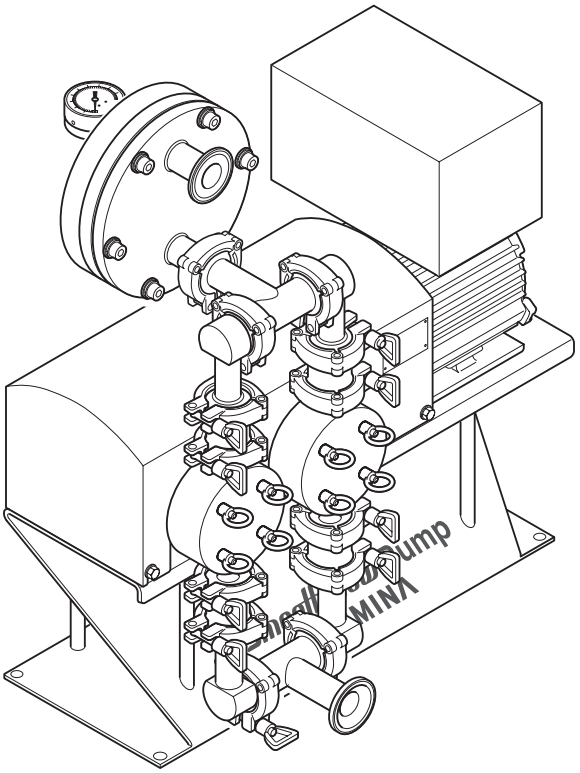
TACMINA

Smoothflow Pump

PLSS Series

User's Manual

Before beginning operation, read this manual carefully!
Ignoring the descriptions in this User's Manual and mishandling the unit may result in death or injury, or cause physical damage.



Applicable Models

PLSS-01
PLSS-05
PLSS-09
PLSS-1
PLSS-2

- TACMINA accepts no liability whatsoever for any damage caused by malfunction of this unit and other damage caused by use of this unit.
- For details on handling the inverter and other components, refer to the respective User's Manual.
- If the pump you bought conforms to special specifications not described in this User's Manual, handle the pump according to details of separate meetings, drawings and approval documents.
- Additional information on this product and manuals in other languages may be found on our website.

www.tacmina.com

For the Safe Use of This Product

This manual is intended to help the operator to handle the product safely and correctly. In support of this aim, important safety-related instructions are classified as explained below.
Be sure to follow them at all times.

⚠ WARNING

• If the product is operated incorrectly in contravention of this instruction, it is possible that an accident resulting in death of serious injury will occur.

⚠ CAUTION

• This indicates that improper operation can result in an injury or physical damage to the product.

IMPORTANT

•This indicates information that should always be followed to maximize the product's performance and service life.

NOTE

•This indicates supplementary explanations.

Conditions of Use

⚠ CAUTION

- **This pump can be used for transfer of liquids only. Do not use this pump for other applications. Doing so might cause accidents or malfunction.**
- **Do not use the pump outside the following usage ranges. Doing so may cause malfunctions.**

Ambient temperature	Ordinary temperature
Temperature of liguid	15 ～ 40℃
Discharge pressure	0.1 ～ 0.5MPa*1
Viscosity of liguid	See the transferrable viscosity table.
Altitude of installation location	Indoors : IP44 or equivalent (water and dust proof) Less than 1,000m Avoid direct sunlight Avoid rapid temperature change

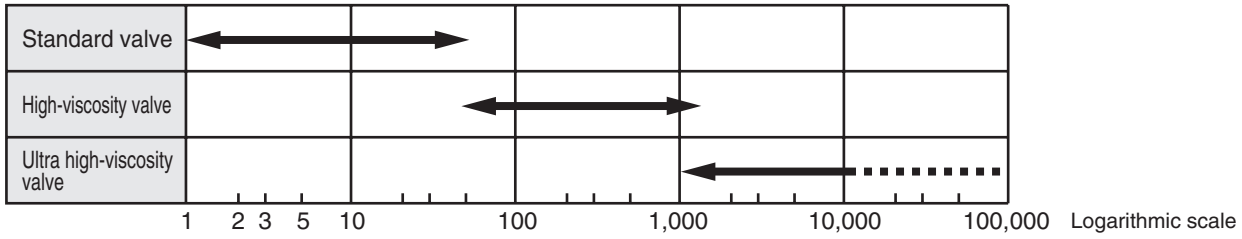
*1 When the pressure at the discharge destination is less than 0.1 MPa, install a throttle valve at a point on the secondary pipe of the refiner.

✻ For details on the operating conditions of the inverter, refer to the separate user's manual of the inverter.

■Transferable viscosity

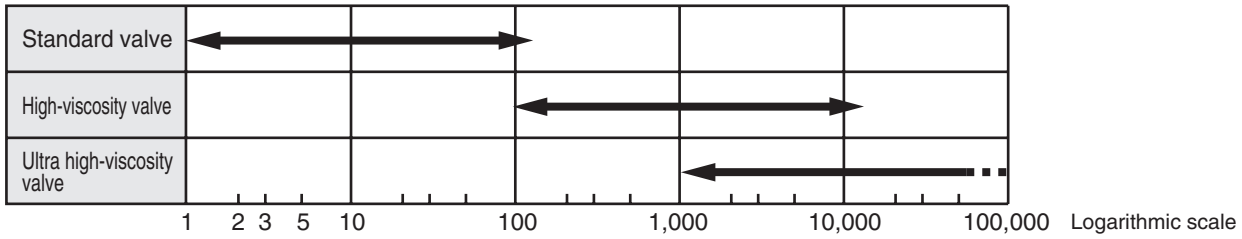
- **Newtonian fluid**

Unit : mPa·S



- **Non-Newtonian fluid**

Unit : mPa·S



✻ It may change depending on the liquid property/transfer conditions of the pumping liquid.

Transportation, Installation & Piping

⚠ WARNING

- Install this pump in a location where it will not come into contact with other people besides the operator.
- Do not stand or move under hoisted pumps. The pump might fall, causing an accident.

⚠ CAUTION

- If this pump has been dropped or damaged, consult your vender or a TACMINA representative. Using a dropped or damaged pump may result in accidents and/or malfunctions.
- Do not install the pump where there is a risk of flooding or where there are high levels of moisture or dust. Doing so may cause electric shocks and/or malfanctions. Doing so may cause electric shocks or malfunction.
- Install a relief valve on the pumping immediately on the discharge side of this product.
- The water used for the shipment tests may be left on the liquid-end parts (the parts that come into contact with the liquid) of the pump. If the pump is to be used for chemical that may harden or give off gas if it reacts with water, be absolutely sure to dry off the liquid-end parts prior to use.
- The flow rate cannot be adjusted by operating valves on the discharge piping.

Electrical Wiring

⚠ WARNING

- Ensure that the proper electrical work for the explosion-proof motor and inverter is carried out correctly.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- Do not turn ON the pump's power during electrical wiring. Attach a "Work In Progress" label to the power switch.
- Reliably ground the earth terminal. Failure to do so might cause electric shocks. Be sure to install a current leakage breaker.

⚠ CAUTION

- The wiring must be done by a qualified electrician or somebody with electrical knowledge.
- 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.

Operation & Maintenance

⚠ WARNING

- Ensure that nobody other than the operators and control personnel will operate the pump.
- Do not operate the pump with wet hands. Doing so may result in electric shocks.
- When trouble has occurred (such as when smoke appears or there is a smell of burning), shut down the pump immediately, and contact your vender or a TACMINA representative. Otherwise, a fire, electric shocks and/or malfunctions may result.
- During the air releasing, chemical may suddenly gush out from the pipes and other parts. Lead the end of the air-release hose bank to the tank or other container, and secure it so that it will not become disconnected.
- If you forget to open the discharge-side valve or if foreign matter clogs the discharge-side piping, the pressure in the pump and pump head may increase beyond the range indicated in the pump specifications. This may result in the chemical leaking or spurting out, or in damage to the pump or piping. Check valves before start operating the pump.

⚠ CAUTION

- Do not turn ON the pump's power during maintenance. Attach a "Work In Progress" label to the power switch.
- When handling liquid-end sections, be sure to wear protective coverings (rubber gloves, mask, protective goggles, chemical-resistant overalls, etc.) appropriate for the chemicals be using used.
- Before maintaining or repairing the pump, be sure to release the discharge-side pressure, drain the chemicals from liquid-end sections, and wash the pump with water.

Other Precautions

⚠ CAUTION

- Do not remodel this pump.
- Adopt preventative measures such as a chemical drain ditch in case chemicals flood out of the pump. Also, install so that the chemical level does not rise up to the surface where the pump is installed.
- When disposing of used pumps, ask an authorized disposal expert to dispose of the pump in accordance with local laws and regulations.

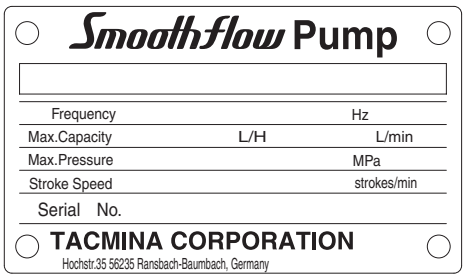
Checking the Product

After unpacking the pump, check the following.

- Is the pump the one that was ordered?
- Do the details on the pump's nameplate match what was ordered?
- Is all the accessories supplied?

  ✻ Check the supplied accessories against the “Accessories list” below.
- Has the pump sustained any damage from vibration or impact during transit?
- Have any of the screws come loose or fallen out?

Every care is taken by TACMINA in the shipment of its pumps, but if you come across anything untoward, please contact your vender or a TACMINA representative.



Accessory List

Accessory	Quantity per pump	Remarks
Refiner*	1	Pressure gauge installed
Regulator*	1	
Hexagonal nipple*	1	
Clamp Band(2K)	1	
Ferrule Packing	1	
Inverter	1	FR-B3-400(Mitsubishi Electric corporation)
User's Manual	1	For pump
User's Manual	1	For Inverter

*Supplied only with the refiner specification model

Contents

Outline

Explanation of product 5
Principle of operation 5
Names of parts 6

Installation

Installation 7
Piping 8
Electrical wiring 12

Operation

Operation 13
Air releasing 15
Refiner adjustments 15
Shutting down 16
Flow rate setting 17
Checking the amount of gear oil 17
Procedure for prolonged shutdown of operation 17

Maintenance

Maintenance 18
Replacing the liquid-end section 19
Replacing the gear oil 25

Troubleshooting

Troubleshooting 26

Specifications

Model code 28
Specification 29
Performance curve 30
External dimensions 31

Others

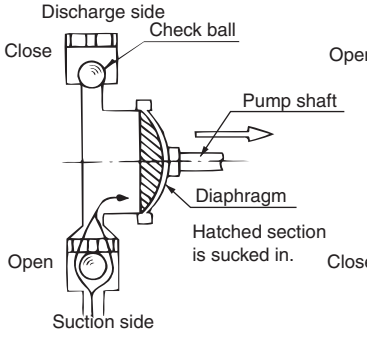
List of consumables 33
Options and related equipment 33
Glossary 33
List of tools 33
After-sales services 34
Maintenance data 35
Table of refiner settings 36

Explanation of product

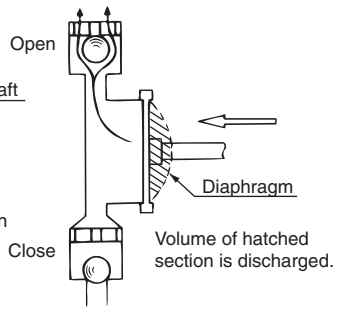
The PLSS Series are direct-drive diaphragm metering pumps that minimize pulsation.
The d2G4 (pressure-resistant, explosion-proof) motor is equipped as standard, enabling use even in explosion-proof areas.

