83.95	166.32	316.8	475.2
Max. discharge pressure	MPa	0.5									
	bar	5									
	psi	72.5									
No. of strokes	strokes/min	9 to 90									
Connection port diameter	Discharge side	ISO10A	ISO10A	ISO10A	ISO15A	ISO15A	ISO15A	1.0S	1.5S	2.0S	2.0S
	Suction side	ISO10A	ISO15A	ISO15A	ISO15A	1.0S	1.0S	1.5S	2.0S	2.5S	2.5S
Weight (kg)*1		41(45)	41(45)	41(45)	51(57)	93(100)	93(100)	94(116)	109(116)	142	142
Sound pressure level		73dB									

*1 Values in ( ) are for MWE type

CAUTION

- **This product generates the noise listed above. If you will be exposed to this noise for a long period of time, use devices to protect your hearing.**

■Motor and inverter specifications

●Motor specifications

Item			Description
Manufacturer			Mitsubishi Electric Corporation
Model			XF-NEVCAO-2
Motor enclosure structure			Explosion-proof outdoor type (d2G4)
Power supply, frequency, no. of poles			3-phase 200V (50Hz) / 200 · 220V (60Hz), 4P
TPL1ME· TPL1MWE	Output		0.4kW
	Motor rated current value	200V/50Hz	2.3A
		200V/60Hz	2.2A
		220V/60Hz	2.2A
TPL2ME· TPL2MWE	Output		1.5kW
	Motor rated current value	200V/50Hz	6.4A
		200V/60Hz	6.5A
		220V/60Hz	6.5A
Insulation class			B
Electrical conduit connection port diameter			G3/4
Other			Has passed explosion proof test as set with inverter below

●Inverter specifications (option)

Item		Description
Manufacturer		Mitsubishi Electric Corporation
Model	TPL1ME·TPL1MWE	FR-B3-400
	TPL2ME·TPL2MWE	FR-B3-1500
Power supply, frequency		3-phase 200V (50Hz) / 200 · 220V (60Hz)
Output	TPL1ME·TPL1MWE	0.4kW
	TPL2ME·TPL2MWE	1.5kW
Other		Has passed explosion proof test as set with motor above

✻ The specifications given in the tables are for Tacmina's standard TPL□ME·TPL□MWE model. In case of non-standard products, check the specifications on the outline drawings.

■Materials used for liquid-end parts

●Pump section standard specifications

Liquid-end parts type / Description of part	Pump head	Diaphragm	Check ball	O-ring	Valve seat	Ball stopper	Ferrule joint
6T6T	SUS316	PTFE	SUS316	PTFE	SUS316	SUS316	SUS316/ SUS316L

●Pump section high-viscosity specifications

Liquid-end parts type / Description of part	Pump head	Diaphragm	Check ball	O-ring	Valve seat	Ball stopper	Ball stopper guide*1	Helical compression spring	Retaining ring*1	Ferrule joint
6T6T	SUS316	PTFE	SUS316	PTFE	SUS316	SUS316	SUS316	SUS316WPA	SUS316WPA	SUS316/ SUS316L

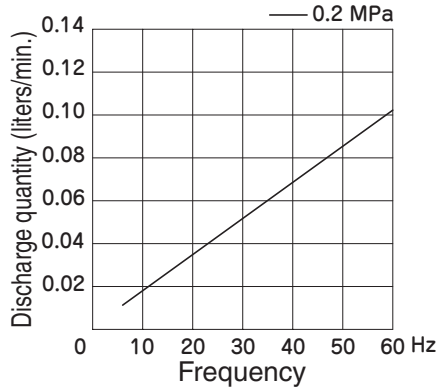
*1 TPL2ME·TPL2MWE only

■Performance curves

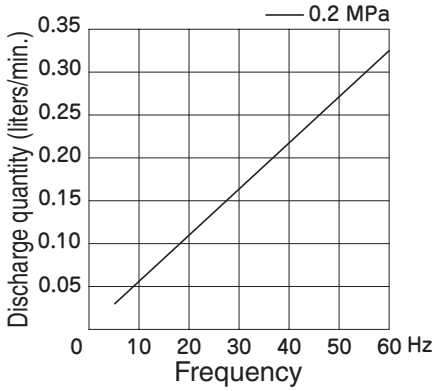
The performance curves presented below give the values measured under the following conditions using Tacmina's test equipment as examples.
Depending on the conditions prevailing on-site and the model used, the actual values yielded may differ slightly from the values in the performance curves.
Based on the conditions under which the pump will be used, measure the discharge quantity, and set the frequency using the performance curve actually obtained.

