

User's Manual

Diaphragm-type Dry Vacuum Pump

Model: DTC-60



Request to Users

Please read this manual thoroughly to ensure safe and effective use of the equipment.

Keep this manual in a safe place.

Due to periodic improvements in performance, the equipment described in this manual is subject to changes in dimensions and specifications without prior notice.

ULVAC KIKO, Inc.

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Pages with a shaded background are those which contain items related to safety.

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Before Using the Equipment

Thank you for purchasing this product. Your custom is very much appreciated. This pump is designed solely for vacuum discharge, and may malfunction or cause accidents if not handled appropriately. Read the manual thoroughly, and pay due attention to inspections, maintenance, and safety.

Personnel Handling the Equipment

Only persons who have read this manual thoroughly, and have sufficient understanding of safety, pump specifications, and method of operation, may operate this pump.

Read the Manual Thoroughly

Read the manual thoroughly in order to use the equipment correctly. Read the section on Safe Use particularly closely.

Keep This Manual in a Safe Place

After reading this manual, be sure to keep it in a safe place which is readily accessible to others needing to use it.

Copying This Manual Is Prohibited

No part of this manual may be copied for use by a third party without the express permission of the manufacturer.

Statutory Requirements for Disposal

Follow all statutory and local authority regulations when disposing of this pump.

Safety During Repair

Please provide a full description of the circumstances of use (particularly the use of dangerous materials) for the safety of repair personnel when requesting the manufacturer for repairs to the pump. Your request for repair of may be refused if these circumstances are unclear.

Checks When Opening Packaging

Check the following after opening the packaging.

- (1) Is the product as you requested?
- (2) Are the accessories and necessary parts included?

Standard accessories

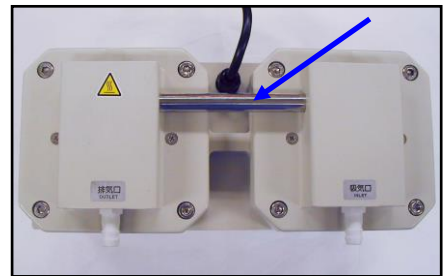
- User's manual ----- x 1
- Inlet and outlet caps (fitted to inlet and outlet) ----- x 2
- Power plug adapter (attached to power cord) ----- x 1

- (3) Is the pump damaged in any way?
- (4) Are any external screws or inlet and outlet pipes loose? Are any components missing?

Contact your agent or the sales division of the manufacturer if there are any problems with the pump.

Note

Do not grip or pull the protector pipe on the top of the pump when removing it from the packing.



Using the Pump Safely

To ensure that the pump is handled correctly, read this section thoroughly before use.

This manual and the warning labels on the pump include safety icons as an aid to understanding safety requirements.

These safety icons warn the operator and others of possible dangers and damage and should always be followed.

- **Safety icons**

The meanings of the safety icons are as follows.



Danger

Incorrect handling of the equipment is very likely to result in death or serious injury to the operator.



Warning

Incorrect handling of the equipment may result in death or serious injury to the operator.



Caution

Incorrect handling of the equipment may result in light or medium injuries to the operator or damage to the equipment.



Note

Incorrect handling of the equipment may result in damage to the equipment and hinder its correct operation.



High Temperatures

Some components reach surface temperatures in excess of 60°C during pump operation. Burns may result if these components are touched during operation.



Electric Shock

To prevent electric shock, always shut-off the primary power supply before working on electrical wiring, or engaging in any electrical work.

Cautions for Safety in Use



Danger

Applications

- (1) This pump is not designed to be explosion-proof, and should therefore not be used to discharge explosive gases.
- (2) In addition to discharge of gas via the outlet, gas may also leak from other parts of the pump, and it should therefore not be used with toxic gases. If toxic gas is discharged for any reason it is important to note that the interior of the pump will be contaminated by the gas, requiring appropriate caution during maintenance.