Principle of operation

(1) Motor rotation is decelerated by a reduction gear.
(2) Rotary action is converted to reciprocating motion by an eccentric cam mechanism.
(3) When the diaphragm at the end of the pump shaft moves in a reciprocal manner, the volume inside the pump head changes.
(4) When the diaphragm moves backward, minus pressure is generated inside the pump head. At this time, the check ball on the discharge side closes the flow path as shown in Figure 1 to prevent reverse flow from inside the discharge-side piping. Meanwhile, on the suction side, liquid flows into the pump head as the check ball opens the flow path.
(5) Next, when the diaphragm is pushed out forwards, positive pressure is generated inside the pump head. For this reason, the check ball on the suction side closes the flow path to open the discharge side, and discharge liquid to the discharge side. (Figure 2)



(Figure 1)

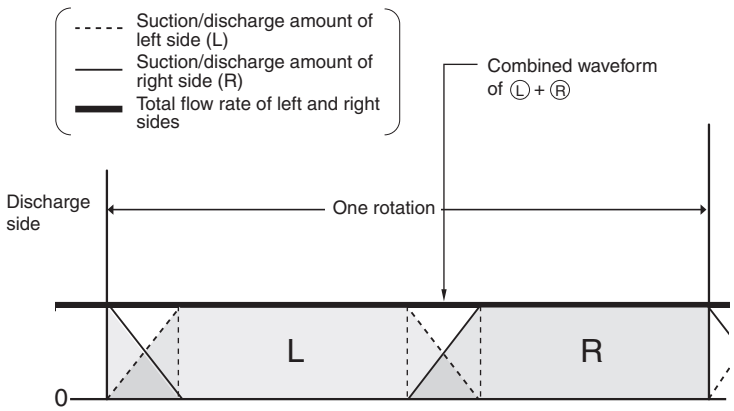


(Figure 2)

■Duplex Pulseless Mechanism

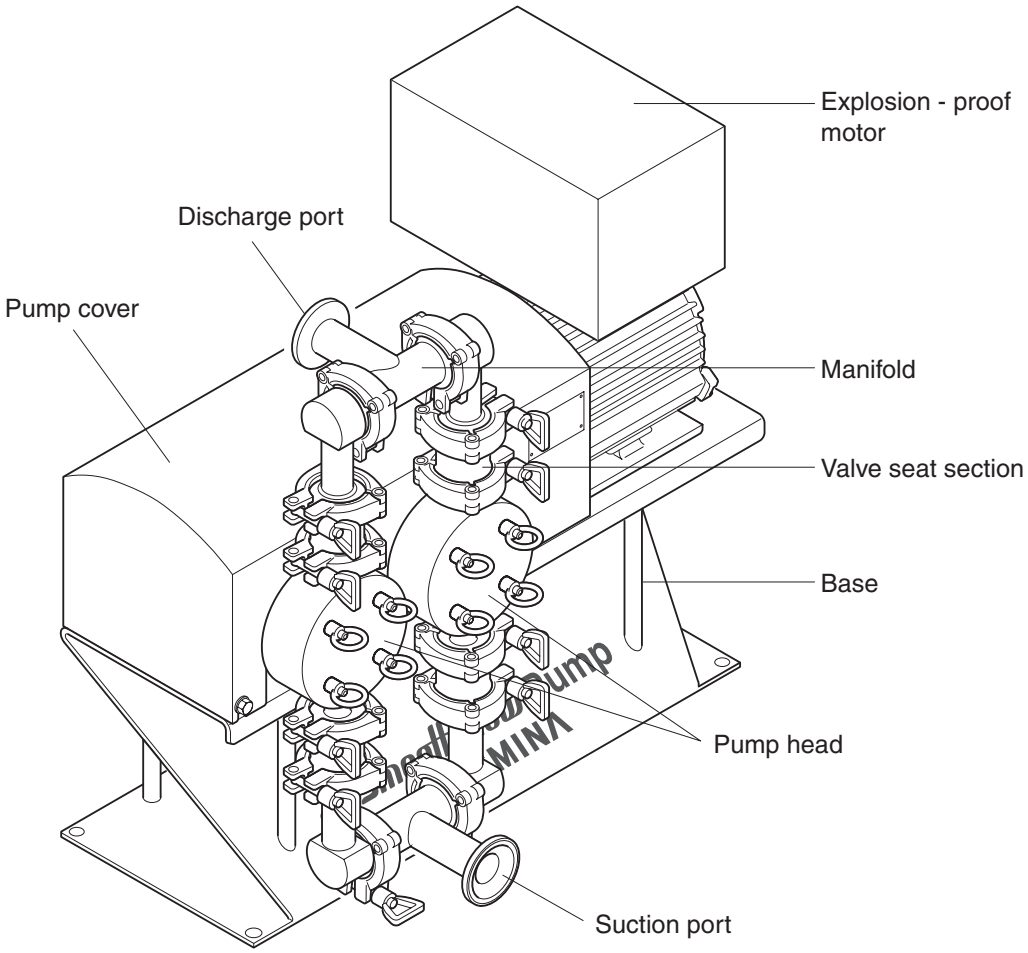
This pump employs a high-precision uniform speed cam mechanism as the eccentric cam mechanism. It results in a trapezoid shaped waveform L as shown in Figure 1, and the successive discharge waveforms from each pump head partially overlapping by a 180° phase in such a way as R that the combined waveform is a horizontal straight line. Pulsation occurs on the suction side.

■Discharge waveform

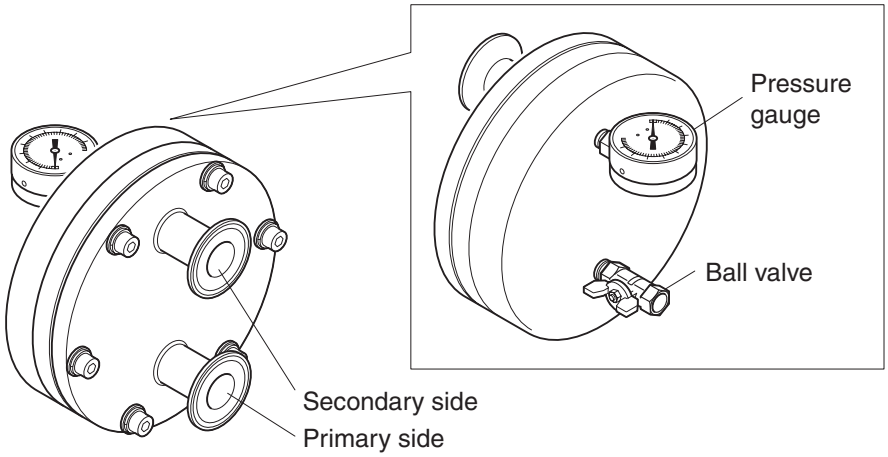


Names of parts

Pump



Refiner



Installation

WARNING

- **Do not stand or move under hoisted pumps. The pump might fall, causing an accident.**
- **Install the pump in a location that cannot be accessed by anyone but control personnel.**

Installation location

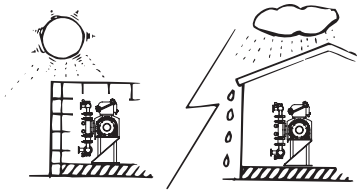
Whenever possible, avoid installing the pump in a location that will shorten its service life

Locations causing inverter malfunctioning and accidents

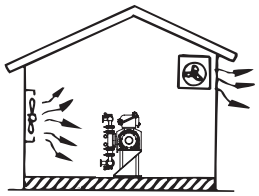
- **Location subject to the direct sunlight**
- **Locations where temperature changes occur suddenly enough to produce condensation**

Avoid the following location:

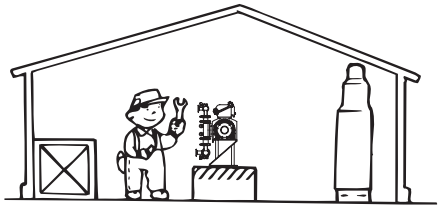
- **Location subject to the direct sunlight or location where corrosive gases are generated**
- **Location exposed to the wind and rain, or poorly ventilated location**
- **Location subject to lots of moisture or dust**



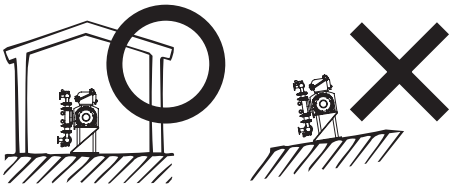
- **Install the pump in a location where the ventilation is good and where the chemical will not freeze.**



- **Provide adequate space around the pump to facilitate maintenance and inspections.**

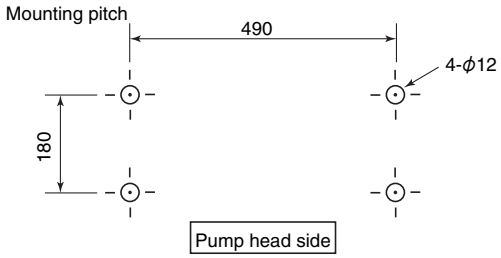


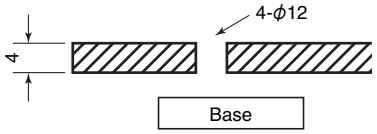
- **Place the pump in a level location, and secure it so that it will not vibrate. Installing the pump at an angle may result in discharge trouble or in the inability of pump to discharge.**



Mounting bolt positions

Prepare four M10 bolts for fixing the base.





Piping

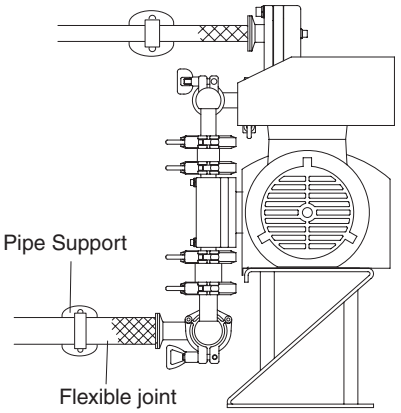
Requests during Piping

● Pressure gauge

To adjust the refiner air, install a pressure gauge on the secondary side of the refiner.

● Pump head joining section with pipes

- The pump head is not designed to support piping.
- Support the piping so that the attachment does not bear the weight of the piping.
- 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.



● Pipe length

- An excessively long pipe/hose may result in increased pressure loss, may cause the pressure to exceed the pump's allowable pressure, or may give rise to overfeed and/or cause pipe vibration.
- When extending the piping, pressure loss might exceed the pump's maximum discharge pressure. So, larger piping must be provided. Notify your supplying agent of (1) viscosity of the liquid, (2) length (positional relationship) of the piping, (3) specific gravity of the liquid, and other information.

  Your supplying agent will select the ideal piping sizes for you.

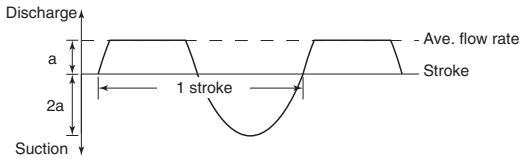
● Pulsation on the suction-side piping

- Though pulsation is minimized on the discharge side, pulsation*1 occurs on the suction piping.
- In principle, the piping aperture must be larger than the pump's aperture.

*1 Pulsation

This pump generates pulsation unique to reciprocating pumps. This pulsation has sine wave characteristics, and the momentary flow rate is about twice that of the average flow rate. For example, this means that a momentary flow rate of 4 L/min is shown on a reciprocating pump having an average flow rate 2 L/min.

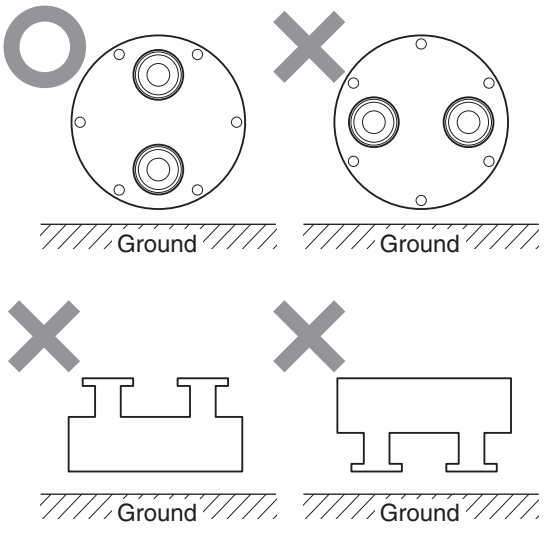
For this reason, when selecting piping, the piping differs from that used on a continuous flow pump such as a centrifugal pump in that a value twice the operating flow rate (L/min) must be used.