●Basic specifications **Conditions: Fresh water, room temperature**

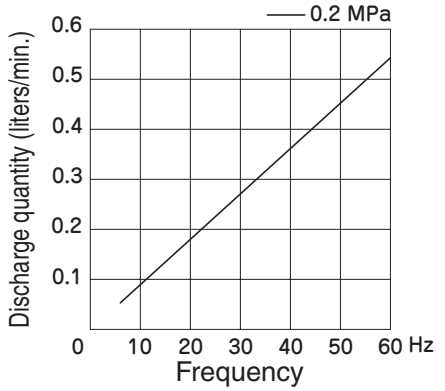
TPL1ME·TPL1MWE-008



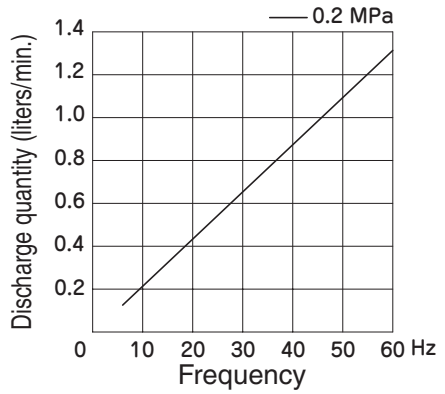
TPL1ME·TPL1MWE-014



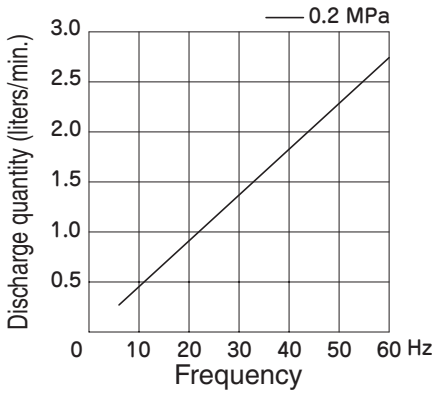
TPL1ME·TPL1MWE-018



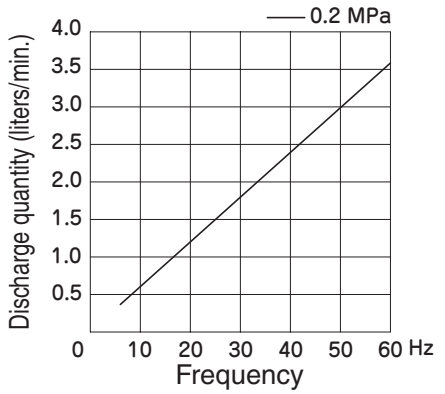
TPL1ME·TPL1MWE-028



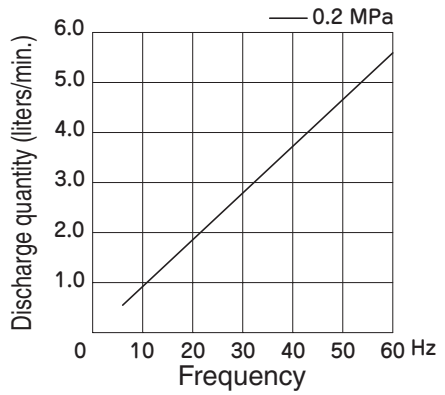
TPL2ME·TPL2MWE-028



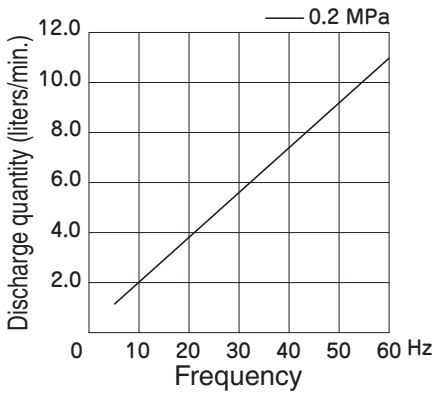
TPL2ME·TPL2MWE-032



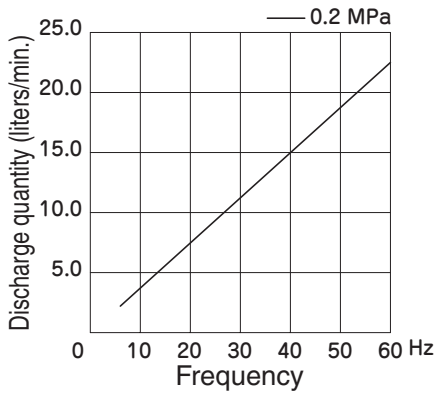
TPL2ME·TPL2MWE-040



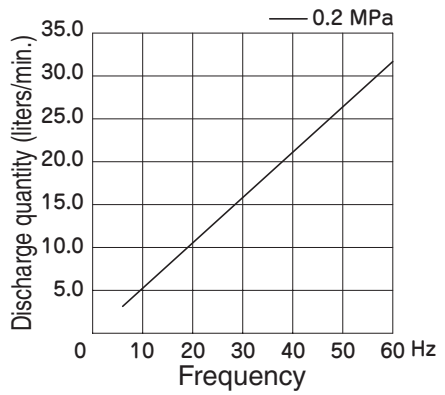
TPL2ME·TPL2MWE-056



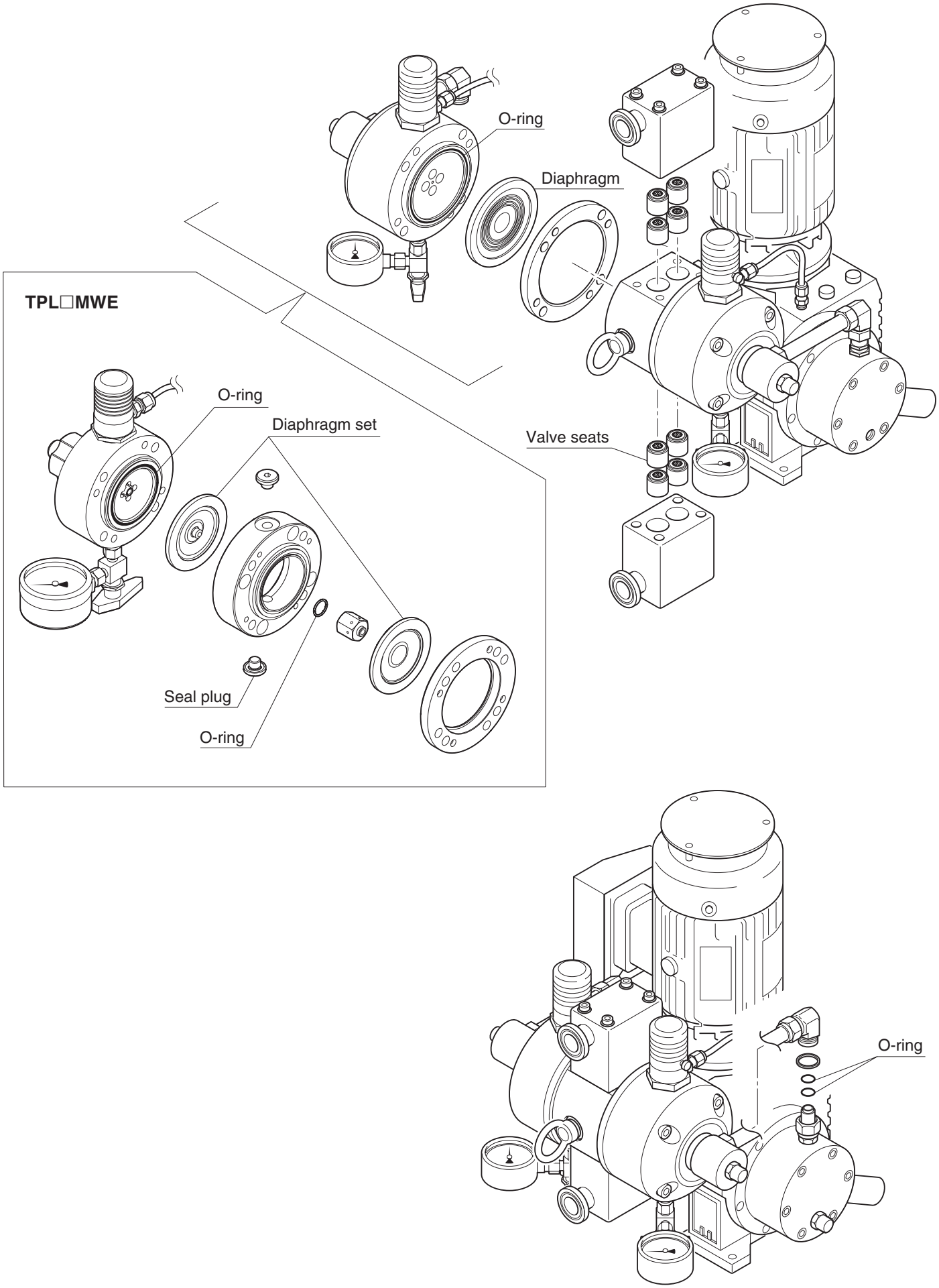
TPL2ME-080



TPL2ME-095



■Consumable parts



Definition of terms

●Overfeeding

A phenomenon that liquid continues to discharge from the piping for a few seconds due to the momentum of discharge (inertia) after stop operating a pump. In case of pulsation flow, the actual discharge volume might be larger than rated one because of this phenomenon.

●Siphoning effect

If the end of the pump discharge pipe is lower than the level of liquid in the suction tank, chemical flows even when the pump is turned off.

●Cavitation

Formation of bubbles in the pump head because of negative pressure, causing the discharge volume to decrease and abnormal sounds or vibration to be produced.

After-sales services

If any aspects of the terms and conditions of the after-sales service applying to the repairs to be provided during the warranty period and other such matters are not clear, consult your vender or a TACMINA representative.

Warranty

(1) The warranty period shall be one year from the date of dispatch from TACMINA's factory.