Maintenance and Repair

- (3) When requesting the manufacturer's service division to dismantle and repair the pump, always note the gas which the pump has been used with on the Usage Check Sheet. Note that if it has been used to discharge toxic gas for any reason it will be contaminated. **Please be aware that use with some gases will preclude dismantling and repair.**



Warning

Installation

- (1) Do not use the pump in an explosive atmosphere. Such use may result in injury and fire.
- (2) Ensure that there are no inflammable materials such as solvents in the vicinity when using the pump.
- (3) Ensure that the motor is freely ventilated to prevent overheating which may result in fire or burns.

Power Supply

- (4) Always remove the power cord from the wall socket before checking or repairing the pump. Failure to do so may result in electric shock, or the pump suddenly starting and causing injury.
- (5) Ensure that the relevant wiring is in accordance with technical standards for electrical equipment and wiring regulations. Incorrect wiring may result in fire.
- (6) Remove the power cord from the wall socket before connecting any wiring. Connecting wiring with the power on may result in electric shock.
- (7) Always ensure that the pump is correctly earthed. A dedicated earth leakage breaker is recommended. Failure to earth the pump correctly may result in electric shock if a fault or earth leakage occurs.
- (8) Use the pump only at the rated voltage. Use at other than the rated voltage will interfere with operation of the overload protection device, and this may result in the motor burning out, or fire.
- (9) Do not damage, modify, pull the power cord, or place objects on it. Damage to the cord may result in electric shock or fire.
- (10) Always fully insert the power cord into the socket. Partial insertion may result in electric shock.
- (11) Remove the cord from the socket while holding the plug. Failure to do so may result in electric shock.
- (12) Touching the power cord with wet hands may result in electric shock.
- (13) Touching electrical wiring etc while inserting the power plug may result in electric shock.

Warning

Operation

- (14) This pump is not designed to be explosion-proof. When using the pump, ensure that there are no inflammable materials such as solvents, or explosive gases, in the vicinity. Use under such conditions may result in injury or fire.
- (15) Inserting fingers or objects into the motor inlet may result in electric shock, injury, or fire.
- (16) Operating the pump with the discharge outlet blocked, or with a device which prevents passage of gas to the discharge outlet, may result in rupture of the pump. The internal pressure of the pump rises and the pump body may rupture and the motor become overloaded.
This pump is not designed to be pressure-resistant. The internal pressure of the pump is limited to 0.03 MPa (gauge pressure).

Maintenance and Repair

- (17) The pump should be dismantled or repaired only by a repair technician trained by the manufacturer.
- (18) To prevent ingestion of microscopic particles resulting from wear of components, use a dust mask and gloves during repair work.

Caution

Installation

- (1) The fine clearances used in this pump require that the following conditions be satisfied during storage, installation, and operation.
 - 1. Ambient temperature of 0~40°C and maximum relative humidity of 85% during operation.
 - 2. Other conditions for storage and operation.
 - a) Level floor of sufficient strength.
 - b) No condensation
 - c) Dust-free environment
 - d) Well ventilated
 - e) Environment free of corrosive or explosive gas.
 - f) Not subject to direct sunlight.
 - g) No danger of fire.
 - h) Maximum ambient temperature of 40°C during assembly of pump.
- (2) To prevent back injury, always use both hands to lift pumps.
- (3) Microscopic particles resulting from wear of components are discharged from the outlet and contaminate the room. If necessary, connect a pipe from the discharge outlet to the outside of the building.

Operation

- (4) Do not use in applications involving organ transplants, or contact with body fluids or living tissue.
- (5) Touching rotating components (eg motor, main shaft, axial joints, cooling fan) while the pump is in operation may result in injury.
- (6) The overload protector operates when the pump becomes excessively hot. Touching it in this condition may result in burns.
- (7) Touching the motor while the pump is in operation or while it is still hot immediately after having been switched off may result in burns.
- (8) Do not insert fingers or objects into, or peer into, the inlet or outlet during operation.