Flow rate wave form of this pump (one side)

● Refiner installation

- Install the refiner by connecting it directly to the discharge port, or in a position close to the pump on the pump discharge side. If the location is far from the pump, the pulsation reduction effect may not be sufficient.
- When installing the refiner, install it perpendicular to the ground and position the discharge port and suction port of the refiner at the top and bottom.



Installation

Piping

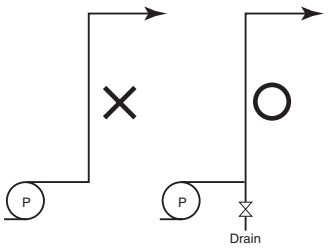
● Liquid containing slurry

When transferring liquid containing slurry on this pump, satisfy the following conditions and observe the piping cautions.

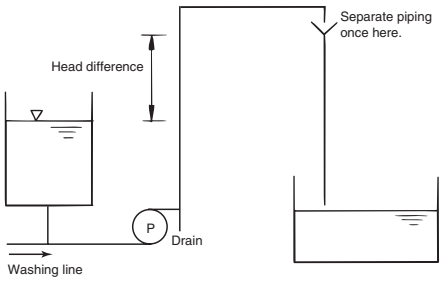
- For details of the size and concentration of slurry that can be transferred by this pump, contact TACMINA.

Piping cautions

- Install a drain on the ascending piping immediately after the joint on the pump's discharge side.



- When transferring liquid is containing slurry, use narrower piping to increase the flow velocity inside the piping within the permissible pressure loss range.
- Install a washing water (pressurized water such as city water) line on the suction-side piping. Before stopping operation, flush the pump and piping with washing water to remove any slurry inside.
- Do not use of a back pressure valve. Slurry sticking to valve seals will prevent the valves from functioning.
- When siphoning or overfeed might occur, provide a countermeasure as much as possible on the ascending piping (by a head difference).



- When a relief valve is installed and is acting, slurry will bite into the seals. So, the piping must be flushed with washing water.

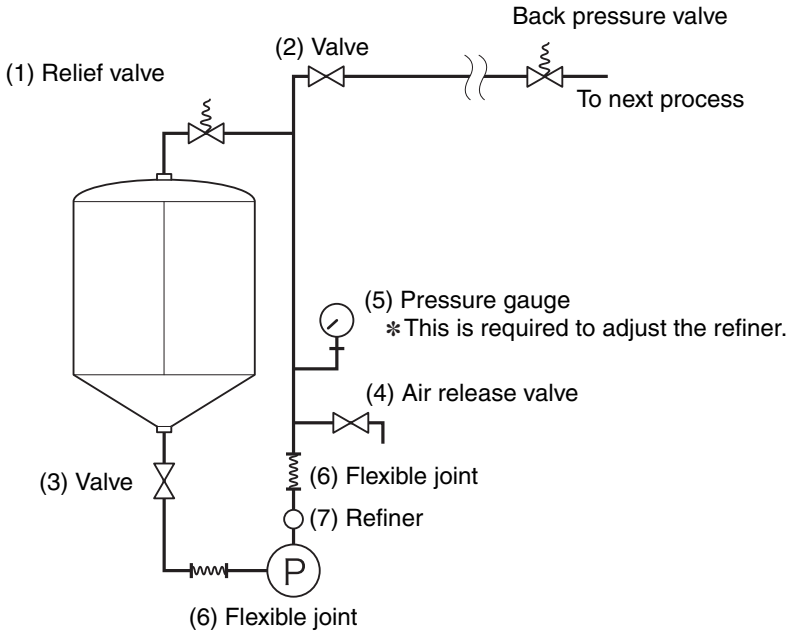
● Other

- When transferring liquid that coagulates due to temperature changes, the transferred liquid will coagulate in the pump head or piping, which sometimes might break the pump or its periphery. Be sure to install a heater or heat retainer.

Piping

Example of recommended piping arrangements

Install the pump so that it is lower than the level of liquid in the tank using 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.

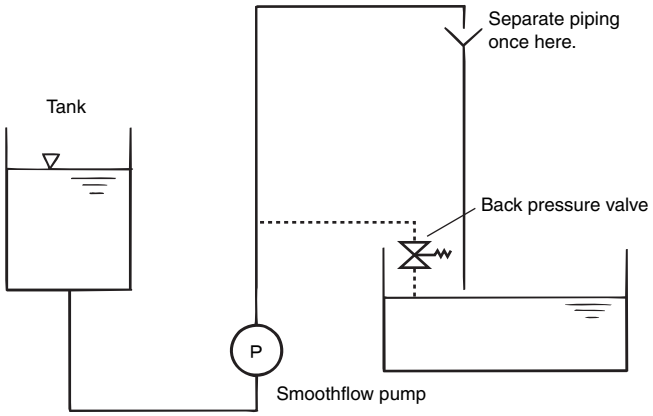


(1)We recommend to install a relief valve*1 for automatically releasing abnormal pressure to air in the discharge-side piping.
(2)To facilitate maintenance, install tightening valves near the pump on both the discharge and suction sides.
(3)Do not use a diaphragm valve as the valve on the suction side.
(4)Installing a valve for releasing air on the piping immediately after the discharge side will come in handy.
(5)Provide a pressure gauge for measuring the pressure on the pump's discharge side.
(6)Use of a flexible joint is recommended in order to minimize piping vibration.
(7)Install the refiner by connecting it directly to the discharge side manifold, or in a position close to the pump on the pump discharge side.

*1 Relief valve
When the discharge-side piping on this pump becomes blocked, the discharge-side pressure increases abnormally, and may cause oil leakage or the pump heads, joints and driven parts to break.
For this reason, a relief valve must be installed on the pump's discharge side. Adjust the relief valve setting pressure to about 120% of the operating pressure.

● When injecting to below the level of liquid in a tank

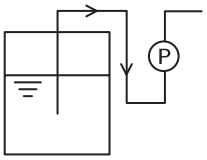
When injecting to a position lower than the level of the liquid in the tank, siphoning will cause liquid to flow down naturally. To prevent this, either install a back pressure valve, or install a ventilation duct at a position above the level of liquid in the tank and near the injection point.



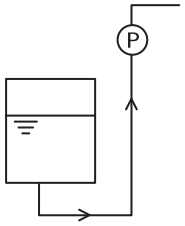
Piping

Bad examples of piping

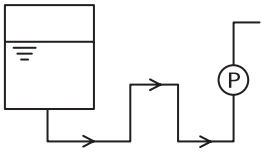
We do not recommend the piping conditions as below since these will cause unstable discharge or liquid may not be able to be discharged.



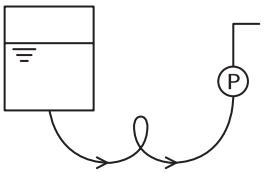
Suction upwards
(reduced accuracy)



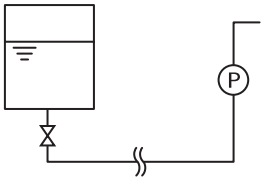
Suction upwards
(reduced accuracy)



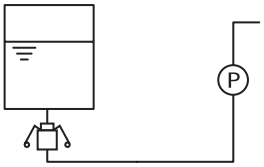
Rise-and-fall midway piping
(reduced accuracy)



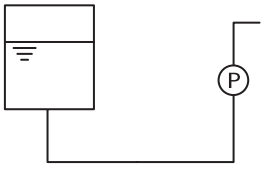
Soft hose
(blockage on suction side, palsation)



Suction-side piping too long
(cavitation, entry of air, pulsation)



Coupler
(entry of air)



Suction-side piping too narrow
(cavitation)

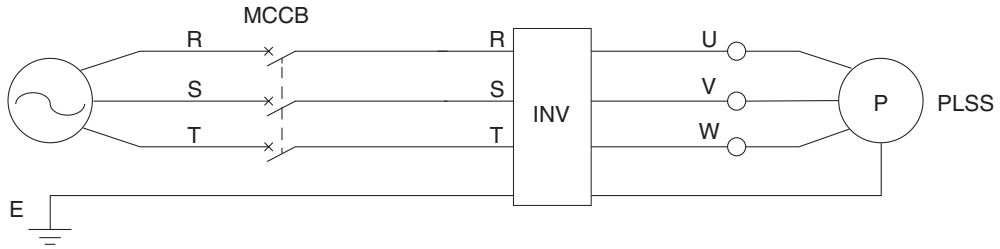
Electrical wiring

WARNING

- **Ensure that the proper electrical work for the explosion-proof motor and inverter is carried out correctly.**
- **Do not operate the pump with wet hands. Doing so may result in electric shocks.**
- **Do not turn ON the pump's power during wiring. Attach a "Work In Progress" label to the power switch.**

The pump's flow rate is adjusted by changing the inverter frequency and controlling the motor speed.
A terminal box is used for the electrical wiring of the motor, and the connection size of the wiring conduit is G3/4.
Use the conduit to protect the electrical wires.

Wiring example



MCCB : Molded case circuit breaker
INV: Inverter

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

Operation

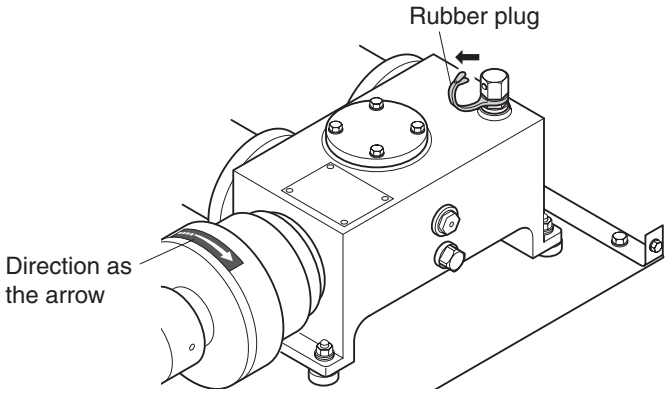
⚠ WARNING

- **When handling the liquid-end sections, be sure to wear protective coverings (rubber gloves, mask, protective goggles, chemical-resistant overalls, etc.) appropriate for the chemicals be using used.**
- **If you forget to open the discharge-side valve or if foreign matter clogs the discharge-side piping, the pressure in the pump and pump head may increase beyond the range indicated in the pump specifications. This may result in the chemical leaking or spurting out, or in damage to the pump or piping. Check valves before start operating pump.**

Before the first operation

- Make sure that the Conditions of use are appropriate. (See “Conditions of Use” on page 1.)
- Flush the piping with water or other safe liquid, and make sure that the piping is free of leaks and blockages. Also, flush the piping to prevent chips and other foreign objects from remaining in the pipes during piping.
- A rubber plug is fitted into the oil supply port of the drive box in order to prevent liquid leakage during transportation. This plug must be removed without fail prior to initiating operation for the first time. Initiating operation without first removing the plug may cause the temperature inside the drive box to rise, causing gear oil to ooze out.

(1)Perform inverter tuning.
・Refer to the user's manual of the inverter, and perform the motor shutdown-type of auto tuning.
(2)Loosen the four bolts and remove the pump cover.
(3)Remove the rubber plug.
(4)Operate the pump in jog mode using the inverter, and check that the motor rotates in the same direction as the arrow on the sticker.
(5)Attach the pump cover and tighten the four bolts.



IMPORTANT

- **Check that the motor rotates in the same direction as the arrow on the sticker. (Do not operate the pump in the opposite direction. If the motor is rotating in the opposite direction, considerable pulse occurs on the discharge side.)**
- **Set the value on the motor’s ratings nameplate as the motor setting used during auto tuning. If there are a multiple number of ratings with a standard motor, for example, set the value for 200 V/60 Hz or 400 V/60 Hz.**

Before operation

Check the following points every day.