(2) If, during the warranty period, the product sustains malfunctions or damages as a result of design, manufacturing, or material defect, or if the product does not meet its specifications, TACMINA will arrange for repairs, provide replacement components, or replace the product, at TACMINA's discretion, at no charge to the customer. However, this warranty only covers direct damage to the product. Any consequential losses or damages, including, but not limited to, profit losses and any secondary damages, caused by malfunctions, breakage, or impaired performance of this product shall not be covered by this warranty. The limitation of TACMINA's liability shall not exceed the sales value of the defective product.
(3) If a malfunction or damage is found, notice shall be given to distributor or TACMINA with documents that prove the malfunction or damage is caused by improper design, manufacturing failure or material defect within 14 days after awareness of such malfunction or damage. If the distributor or TACMINA does not receive such notice within aforementioned period, even though the warranty period is still in effect, TACMINA shall not be liable for any malfunction and damage.
Please note that TACMINA may request to give further information or to return the product for investigation. If the cause is attributable to TACMINA's action, the shipping fees, cost of investigation and checks performed by TACMINA shall be borne by TACMINA.
(4) Even in the warranty period, the cost of repairs in the following conditions shall be paid to the distributor or TACMINA.
1) Damages and deterioration of consumables.
2) Damages or malfunctions of the warranted product caused by carelessness in handling or incorrect use.