Caution

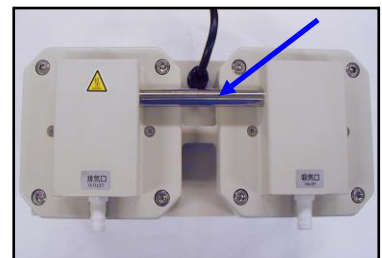
Maintenance and Repair

- (9) Dispose in accordance with legislation for disposal and cleaning of waste products, handle as industrial waste, and do not incinerate.
Toxic fluorine gas is generated by incineration of fluorine-based plastics.
- (10) If the pump ceases operation, turn power OFF (set switch to O) immediately to prevent accidents, remove the power cord from the wall outlet, and contact your dealer or the manufacturer for inspection and repair.
- (11) Leave the pump for at least 30 minutes until it has cooled, and begin operation again. Touching the pump immediately after it has stopped may result in burns.

Note

Installation

- (1) The pump may malfunction if it is subjected to shocks or tipped over on its side.
- (2) Do not hold or push the tube at the top of the pump (see below). Damage to the tube may affect performance of the pump.



Applications

- (3) This pump is not designed to be corrosion-proof. Use it only with clean air at normal temperature, or with gases of equivalent characteristics.
- (4) This pump is designed for general corrosion resistance, however it is not resistant to molten alkali metals such as molten sodium, to fluorine at high temperatures, and to some oxides of fluorine.
- (5) Ingestion of liquids or compressed and gases into the pump will result in damage and prevent proper operation.
- (6) Ingestion of rubbish and dust in the air entering the pump will interfere with its proper function. If the air is likely to contain rubbish or dust, a filter should be fitted to the inlet to protect the pump.
- (7) Ducting should always be fitted to the pump outlet if toxic corrosive gases, or steam, enters the pump.

Note

Operation

- (8) Use the pump within an ambient temperature range of 40°C. Use at high ambient temperatures will dramatically reduce the life of the pump.
- (9) Back pressure at the outlet while the pump is starting may overload the motor.
- (10) The thermal protection relay operates when the pump reaches a very high temperature. Touching the pump in this condition may result in burns.
- (11) To maintain the performance of the pump, always ensure that it is cleaned internally after use. Clean by ingesting clean air for 3~5 minutes under no-load conditions.

Maintenance and Repair

- (12) The fine clearances used in this pump require skill in its assembly. If a repair technician is unavailable, replacement of all consumables should be left to the manufacturer's service division.



1. Product Outline

1.1 Purpose of Use and Prohibitions

This product is a dry vacuum pump which employs reciprocating motion of a rubber diaphragm for vacuum discharge.

PTFE is a highly corrosion-resistant plastic and is used in components which come in contact with gas.

Observe the following prohibitions to ensure normal operation of the pump.

| < Prohibitions > | |
|--|--|
|  Warning | (1) This pump employs only vacuum operation, and must not be pressurized. (2) Do not re-sell, repair, or modify this pump without the approval of the manufacturer. |
|  Note | (3) This pump is designed for general corrosion resistance, however it is not resistant to molten alkali metals such as molten sodium, to fluorine at high temperatures, and to some oxides of fluorine. (4) Ensure that the gas entering the pump does not contain rubbish, dust, or water (except steam). (5) Do not operate the pump for long periods at near-atmospheric pressure. |



1.2 Specifications

Table 1.1 Product Specifications

| Model | | DTC-60 | |
|---------------------------|------|--|---|
| Discharge rate (L/min) | 50Hz | 60 | |
| | 60Hz | 70 | |
| Pressure achieved (Pa) | | 1.0×10^3 | |
| Motor | | 200 W, 4P, with condenser-run thermal protection relay (automatic reset) | |
| | | Single phase, AC 100 V ($\pm 10\%$) (50/60Hz) | Single phase, AC 220 V ($\pm 10\%$) (50/60Hz) |
| Rated current (A) | 50Hz | 3.8 | 1.7 |
| | 60Hz | 3.9 | 1.6 |
| Speed (r.p.m.) | 50Hz | 1400 | 1400 |
| | 60Hz | 1630 | 1680 |
| Inlet and outlet piping | | O.D. $\Phi 14 \times$ I.D. $\Phi 9$ (G3/8) | |
| Weight (kg) | | 18.0 | |
| Air temperature (°C) | | 0~40 | |
| Dimensions (mm) | | 150 (W) \times 340 (L) \times 242 (H) | |