Check Point	Details to Check	Remarks
Chemical tank	Make sure that there are sufficient chemicals in the chemical tank. Replenish the chemical tank if necessary.	Pay particular attention when handling chemicals or performing processes that are adversely affected by contact with air.
Piping	Check the piping for any disconnections, liquid leaks caused by damage to piping. Reconnect or repair damage if necessary.	
Valves (suction side and discharge side)	Make sure that valves on the suction side and discharge side are open. Open any closed valves.	Closed valves may cause pressure to build up, chemicals to spurt out or damage piping.
Power supply	Make sure that the pump is connected correctly to the specified power supply.	Connection to a wrong power supply may cause motor seizure.
Electrical wiring	Make sure that electrical connections to inverters and other devices are correct.	Wrong connections may cause short circuits or electrical leakage.
Driven parts	Make sure that the amount of gear oil in the drive box is appropriate. Check the drive box for oil leakage.	Refer to "Checking the amount of gear oil" on page 17 and re-tighten if you find an oil leak.
Pump head	Check the eye-nuts for looseness.	If there is any looseness, re-tighten.
Clamp	Check the butterfly-nuts for looseness.	If there is any looseness, re-tighten.
Packing	Check for damage and sagging.	If any damage or sagging is found, replace with a new part.

During operation

Check Point	Details to Check	Remarks
Pump head	Check for any liquid leaking from the hole at the bottom part of the subring located behind the pump head.	Liquid leaks may indicate the damage of diaphragm. So, inspect the diaphragm also.
Joints	Check for liquid leakage.	If there are liquid leaks, inspect for insufficient tightening and loosening of bolts, and re-tighten as necessary. If this does not correct the liquid leak, inspect each of the O-rings
Discharge-side pressure	Check the pressure gauge on the pump discharge side.	If an abnormal numerical value is indicated, the piping may be clogged or valves may be blocked. Inspect the piping also.
Motor unit Pump unit	Check for generation of heat or abnormal noise.	Refer to "Troubleshooting" on page 26.

• When using the pump for the first time
• When changing the flow rate

Flow rate setting (page 17)

• When shutting down operation for a prolonged period
• When resuming operation after a prolonged shutdown of operation

Procedure for prolonged shutdown of operation (page 17)

• When liquid is not sucked up by operation

A probable cause is that foreign objects are biting into the seals on the discharge or suction side (sections sealed by check balls). Remove any dirt by the following procedure:

(1) Turn off the pump's power.
(2) Remove the manifold or valve seats, and wash the check balls and valve seats with water or cleaning fluid.
(3) Re-assemble the check balls and valve seats into the pump heads while still wet making sure not to mistake the discharge and suction sides.

Air releasing

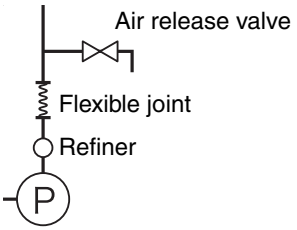
Follow the steps below to release the air when not pumping liquids, for instance, because pressure is being supplied to the discharge side.

(1) Release the pressure in the discharge-side pipe.

(2) Start operating the pump. (Set the frequency of the inverter from 6 to 10Hz.)

(3) Shut down the pump after its pump head is filled with the liquid.

(4) Set the discharge-side piping again.



Refiner adjustments

IMPORTANT

• Be sure to adjust the refiner before operating the pump. Pulsation may occur if the refiner is not adjusted correctly.

■When a pressure gauge enabling the line pressure to be measured is provided at the pump discharge side

Be absolutely sure to install the pressure gauge for checking the line pressure as close to the pump as possible. The discharge pressure supplied to the pump and refiner cannot be measured using a pressure gauge that has been installed at the discharge end, since a lower pressure level would be indicated than if installed at a location closer to the pump.

(1) Operate the pump at the target flow rate, and check the line pressure.

✻ A small amount of pulsation occurs at this point in time. Check the highest level of the pressure in its fluctuation range.

(2) Shut down the pump.

(3) Release the pressure in the discharge-side pipe.

(4) Open the ball valve, and use the regulator to supply air at a pressure that is 0.7 to 0.8 times higher than the line pressure that was checked in step (2) to the refiner.

(5) Close the ball valve that is installed on the refiner.

(6) Set the discharge-side piping again.

■When a pressure gauge for checking the line pressure is not provided at the pump discharge side

	Operation procedure	Example of what is entered
1	Shut down the pump, and supply air to the refiner until a pressure of 0.07 MPa is reached.	
2	Operate the pump, and enter the value indicated by the pressure gauge of the refiner in column B on the table.	Enter the refiner pressure at B1. Example: “0.15”
3	Enter the value obtained by multiplying the value in column B by 0.7 in column C.	Enter 0.15 x 0.7 for C1. The result of this calculation is “0.105.”
4	Shut down the pump, supply air to the refiner until a pressure of 0.105 MPa is reached, and enter the value in column A.	Enter “0.105” for A2.
5	Operate the pump, and enter the value indicated by the pressure gauge of the refiner in column B on the table.	Enter the refiner pressure for B2. Example: “0.20”
6	Calculate the difference between the pressure that was obtained when the pump was operating and that previously entered for B2.If the difference is less than 0.01 MPa, the settings are complete.	0.20 (B2) - 0.15 (B1) = 0.05 • In this example, the difference is greater than 0.01 MPa so proceed to step (7). • If the difference is less than 0.01 MPa, the settings are complete.

	Operation procedure	Example of what is entered
7	Enter the value obtained by multiplying the value in column B by 0.7 for column C.	Enter 0.20 x 0.7 for C2. The result of this calculation is "0.14."
8	Shut down the pump, supply air to the refiner until a pressure of 0.14 MPa is reached, and enter the value for column A.	Enter "0.14" for A3.
9	Operate the pump, and enter the value indicated by the pressure gauge of the refiner for column B on the table.	Enter the refiner pressure for B3. Example: "0.20"
10	Calculate the difference between the pressure that was obtained when the pump was operating and that previously entered for B3.	0.20 (B3) - 0.20 (B2) = 0 • If the difference is less than 0.01 MPa, the settings are complete.

• Refiner setting table

(In this table are entered the figures for the above example. When performing the refiner settings, copy and use the refiner setting table on page 36.)

	A	B	C
	Refiner pressure [MPa] while pump is shut down	Refiner pressure [MPa] while pump is operating	Refiner pressure setting [MPa](Refiner pressure while pump is operating x 0.7)
1	0.07	0.15 (2)	0.105 (3)
2	0.105 (4)	0.20 (5)	0.14 (7)
3	0.14 (8)	0.20 (9)	
4			
5			

Shutting down

When shutting down the operation, clean the inside of the pump head and refiner.
For disassembly and cleaning of the pump head and refiner, refer to "Maintenance."

⚠ CAUTION

- **After using (shutting down) the pump, release the pressure inside the refiner to return it to the atmospheric pressure.**
- **If air is left inside the refiner for a long time while the pump is shut down, it may cause diaphragm deformation, sticking on the refiner head or liquid leaks, resulting in damage to the diaphragm or reducing the refiner effect.**

Flow rate setting

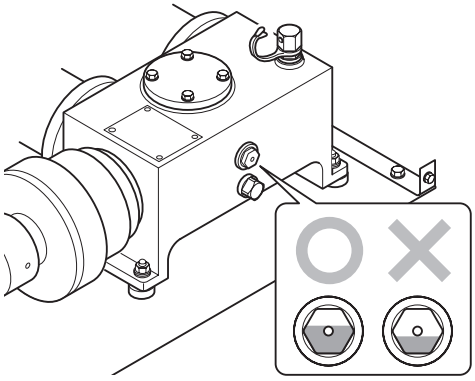
IMPORTANT

- **Set the maximum frequency of the inverter to 60 Hz.**

This pump does not have a flow rate adjusting dial as a general metering pump does.
Flow rate is controlled by changing frequency and adjusting the motor speed with inverter.
Any frequency from 6 to 60 Hz can be used as the inverter frequency.

Checking the amount of gear oil

(1) Turn off the pump's power.
(2) Remove the pump cover.
(3) Visually check the amount of gear oil by inspecting the oil gauge.
The oil gauge must be completely filled with oil.



Procedure for prolonged shutdown of operation

Perform the following operation when stopping operation for a long time (e.g. due to an off season) and restarting pump operation after a prolonged downtime.

To shutdown the pump

(1) Operate the pump so that clean water or cleaning fluid is sucked in and discharged for about 30 minutes, then disassemble and wash to clean the inside of the pump head.
(2) Turn off the pump's power completely.
(3) Place the cover over the pump to protect the pump from the build-up of dust and corrosive environments.

To resume operation

(1) Check the inside of the tank for sediment, clouding of liquid and other abnormalities. If the liquid inside the tank has deteriorated, drain the liquid, wash the inside of the tank with water, and completely replace with fresh liquid.
(2) Check the check ball and valve seats inside the pump heads for adhesion of dirt.

Maintenance

⚠ WARNING

- **When handling liquid-end sections, be sure to wear protective coverings (rubber gloves, mask, protective goggles, chemical-resistant overalls, etc.) appropriate for the chemicals be using used.**
- **Do not turn ON the pump's power during maintenance. Attach a "Work In Progress" label to the power switch.**
- **Before disassembling liquid-end sections, be sure to release the discharge-side pressure, drain the chemicals from liquid-end sections, and clean the liquid-end parts.**

Periodic Inspection

- 4000 hours of operation or once every year
- Abnormal discharge (reduced flow rate)
- Chemical leakage around the pump head

→ **Replacing the diaphragm (page 23)**

→ **Replacing the valve seat and check ball (page 20, 21)**

- 4000 hours of operation or once every year
- Abnormal noise from the drive section
- Abnormal generation of heat on the drive section

→ **Replacing and checking the gear oil (page 17, 25)**

When an Abnormality Occurs

- Other abnormalities

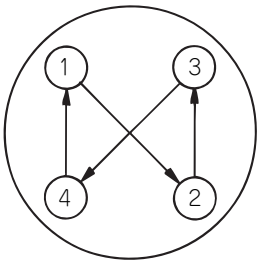
→ **Troubleshooting (page 26, 27)**

NOTE

- **Perform maintenance and inspection every 4000 hours of operation or once every year, whichever comes first.**

IMPORTANT

- **When loosening or tightening the eye-nuts of the pump head, uniformly loosen or tighten the eye-nuts in pairs located diagonally opposite each other, as shown in the figure on the right, little by little. If the eye-nuts are tightened more on one side than on the other, liquid may leak from the pump head.**
- **During assembly, first loosely tighten the pump head, and then install the valve seats and manifold before tightening it up.**