3) Damages or malfunctions of the warranted product caused by the failure to perform maintenance such as periodic inspections and repairs and replacements of consumables.
4) Damages or malfunctions of the warranted product caused by falls or impacts.
5) Damages or malfunctions of the warranted product resulting from the use of parts other than the ones supplied by TACMINA.
6) Damages or malfunctions of the warranted product resulting from product repairs or remodeling undertaken by individuals other than TACMINA employees or personnel of businesses authorized by TACMINA.
7) Damages or malfunctions of the warranted product resulting from fires, natural disasters, geological calamities, and force majeures.
8) Damages or malfunctions of the warranted product resulting from loose bolts or nuts or from defective hose connections.
9) Discoloration, deterioration, damages, or malfunctions of the warranted product resulting from ultraviolet rays, corrosive gases, or flooding.
10) Damages or malfunctions of the warranted product resulting from corrosion, swelling, or melting caused by the adhesion or chemical effect of the used liquid.
11) Damages or malfunctions of the warranted product resulting from damages to products other than those made by TACMINA.
12) Damages or malfunctions of the warranted product resulting from usage outside of the range of the usage conditions listed in the operation manual.
(5) The judgment of damages, malfunctions, and impaired performance as well as the judgment of whether the cause is the design of the product and product defects shall be performed by TACMINA's technical department.