1.3 Thermal Protection Relay

- 1) This pump is fitted with an automatic reset thermal protection relay for overload protection. This device shuts off the motor power supply circuit automatically to prevent burn-out if the motor temperature rises due to a pump fault which prevents rotation, or if load becomes excessive.
- 2) It is recommended that additional protective devices (eg. earth leakage breaker, motor breaker) be fitted.

| | |
|--|----------------------|
|  Warning | See Warning (8), P04 |
|  Caution | See Caution (6), P05 |

2. Dimensions

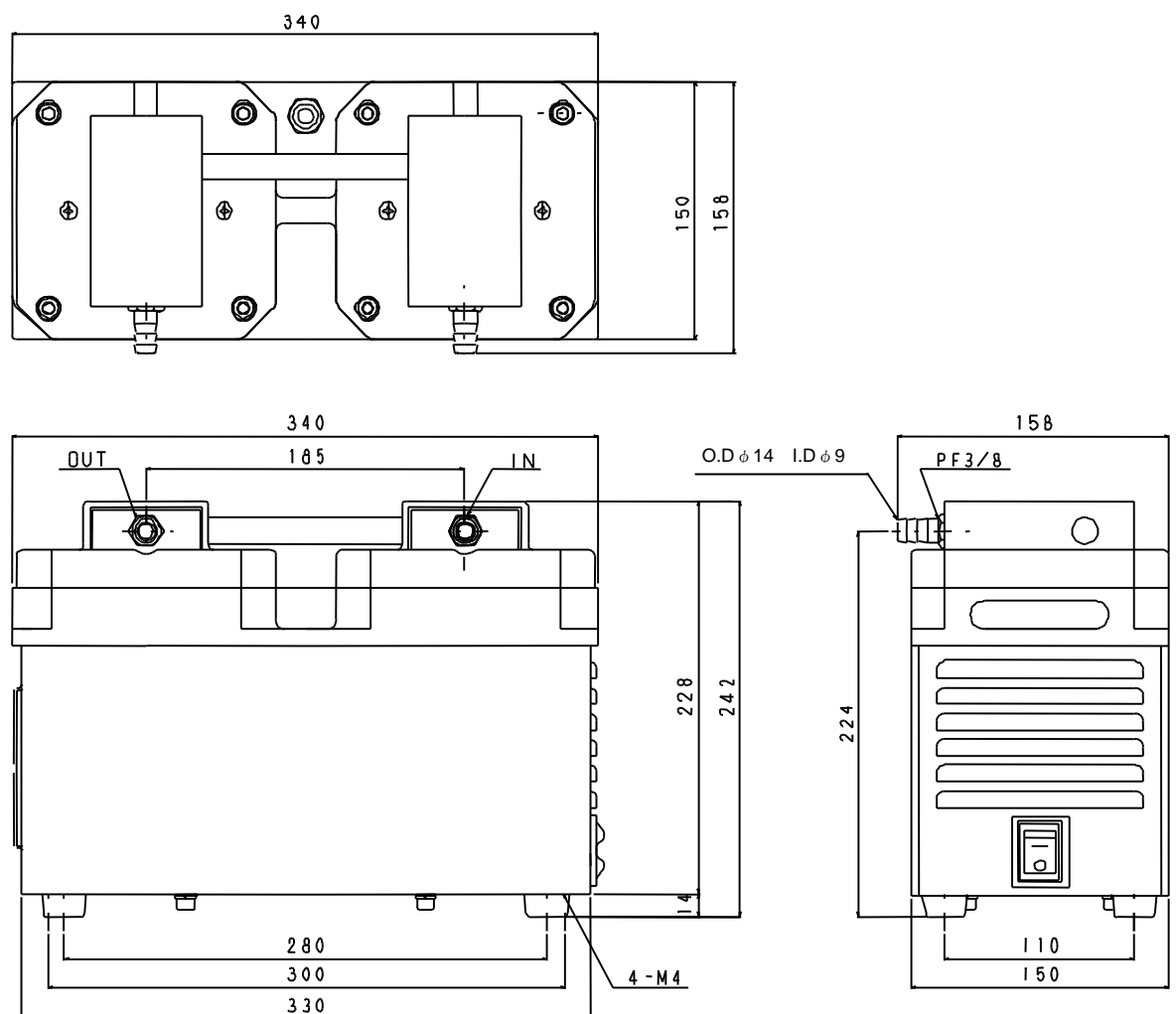





Fig.2.1 DTC-60 Dimensions

3. Installation and Storage

3.1 Cautions for Installation and Storage

| | |
|--|--|
|  Warning | See Warning (1)(2)(3)(5)(6)(7)(8)(9)(10)(11)(12)(13), P04 |
|  Caution | See Caution (1)(2)(3), P05 |
|  Note | See Note (1)(2), P06 |

3.2 Environmental Conditions for Installation, Storage, and Operation

The fine clearances used in this pump require that the following conditions be satisfied during storage, installation, and operation.

1. Ambient temperature of 0~40°C and maximum relative humidity of 85% during operation.
2. Other conditions (during storage and operation).
 - a) Level floor of sufficient strength.
 - b) No condensation
 - c) Dust-free environment
 - d) Well ventilated
 - e) Environment free of corrosive or explosive gas.
 - f) Not subject to direct sunlight.
 - g) No danger of fire.
 - h) Maximum ambient temperature of 40°C during assembly of pump.

3.3 Location

The pump should be installed level in a location with minimal dust and humidity. This location should be selected in consideration of ease of installation and removal, inspection, and cleaning. Particular attention should be paid to ambient temperature when fitting the pump to equipment. Use anti-vibration rubbers to isolate the pump from vibrations in the equipment. See 3.2 Environmental Conditions for Installation, Storage, and Operation for details.