Replacing the liquid-end section

Disassemble and Washing the Refiner

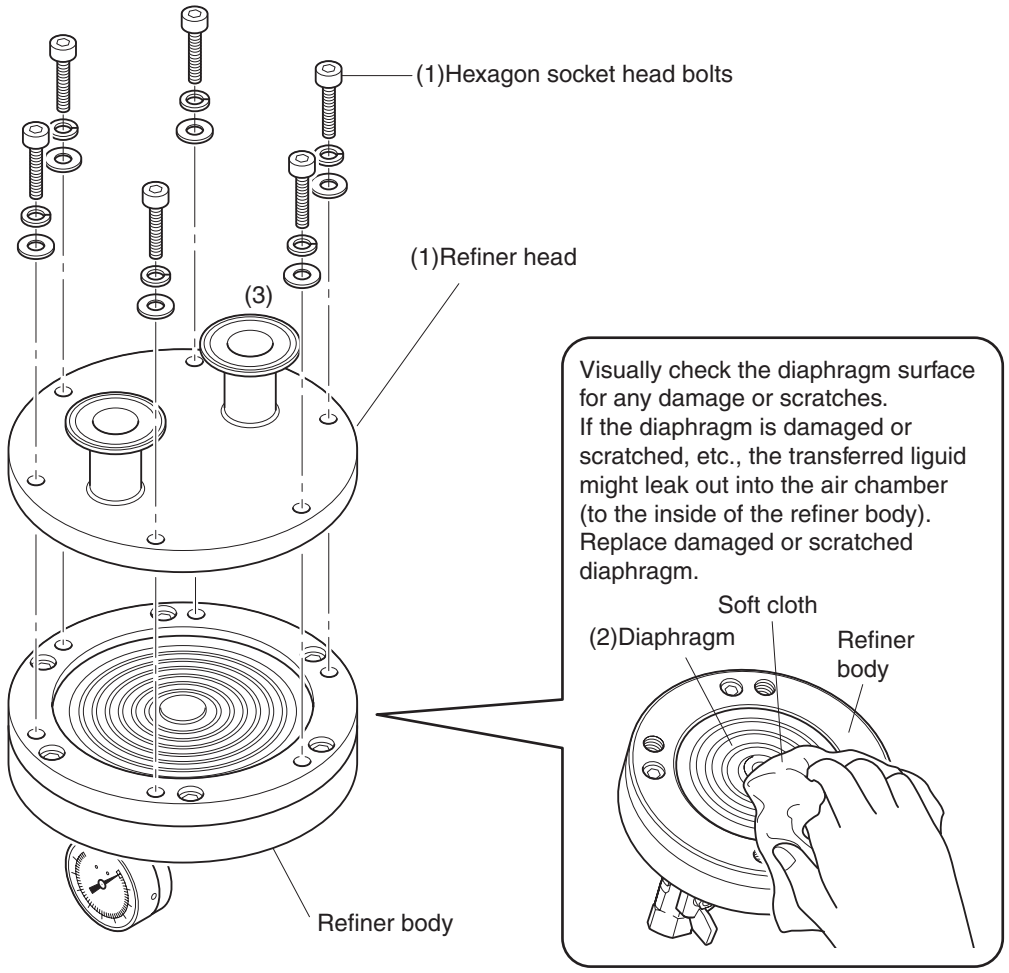
Before proceeding with disassembly, check that the pump has been shut down.

Also, make sure that the pump is not operated by mistake at any point during the disassembly procedure.

(1) Loosen the hexagon socket head bolts mounted on the refiner head, and remove the refiner body. (Four bolts are used in the RF0 type, and six bolts are used in the RF1 and RF2 types.)

(2) Clean the diaphragm surface.

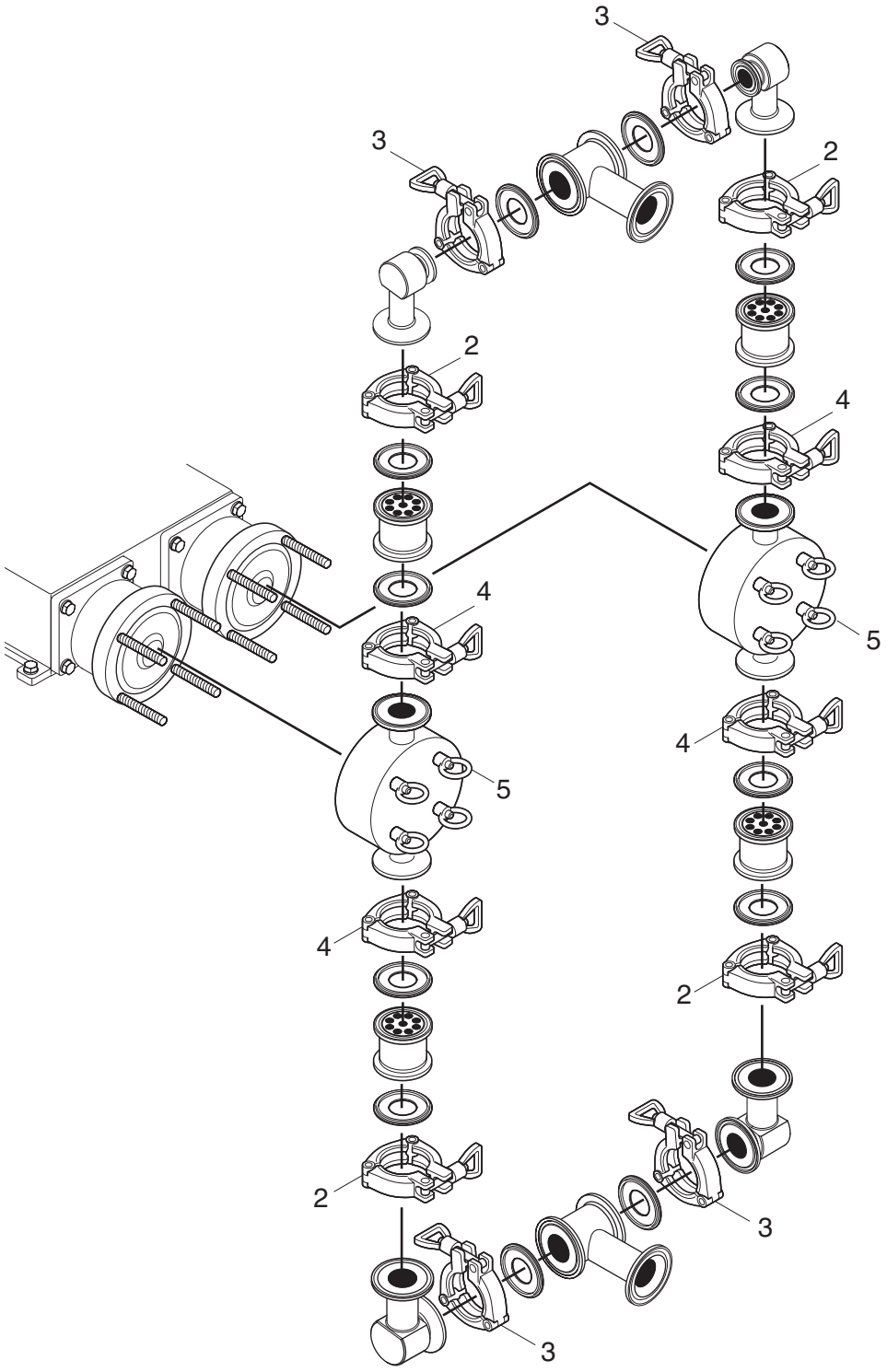
(3) Clean the interface with refiner head piping.



Disassemble the Liquid-end section

Before disassembling the liquid-end sections, follow the steps in “Disassembling and Washing the Refiner” and remove the refiner body.

(1) Disconnect the pump from the line pipe.
(2) Remove the clamps that fasten the top and bottom manifolds.
(3) Remove the clamps from the manifold sections.
(4) Remove the clamps that fasten the top and bottom valve seat sections.
(5) Remove the eye-nuts, and then remove the pump heads.

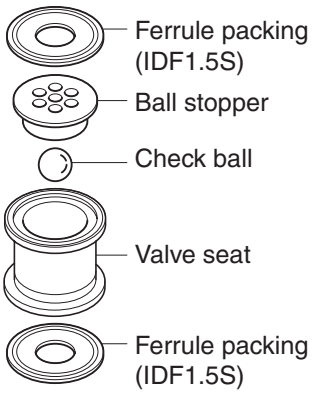


■How to inspect the valve seats

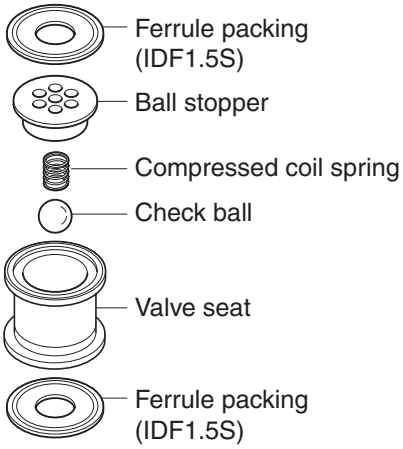
Refer to the figures below which shows the valve seat sections, and proceed while ensuring that all the parts are re-assembled and re-assembled correctly.

- 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).

■Standard valve specification

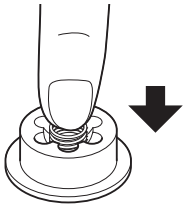


■High-viscosity valve specification

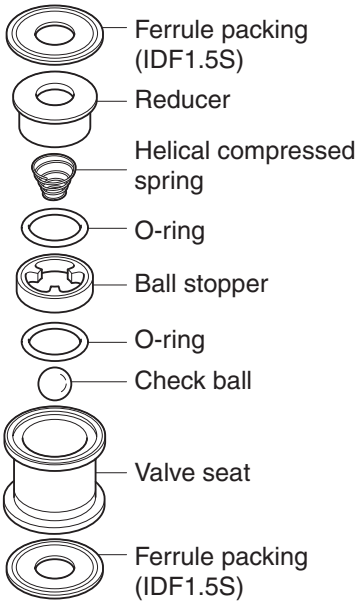


● Inserting the spring

Place the spring on the ball stopper and press it with the tip of your finger.

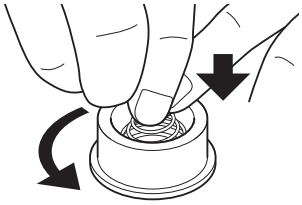


■Ultra high-viscosity valve



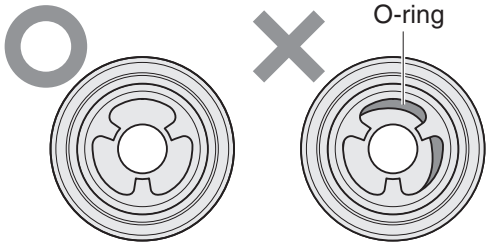
● Inserting the spring

Place the spring on the reducer, turn the spring counterclockwise and press it in.



● Checking the O-ring

Insert an O-ring into the groove on both sides of the ball stopper.
Viewing the valve seat from above, check that the O-ring does not protrude.



✻ In the valve seat section, push up the check balls from underneath the valve seat prior to incorporating them, and check that they move up and down smoothly.

■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.

■Precautions for valve seat installation

- In some models, the size of parts such as the check ball, valve seat and ball stopper are different on the discharge side and the suction side. Incorrect installation may result in reduced discharge precision or inability to discharge. Install correctly by referring to the correspondence tables below.