Repairs

■Before requesting repairs
Please read this operation manual carefully and inspect the product again.

■Who to request repairs from
Ask your vendor to take care of the repairs. If you are not sure of who your vendor is, contact TACMINA.

■Precautions when sending the product for repairs
Be sure to observe the following items to protect worker safety and to protect the environment:
• If any chemicals have affixed to the product, wash it clean.
• Attach the safety data sheet (SDS) to the product.
• If a "maintenance data" page is present at the end of the operation manual, fill in this page and attach it to the product.
✻ The product may not be repaired if the necessary materials are not attached.
✻ Even when the necessary materials are attached, TACMINA may send the product back if it is determined that repairing the product will constitute risks or dangers.

■Minimum retention period for consumables
TACMINA will continue to supply consumables for its pumps for a period of eight (8) years after the manufacture of the pumps has been discontinued.

EU DECLARATION OF CONFORMITY
(Directive 2006/42/EC and 2014/30/EU)

Manufacturer : TACMINA CORPORATION
Address : 2-2-14, Awajimachi Chuo-ku, Osaka 541-0047, Japan

Herewith declares that

Machine Name : Metering Pump
Brand Name : Smoothflow Pump
Model (Type) : TPL Series (TPL1M, TPL1MC, TPL1ME, TPL1MEN,TPL2M, TPL2MC, TPL2ME, TPL2MEN)

- is in conformity with the provisions of Machinery Directive 2006/42/EC,
- and, is in conformity with the provisions of EMC Directive2014/30/EU

And furthermore declares that

- the following (parts / clauses of) harmonized standards have been applied :

EN809: 1997+A1:2009/AC:2010	Pumps and pump units for liquids-Common safety requirements
EN12100:2010	Safety of machinery-General principles for design -Risk assessment and risk reduction
EN60204-1: 2006+A1:2009	Safety of machinery —Electrical equipment for machines —Part 1: General Requirements
EN61000-6-2: 2005	Electromagnetic compatibility(EMC) —Part 6-2:Generic standards—Immunity for industrial environments
EN61000-6-4: 2006	Electromagnetic compatibility(EMC) —Part 6-4:Generic standards—Emission for industrial environments

Date: November 1, 2016

Name : Hirokimi Inoue
Position : Head of Development Center
TACMINA CORPORATION

EU DECLARATION OF CONFORMITY
(Directive 2006/42/EC and 2014/34/EU)

Manufacturer : TACMINA CORPORATION
Address : 2-2-14, Awajimachi Chuo-ku, Osaka 541-0047, Japan

Herewith declares that

Machine Name : Metering Pump
Brand Name : Smoothflow Pump
Model (Type) : TPL Series (TPL1M, TPL1MC, TPL1ME, TPL1MEN,TPL2M, TPL2MC, TPL2ME, TPL2MEN)
- without motor type
- pump head material is metallic type

- is in conformity with the provisions of Machinery Directive 2006/42/EC,
- and, is in conformity with the provisions of ATEX 2014/34/EU

And furthermore declares that

- the following (parts / clauses of) harmonized standards have been applied :

EN809: 1997+A1:2009/AC:2010	Pumps and pump units for liquids-Common safety requirements
EN12100:2010	Safety of machinery-General principles for design -Risk assessment and risk reduction
EN ISO 80079-36: 2016 Explosive atmospheres-Part36	Non-electrical equipment for explosive atmospheres-Basic method and requirements

Type of Protection : CE Ex II 2 G Ex h IIB T4 Gb

Date: August 1, 2019

H. Inoue

Name : Hirokimi Inoue
Position : Director of Technical Headquarters
TACMINA CORPORATION

Product designs and specifications are subject to change without notice for product improvement.

TACMINA CORPORATION

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