3.4 Checking Operation After Installation

- 1) Remove the rubber caps from the inlet and outlet.
- 2) Check that the pump switch is OFF (set to O), and insert the plug into the 100 V wall socket.

Note: When using a power adapter other than the one provided with the unit, be sure that it meets the voltage and amperage specifications.

Note: Extension cords should be 3-wire, with lead wires having a cross-sectional area of at least 0.75 mm².

- 3) Turn the switch ON (set to I) and check that gas is being drawn into the inlet.
- 4) When this check is complete, turn the power switch OFF (set to O) to stop the pump.

3.5 Piping

- 1) Install piping carefully to prevent leaks.
- 2) Piping connected to the inlet should be at least 9 mm inside diameter.
- 3) Ensure that piping connected to the outlet does not cause back pressure. Maximum back pressure is 0.03 MPa (gauge pressure).
- 4) In case of selecting the inlet pipe and exhaust pipe that are not from our products, please select the exhaust pipe that has same or larger inner diameter length with the inlet pipe.

- 5) When starting the pump, it may not start if the intake-side pressure is lower than the atmospheric pressure.
Attach an atmospheric release leak valve between the pump intake pipe and vessel, and set the intake-side pressure to atmospheric pressure when starting the pump.
After starting the pump, always close the leak valve.
- 6) When evacuating a vessel, ensure that a shut-off valve is placed between the pump inlet pipe and the vessel (see Fig.3.1).

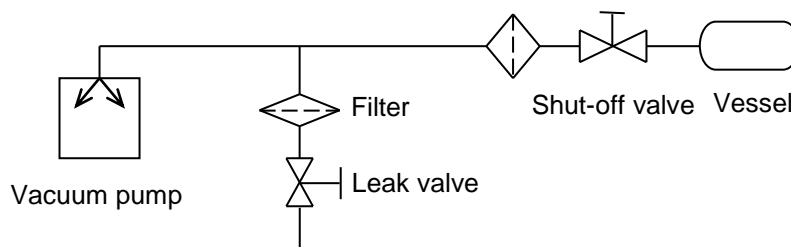


Fig.3.1 Example of Piping Used When Evacuating a Vessel

3.6 Storage

Turn the switch OFF (set to O), remove the power plug from the outlet, place the rubber caps over the inlet and outlet, and store the pump in an area of low humidity.