Standard valve specification(CWS)

	01	05	09	1	2
Discharge	9.525	9.525	9.525	9.525	9.525
Suction	9.525	9.525	9.525	9.525	15.875

High-viscosity valve specification(CVS)

	01	05	09	1	2
Discharge	9.525	9.525	9.525	9.525	9.525
Suction	9.525	9.525	9.525	9.525	15.875

Ultra high-viscosity valve(CKS)

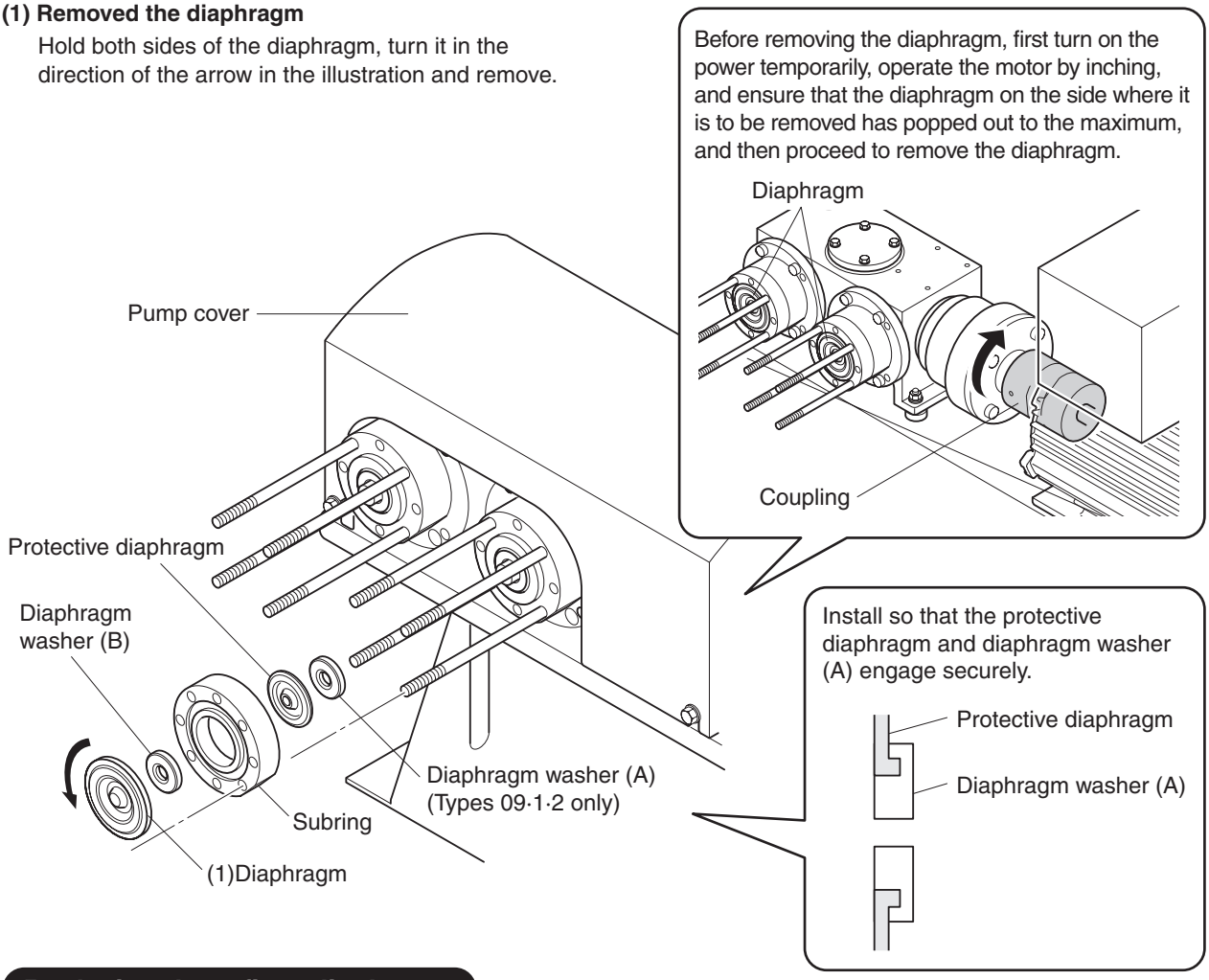
	01	05	09	1	2
Discharge	12.7	12.7	12.7	15.875	15.875
Suction	15.875	15.875	19.05	22.225	22.225

✻ The values above indicate the diameters (mm) of the standard check balls. For other parts such as the valve seat and ball stopper, install parts of a suitable size.
✻ The size of special order parts may be different from the above. Refer to the individual special order drawings.

Replacing Diaphragm

(1) Removed the diaphragm

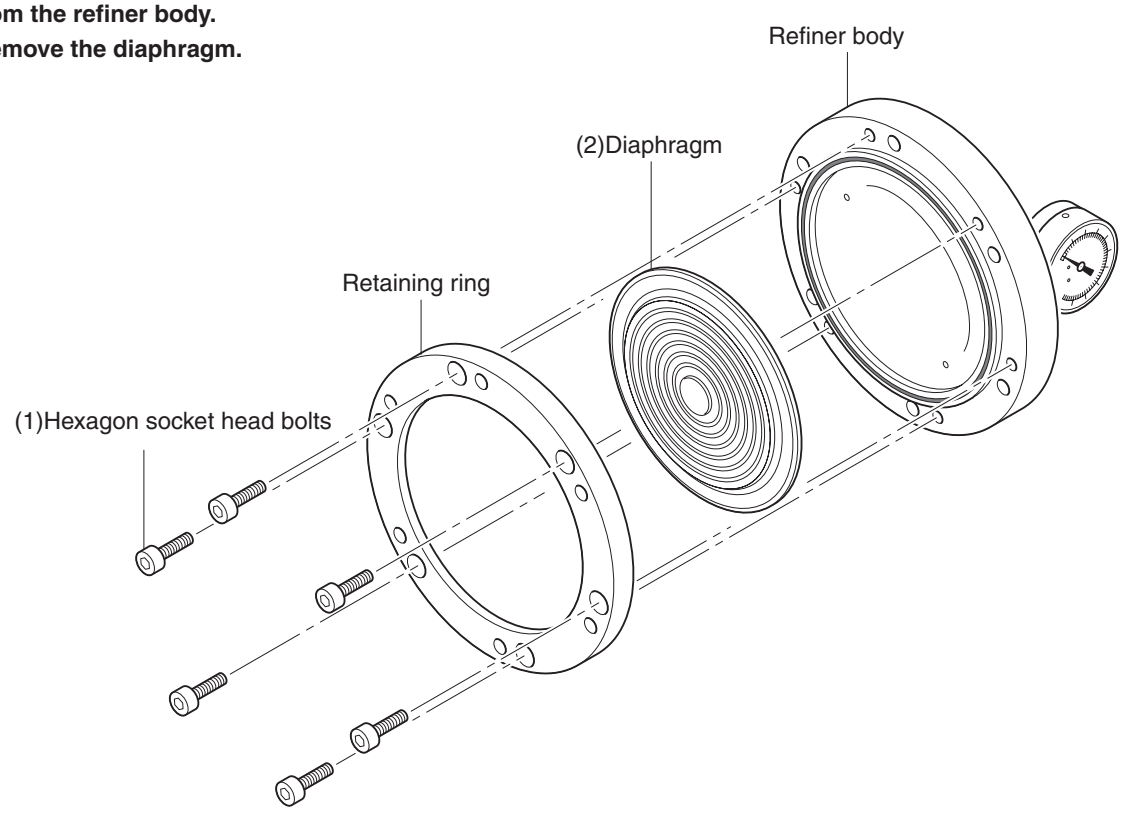
Hold both sides of the diaphragm, turn it in the direction of the arrow in the illustration and remove.



Replacing the refiner diaphragm

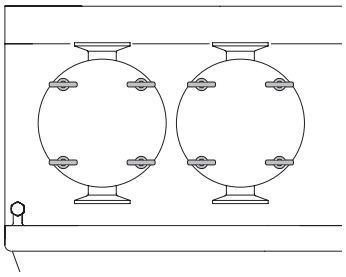
(1) Remove the hexagon socket head bolts (M6) from the refiner body.

(2) Remove the diaphragm.

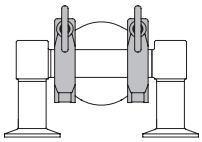


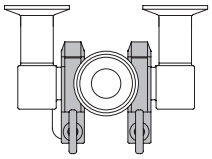
Assembly the liquid-end section

(1) Install the pump head, and loosely tighten the eye-nuts.

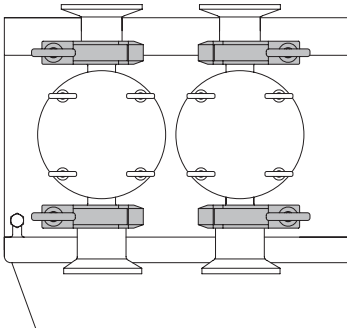


(2) Assemble the discharge-side manifold and suction-side manifold with each loosely fastened.

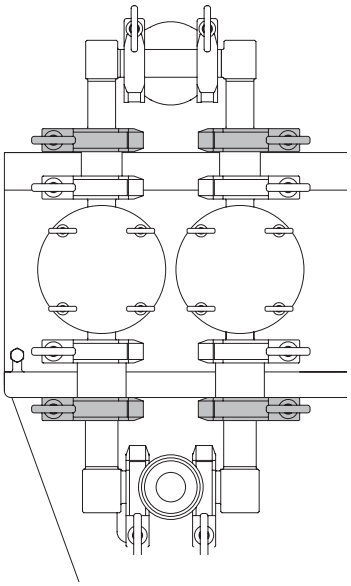




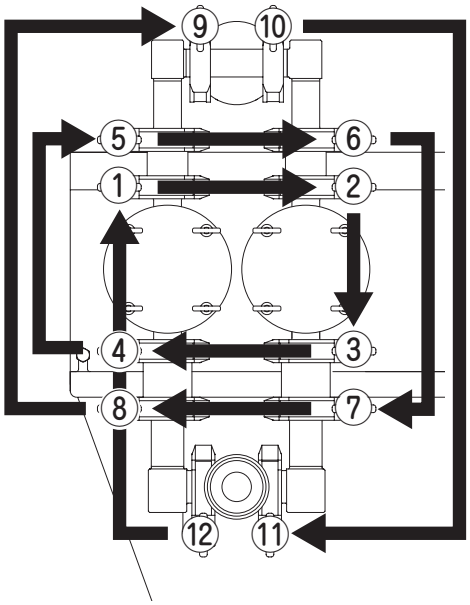
(3) Loosely tighten the valve seat section on the pump head using the clamps.



(4) Loosely clamp the discharge-side manifold to the upper valve seat and the suction-side manifold to the lower valve seat.



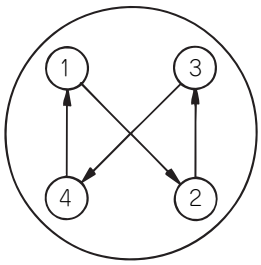
(5) Tighten up the loosely fastened clamps in the numerical sequence shown in the figure.



(6) Tighten up the eye-nuts of the pump head.

IMPORTANT

- **When tightening the eye-nuts of the pump head, uniformly tighten the eye-nuts in pairs located diagonally opposite each other, as shown in the figure on the right, little by little. If the eye-nuts are tightened more on one side than on the other, liquid may leak from the pump head.**



Replacing the gear oil

Type and amount of gear oil

The drive section uses an oil bath system. Change all of the gear oil after 4,000 hours of operation or once every year.

■Amount of gear oil when changing oil (to max position on oil gage)

All models	500mL

■Recommended gear oill

When shipped, the pump is filled with Daphne Super Gear Oil 320, manufactured by Idemitsu Kosan Co., Ltd.
Other recommended products can be checked by accessing the following URL.
www.tacmina.co.jp/gearoil

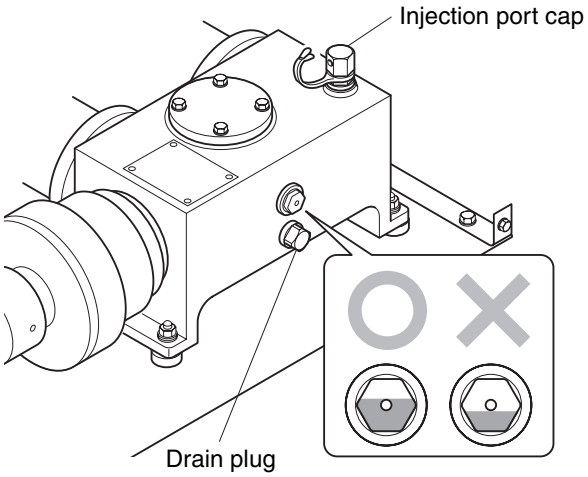
Replacing the gear oil

When draining off the gear oil, be absolutely sure to catch the oil in an oil pan or other container.

(1) Remove the injection port cap.
(2) After catching the oil in the oil pan, remove the drain plug.
(3) Drain off all the gear oil.
(4) Wind new sealing tape around the drain plug, and re-insert the plug.

✻ The proper torque when tightening the drain plug is 16 N・m. Do not use excessive force, as this may damage the drive box.

(5) Pour in the appropriate amount of fresh gear oil.
(6) Insert the injection port cap.



Troubleshooting

■Liquid is not discharged.

Details of trouble		Cause	Remedy
Pump does not operate.	Motor does not run.	(1) Defective power supply and voltage	(1) Check the power supply and voltage, and connect to the correct power supply.
		(2) Defective motor wiring	(2) Inspect the wiring and correct as required.
		(3) Disconnection of leads	(3) Repair or replace.
		(4) Switch is OFF	(4) Turn ON the switch correctly.
		(5) Breaker tripped or fuse blown	(5) Check the causes, and restore or replace the fuse.
		(6) Motor immersed in water	(6) Replace the motor.
		(7) Motor malfunction	(7) Replace the motor.
		(8) Defective magnet switch	(8) Replace the magnet switch.
		(9) Inverter malfunction	(9) Inspect and repair the inverter.
		(10) Inverter setting frequency too low	(10) Set the appropriate frequency.
	Motor runs.	(1) Damaged speed reduction mechanism	(1) Repair or replace.
		(2) Damaged eccentric cam mechanism	(2) Replace.
Pump operates though liquid is not transferred.	Air enters the pump.	(1) Gas is being generated due to the nature of the liquid.	(1) Remove causes of gas generation.
		(2) Liquid leaks from joints, seals, etc.	(2) Check O-rings, etc. and re-tighten.
		(3) Empty chemical tank	(3) Replenish transferred liquid and release air.
	Liquid is not sucked in.	(1) Clogged strainer	(1) Wash the strainer and tank.
		(2) Dirt biting into valve seats	(2) Disassemble and wash.
		(3) Scratched valve seats	(3) Replace.
		(4) Valve seat is installed in the wrong direction	(4) Install the valve seat in the correct direction.
	Liquid leakage	(1) Damaged diaphragm	(1) Replace the diaphragm.

■Low flow rate

Details of trouble	Cause	Remedy
Low flow rate though pump operates normally.	(1) Damaged diaphragm	(1) Replace the diaphragm.
	(2) Foreign matter biting into valve seats and check balls.	(2) Inspect and clean.
	(3) Air sucked in from suction-side piping	(3) Inspect and re-tighten the piping.
	(4) Defective valve seats and seals	(4) Replace the valve seat, check balls and O-rings.
	(5) Cavitation occurring in suction-side piping and pump head.	(5) Provide larger or shorter suction-side piping.

■Excessive flow rate

Details of trouble	Cause	Remedy
Excessive flow rate though pump operates normally.	(1) Overfeed is occurring.	(1) Review the piping and install a back pressure valve.
	(2) Connected to the suction side (minus pressed side) of the main pump	(2) Install a back pressure valve.
Liquid discharge does not stop.	(1) Siphoning is occurring.	(1) Review piping, and provide a ventilation duct or install a back pressure valve.
	(2) Air remains in piping, or damper effect is occurring.	(2) Release air inside the piping.

Troubleshooting

■Unstable flow rate

Details of trouble	Cause	Remedy
Unstable flow rate	(1) Cavitation occurring in suction-side piping and pump head.	(1) Provide larger or shorter suction-side piping.

■Large pulsation

Details of trouble	Cause	Remedy
Large pulsation	(1) Motor is rotating in the opposite direction. (2) The flow rate of each pump head is not uniform as the check valve in the pump head is worn or foreign matter is biting into the check valve. (3) Pulsation is being carried in by the suction-side piping.	(1) Change the wiring or switch pump operation by the inverter. (2) Replace parts or disassemble and wash. (3) Connect the pump to the piping or firmly support the piping using flexible joints.
The level of pulsation increases slightly.	(1) The refiner diaphragm is damaged. (2) The air pressure setting of the refiner is not correct.	(1) Replace (2) Adjust the air pressure setting.

■Liquid leakage

Details of trouble	Cause	Remedy
Liquid leakage	(1) Pressure rise caused by blockage inside discharge-side piping (2) Damaged diaphragm (3) Insufficiently tightened screws (4) Deteriorated O-rings (5) Defective valve seat mounting (6) Unevenly tightened bolts	(1) Disassemble and clean. (2) Replace the diaphragm. (3) Re-tighten. The bolts on the pump head are insufficiently tightened. (4) Replace. (5) Mount correctly. (6) Tighten the bolts evenly.

■Abnormal heat generation or sounds

Details of trouble	Cause	Remedy
Abnormal noise or heat is being generated at the drive section.	(1) Overload (2) Insufficient lubrication (3) External temperature or temperature of transferred liquid too high (4) Speed reduction mechanism worn or damaged (5) Damaged springs (6) Abnormal pressure applied on discharge side (7) Inverter setting frequency too high or too low	(1) Inspect discharge pressure and clogging of parts. (2) Inspect the gear oil. (3) Improve the installation environment. (4) Repair or replace. (5) Replace. (6) Inspect the piping. (7) Set the inverter to the appropriate frequency.

Model code

PLSS - 01 - STST - C W S

(1) (2) (3) (4) (5) (6)

(1) Series name

(2) Model (flow rate standard)
01/05/09/1/2

(3) Liquid-end material

Type	Pump head	Diaphragm	Check ball	O-ring
STST	SUS304	PTFE	SUS304	PTFE
6T6T	SUS316	PTFE	SUS316	PTFE

(4) Connection type

C	Ferrule
X	Special

(5) Valve structure

W	Standard
V	High-viscosity type
K	Ultra-high-viscosity type

(6) General specification

S	Standard
X	Special

Specification

Specification \ Model			01	05	09	1	2
Max. flow rate	L/min		0.14	0.5	0.9	1.5	2.5
	L/h		8.4	30	54	90	150
	US G/h		2.21	7.92	14.25	23.76	39.6
Max. discharge pressure	MPa		0.5				
	bar		5				
	psi		72.5				
Stroke length	mm		4	6			8
Stroke speed	strokes/min		8 to 75				10 to 98
Reduction ratio			1/23				1/17.8
Connection	Discharge side		15A			15A(1.0S*1)	
	Suction side		1.5S				
Use condition	Ambient temperature		Ordinary temperature				
	Transferring liquid temperature		15 to 40℃				
	Transferring liquid viscosity		See “Transferable viscosity” on page1.				
Motor	Type		Flame-proof enclosures type, d2G4				
	Power supply(V) / Frequency(Hz)		3-phase / 200V(50Hz/60Hz), 220V(60Hz)				
	No. of poles(P)		4P				
	Output(kW)		0.4				
	Rated current(A) /Max. startup / current(A)	200V /50Hz	2.3A / 3A				
		200V /60Hz	2.2A / 3A				
		220V /50Hz	2.2A / 3A				
	Insulation class		B				
Paint color	Body		Munsell (approximate) N7				
	Motor		Munsell (approximate) N5.5				
Weight	kg		51			53	

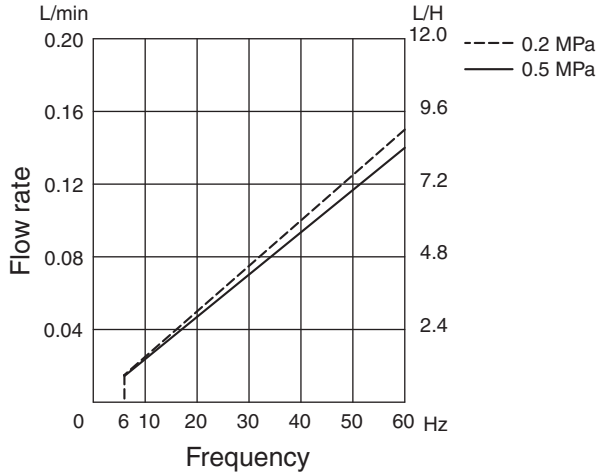
*1 The specification value for Ultra high-viscosity type

Performance curve

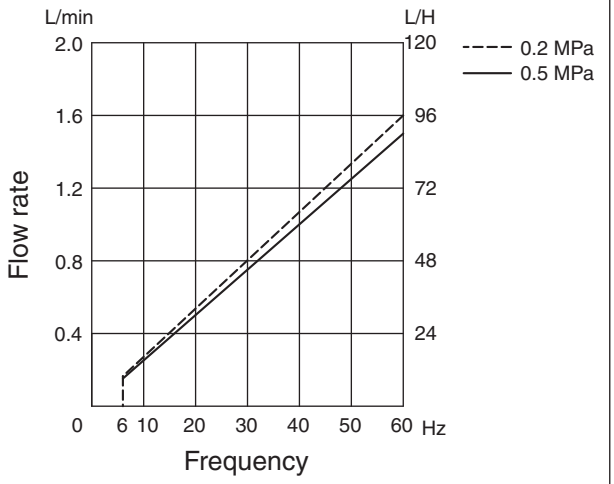
The following performance curves were obtained by measuring on test equipment at TACMINA under the following conditions.
These performance curves may differ slightly depending on various on-site conditions and product differences.
Measure the flow rate under actual operating conditions, and set the frequency according to the performance curve that is obtained.