4. Cautions for Operation

4.1 Cautions for Operation

| | |
|----------------|--|
| Danger | See Danger (1)(2), P04 |
| Warning | See Warning (8)(14)(15)(16), P04,05 |
| Caution | See Caution (4)(5)(6)(7)(8), P05 |
| Note | See Note (3)(4)(5)(6)(7)(8)(9)(10)(11), P06,07 |

- 1) To maintain the performance of the pump, always ensure that it is cleaned internally after use.
Clean by ingesting clean air for 3~5 minutes under no-load conditions.
- 2) Consult the manufacturer if the pump is to be used in a special application.

4.2 Operation of the Thermal Protection Relay

- 1) When the thermal protection relay operates, switch the pump power supply OFF (set to O), remove the power cord from the outlet, and contact the manufacturer. Note that the pump will be very hot and should not be touched.
- 2) The pump operates automatically when temperature drops. Shut-off the power supply, and determine the cause of operation of the thermal protection relay.
- 3) Once the cause of the fault has been removed, wait until the motor cools and restart operation.

| | |
|----------------|----------------------|
| Caution | See Caution (6), P05 |
|----------------|----------------------|

4.3 Precautions when starting

1) Starting in cold weather

Cold weather will increase the viscosity of bearing grease and harden diaphragms, resulting in the pump being difficult to start. Follow the procedure below in such conditions.

A) Turn the switch ON/OFF 2~3 times with the inlet open to atmosphere until the pump starts. If the pump still does not start, raise the ambient temperature to beyond 0°C.

B) With the inlet open to atmosphere, run the pump for a few minutes to warm it.

C) Commence normal operation once the pump has warmed.

2) Precautions regarding the intake-side pressure

Set the intake-side pressure to atmospheric pressure when starting the pump.

If the pressure is lower than atmospheric pressure, it will apply a load on the motor and may prevent the pump from starting.

If it is necessary to maintain a vacuum, attach a shut-off valve or three-way valve between the pump and vessel. Refer to fig.3.1 for a piping example using a shut-off valve.

5. Pump Performance

5.1 Pressure Achieved

The term “pressure achieved” as employed in the catalogue and in this manual is defined as “the minimum pressure obtained by the pump without introduction of gas from the pump inlet (ie the no-load condition)”.

Note that the indicator values for pressure may differ between types of vacuum gauges.

The pressure achieved in practice is higher than that noted in the catalogue for the following reasons.

(1) The fact that the vacuum gauge is mounted a distance from the pump, the steam generated by water droplets and rust etc on the inside walls of the pump and piping, and a variety of gases present in the system result in increased pressure.

(2) Leaks into the vacuum system introduce other gases, resulting in increased pressure.

5.2 Evacuation Rate

The maximum rate of evacuation is reached when air is introduced, and decreases slightly as pressure is reduced.

The resistance of the piping system increases with small bore piping which extends over long distances, and this reduces the rate of evacuation.





The declared rate of evacuation for this pump is the maximum value achieved with dry air.

5.3 Power Requirements

The power required to drive the pump is the total of the work required to overcome the rotational resistance of the pump (mechanical work), and the work required to compress the air (compression work), and is at a maximum at an inlet pressure of $2.7 \times 10^4 \sim 4 \times 10^4$ Pa. At pressures below this range the compression work is considerably reduced and power is expended in mechanical work.

6. Maintenance, Inspection, and Repair

6.1. Cautions for Maintenance, Inspection, and Repair

| | |
|--|---------------------------------|
|  Danger | See Danger (3), P04 |
|  Warning | See Warning (4)(17)(18), P04,05 |
|  Caution | See Caution (9)(10)(11), P06 |
|  Note | See Note (12), P07 |

Maintenance and repair by the customer's repair technician is limited to the following procedures. Do not undertake other repairs, or make modifications other than the standard options supplied by the manufacturer.

- 1) Replacing diaphragms
- 2) Replacing inlet and outlet valves
- 3) Replacing O-rings

6.2 Maintenance

The following checks are required at least once every three days during operation.

- (1) Check for abnormal noises.
- (2) Check for abnormal heating of the pump.
- (3) Check that gas is discharged normally.

If a problem is found, take the measures described in 6.5 Troubleshooting List.