Conditions: clean water, room temperature

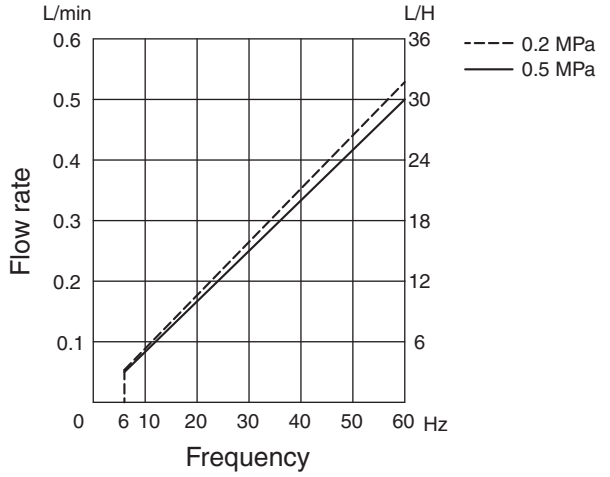
PLSS-01



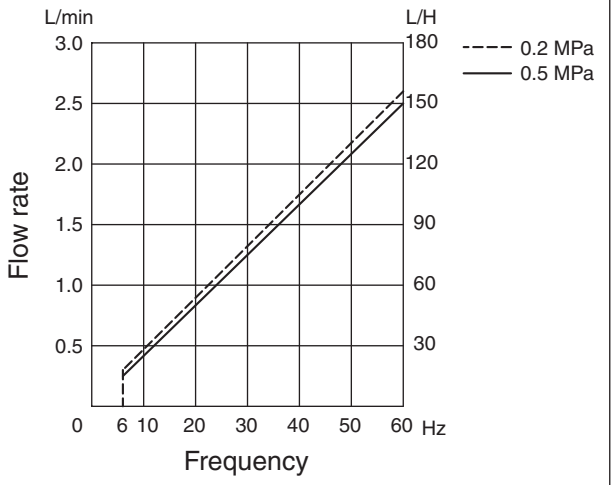
PLSS-1



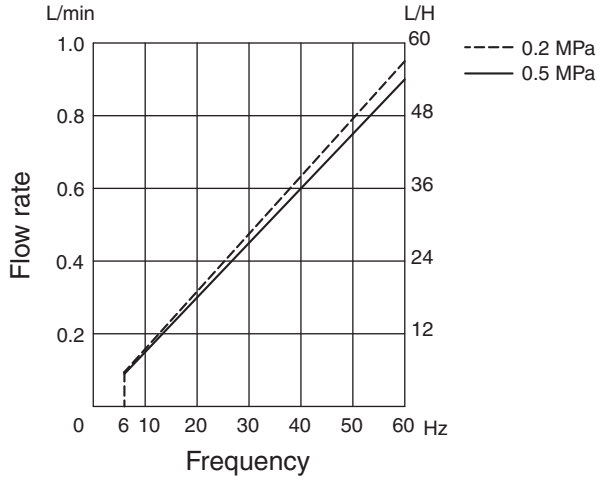
PLSS-05



PLSS-2

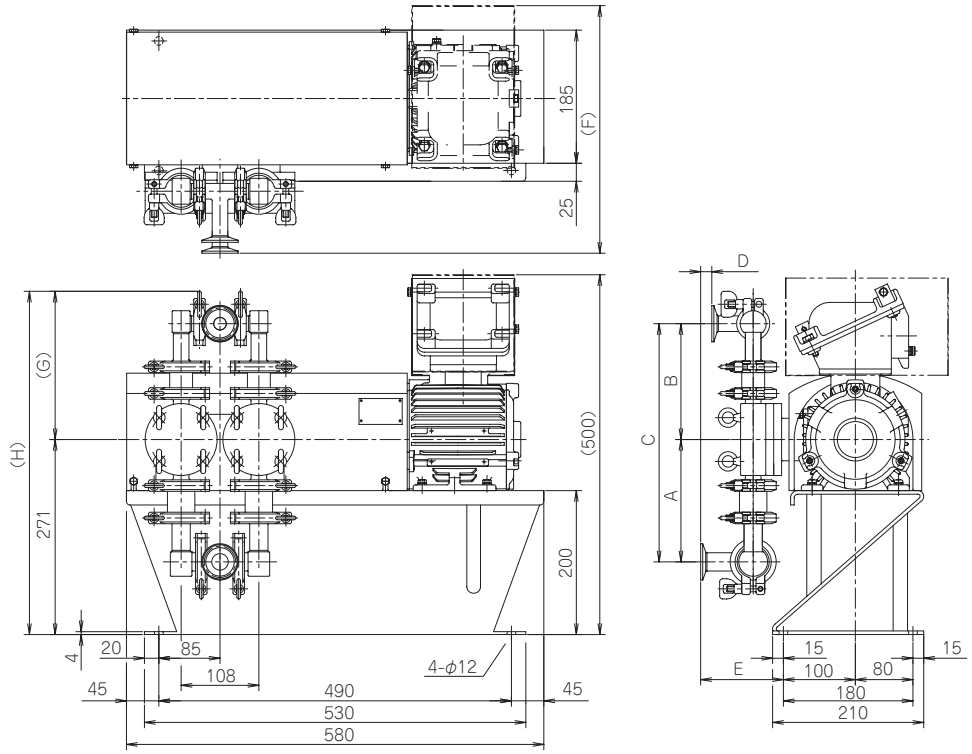


PLSS-09



External dimensions

PLSS

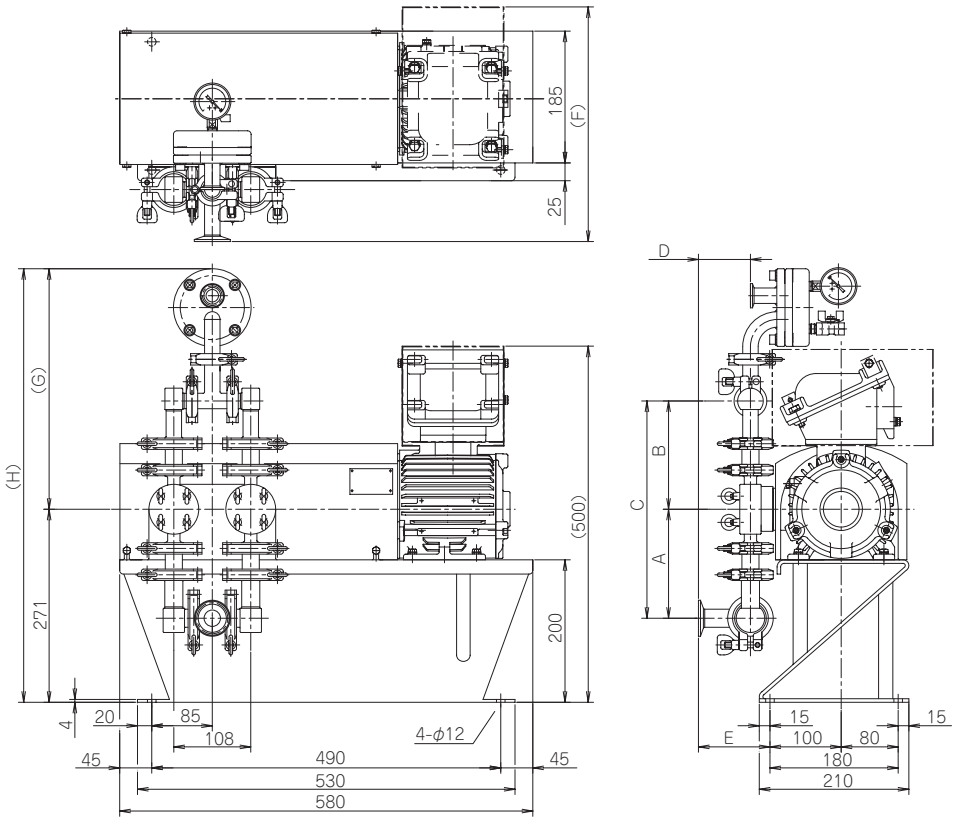


Model			A	B	C	D	E	F	G	H	Discharge part
PLSS-	01-STST- 01-6T6T-	CWS	153	152	305	15.5	100.5	329.5	197	468	15A
		CVS									
		CKS									
	05-STST- 05-6T6T-	CWS	155	154	309	15.5	102	331	199	470	15A
		CVS									
		CKS									
	09-STST- 09-6T6T-	CWS	160.5	159.5	320	15.5	101.5	330.5	205	476	15A
		CVS									
		CKS									
	1-STST- 1-6T6T-	CWS	162	161	323	15.5	115	344	206	477	15A
		CVS									
		CKS	170		331						1.0S
	2-STST- 2-6T6T-	CWS	162	161	323	15.5	115	344	206	477	15A
		CVS									
		CKS	170		331						1.0S

Specifications

External dimensions

PLSS (Refiner specification model)



Model			A	B	C	D	E	F	G	H	Discharge part
PLSS-	01-STST-01-6T6T-	CWS	153	300	453	73	100.5	329.5	337.5	608.5	15A
		CVS		215	368	132.5			295.5	566.5	
		CKS									
	05-STST-05-6T6T-	CWS	155	301.5	457	73	102	331	339.5	610.5	15A
		CVS		217	372	132.5			297.5	568.5	
		CKS									
	09-STST-09-6T6T-	CWS	160.5	307	468	73	101.5	330.5	345.5	616.5	15A
		CVS		222.5	383	132.5			303.5	574.5	
		CKS									
	1-STST-1-6T6T-	CWS	162	224	386	132.5	115	344	304.5	575.5	15A
		CVS									
		CKS	170	257	427				342	613	1.0S
	2-STST-2-6T6T-	CWS	162	224	386	132.5	115	344	304.5	575.5	15A
		CVS									
		CKS	170	257	427				342	613	1.0S

✻ The refiner shape varies depending on the model.

Specifications

List of Consumables

The recommended replacement interval is shown in the table below.
The recommended replacement cycles are for cases where the pump is operated under constant conditions (room temperature and clean water). These cycles change according to individual site conditions. Use these cycles as rough guidelines for replacing consumables. Neglecting to replace consumables may cause defective discharge (injection) or malfunction.

■Standard type

Part		Quantity per pump	Recommended replacement cycles
Diaphragm		2	4000 hours of operation or 1 year*
Valve seat section	Valve seat	4	
	Check ball	4	
	Ball stopper	4	
Ferrule packing (IDF1.5S)		8	
Ferrule packing (15A)		2	
Ferrule packing (IDF1.0S)		2	
PTFE sheet		2	When the diaphragm is replaced
Oilseal ring		2	
Gasket		2	
Protective diaphragm		2	
Gear oil		500mL	4000 hours of operation or 1 year*

* Whichever is reached the earliest

■High-viscosity type

Part		Quantity per pump	Recommended replacement cycles
Diaphragm		2	4000 hours of operation or 1 year*
Valve seat section	Valve seat	4	
	Check ball	4	
	Ball stopper	4	
	Ferrule packing (IDF1.5S)	8	
	Coiled spring	4	
Ferrule packing (15A)		2	
Ferrule packing (IDF1.0S)		2	
PTFE sheet		2	When the diaphragm is replaced
Oilseal ring		2	
Gasket		2	
Protective diaphragm		2	
Gear oil		500mL	4000 hours of operation or 1 year*

* Whichever is reached the earliest

■Ultra high-viscosity type

Part			Quantity per pump	Recommended replacement cycles
Diaphragm			2	4000 hours of operation or 1 year*
Valve seat section	Discharge side	Valve seat	2	
		Check ball	2	
		Ball stopper	2	
		Reducer	2	
		Ferrule packing (IDF1.5S)	4	
		O-ring	4	
		Conic coiled spring	2	
	Suction side	Valve seat	2	
		Check ball	2	
		Ball stopper	2	
		Reducer	2	
		Ferrule packing (IDF1.5S)	4	
		O-ring	4	
		Conic coiled spring	2	
Ferrule packing (15A)			2	
Ferrule packing (IDF1.0S)			2	
PTFE sheet			2	When the diaphragm is replaced
Oilseal ring			2	
Gasket			2	
Protective diaphragm			2	
Gear oil			500mL	4000 hours of operation or 1 year*

* Whichever is reached the earliest

■Refiner

Part	Quantity per pump	Recommended replacement cycles
Diaphragm	1	4000 hours of operation or 1 year*
O-ring	1	

* Whichever is reached the earliest

Options and related equipment

● Relief valve

This valve automatically releases the pressure when excessive pressure is produced in the pump's discharge-side piping due to clogging by foreign objects or a closed valve.

● Diaphragm-type pressure gauge

The materials to be used for the connections and diaphragm can be selected to suit the application so that they are suited to metering corrosive liquids, highly viscous liquids, coagulative liquids, etc.

Glossary

● Siphoning

A phenomenon where the transfer liquid continues to flow even when the pump is stopped because the position of the end of the pump's discharge-side piping is lower than the level of the liquid in the suction-side tank.

● Cavitation

A phenomenon where air bubbles are produced from the liquid in the pump head and in the suction-side piping by negative pressure, which reduces the flow rate and causes unusual sounds and vibrations.

List of tools

■Drain plug

Model	Tool used
All models	Spanner, 12mm across flats

■Pump head

Model	Tool used
All models	Allen wrench, 7mm across flats Allen wrench, 6mm across flats

■Refiner

Model	Tool used
All models	Allen wrench, 7mm across flats Allen wrench, 6mm across flats

■Pump cover

Model	Tool used
All models	Spanner, 10mm across flats

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.

Maintenance data

If the pump requires repair, wash the interior thoroughly with water, make a copy of this sheet and fill out all relevant details. Then enclose a copy when you dispatch the pump for repair.

	No.
Customer name:	Telephone No.:
Address:	
Department:	Person in charge:
Name of sales agent:	
Model:	Serial No.:
Power source: ☐ 50 Hz ☐ 60 Hz ☐ 3-phase ☐ 200 V ☐ Other (V)	
Control method: ☐ Inverter ☐ Other ( )	
Delivery date: ___ (D) ___ (M) _____ (Y)	First operation date: ___ (D) ___ (M) _____ (Y)
Operating hours: _____ hours/day	
Inverter frequency setting ( ) Hz.	
Installation conditions: ☐ Indoor ☐ Outdoor	Ambient temperature ( ) ˚C
Name/composition of chemicals transferred:	Concentration ( )%
Specific gravity: ( ) Temperature: ( ) ˚C	Viscosity: ( )mPa·s
Slurry: ☐ No ☐ Yes Content ratio: ( )wt%	Particle size: ( )
Layout (Flow sheet)	Piping diameter:_____A Piping length Suction side: _____m Discharge side: _____m Discharge pressure: _____MPa Accessories used:
Failure explanation (summary)	

Others

Table of refiner settings

	A	B	C
	Refiner pressure [MPa] while pump is shut down	Refiner pressure [MPa] while pump is operating	Refiner pressure setting [MPa](Refiner pressure while pump is operating x 0.7)
1	0.07		
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			

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

TACMINA CORPORATION

Head Office:
2-2-14 Awajimachi, Chuo-ku, Osaka 541-0047 Japan
Tel.+81(0)6-6208-3974 Fax.+81(0)6-6208-3978
URL www.tacmina.com
E-mail trade@tacmina.com

EM-124(7)-
2022/3/I--

Z1168