6.3 Regular Inspections

Inspect consumables after the first 3000 hours of operation, and replace and clean in accordance with the Replacement and Cleaning Guide on the following page. Refer to 6.4 Replacing and Cleaning Consumables for procedures.

Request replacement by the manufacturer's service division if a repair technician is not available.

Table 6.1 Consumables List

| Components | Quantity | Material | Average life |
|--------------------------|----------|--|--------------|
| Diaphragms | 2 | Synthetic rubber (EPDM) In contact with gas: PTFE | 6,000hr |
| Inlet valves A | 1 | PTFE | 6,000hr |
| Inlet valves B | 1 | PTFE | 6,000hr |
| outlet valves A | 2 | PTFE | 6,000hr |
| outlet valves B | 2 | PTFE (Soft) | 6,000hr |
| outlet valves A retainer | 1 | PTFE (Soft) | 6,000hr |
| O-rings (P-38) | 4 | Synthetic rubber (FPM) | 6,000hr |
| O-rings (P-14) | 2 | Synthetic rubber (FPM) | 6,000hr |
| O-rings (N-11) | 4 | Synthetic rubber (FPM) | 6,000hr |
| Bearings | 1 set | ——— | 15,000hr |

Note that the average life for a component varies with the conditions of use.

Always follow 4.1 Cautions for Operation, and remember that life is extended by running the pump at minimal load (running the pump at minimal load is operation at the achieved pressure (inlet closed)).

Bearings are replaced by the manufacturer's service division.

<Replacement Guide>



Replace or clean components if performance is reduced or the following symptoms become apparent.

- Diaphragms : Replace if PTFE components are worn or peeling, or if rubber components are deformed, hard or cracked.
- Inlet and outlet valves : Replace if deformed, hard, or cracked.
- O-rings : Replace if hard, cracked, or stretched.
- Bearings : Request manufacturer for repair if abnormal noises, or abnormal motor vibration, is noted.

Table 6.2 Locations for Maintenance and Inspection

| Period of operation | Inspection item | Replacement guidelines | Method of inspection |
|---------------------|-----------------------------------|---|----------------------|
| 3,000 hours | Diaphragms | Wear of PTFE components, deformation, hardening, or cracking of rubber components | Visual inspection |
| | Inlet and outlet valves, retainer | Deformed, hard, or cracked | Visual inspection |
| | O-rings | Hard, cracked, or stretched | Visual inspection |
| | Bearings | Abnormal noises | Listen |

6.4 Replacing and Cleaning Consumables

| | |
|--|-----------------------|
|  Warning | See Warning (18), P05 |
|  Caution | See Caution (11), P06 |

- ① Leave the pump at rest for approximately 30 minutes after it has stopped and be certain that it has sufficiently cooled down before starting any repair or cleaning work. The interior of the pump is still hot even after its operation has ended.
- ② When replacing the diaphragm, inlet and outlet valves, wear a dust mask and gloves. Fine, abrasive, airborne particles may be breathed into the body.
 - ※ Wear a full-face mask (for explosive atmosphere) whenever using the pump for an application where harmful gases may occur.
- ③ When replacing the diaphragm, always wear gloves to reduce the risk of injury.

Use the following tools, and refer to the photographs, when replacing cleaning components. Contact the manufacturer's service division for this work if the necessary tools are not available.

1. Phillips screwdriver : No.2
2. Hex socket wrench : (1) 4mm (2) 6mm
3. Torque wrench : (1) With 4 mm socket. Ensure that it is capable of being set to 0.5 N.m torque.
(2) With 6 mm socket. Ensure that it is capable of being set to 18 N.m torque.
4. Spanners : 17 mm or equivalent adjustable spanner
5. Vacuum grease : For replacing O-rings.
6. Solvent : Use a solvent such as ethylalcohol which has no effect rubber components.
7. Paper towels etc
8. Gloves, full-face mask (for explosive atmosphere), gas mask

1) Replacement of diaphragm

(It is recommended that two diaphragms be replaced at the same time.)

Caution Always wear gloves to reduce the risk of injury when mounting or dismounting the diaphragm.

Tools used: 2-②, 3-②, 5, 6, 7, 8

- (1) Remove the four hexagon socket head cap screws (M8×25) from one of the pump head assemblies. Remove the protection pipe and connection tube simultaneously from the pump head assembly on the opposite side. (Photo 1)

Caution Place the removed pump head assembly on a soft cloth.

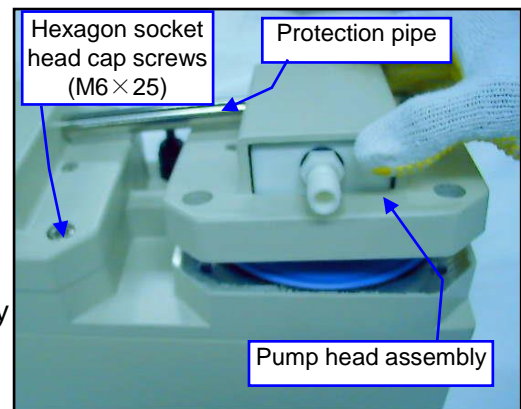


Photo 1

- (2) Remove the remaining pump head assembly and place them on a soft cloth.

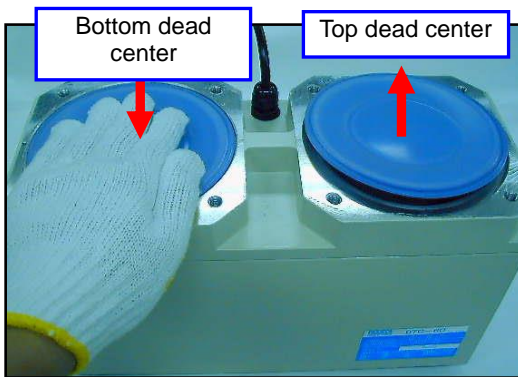


Photo 2

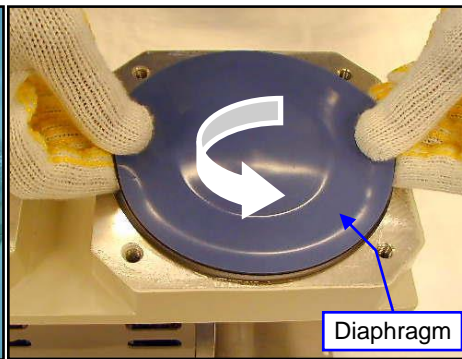


Photo 3

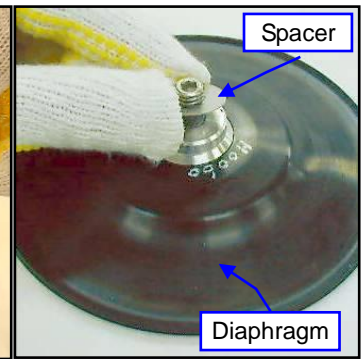


Photo 4

- (3) If one of the diaphragms is pushed down (bottom dead center), the other diaphragm rises (top dead center) enabling the edge of the diaphragm to be gripped. (Photo 2)

- (4) Hold the diaphragm's edge and rotate it counterclockwise to remove the diaphragm. (Photo 3)

Caution If the diaphragm is difficult to remove, two people may grip it simultaneously.

Caution A spacer (washer) is mounted between the diaphragm and connecting rod.

Remove the spacer exercising caution so as not to let it drop into the pump. (Photo 4)

- (5) Remove the diaphragm and wipe stains completely from the tap section with a solvent.

- (6) Apply a small amount of vacuum grease to one surface of the spacer that was removed in step (4) and mount it to the screw section of the new diaphragm.

- (7) Apply a small amount of vacuum grease to the screw section of the new diaphragm (to prevent scoring).

- (8) Rotate the diaphragm clockwise and tighten it 5° to 10° after it has stopped.

Caution Mount the spacer that was removed in step (4).

Caution Do not apply excessive force when mounting the diaphragm. Otherwise, wrinkles may develop on the diaphragm surface.

- (9) Mount the other diaphragm with the same procedure.

- (10) Apply a small amount of vacuum grease to an area of about 5 mm from both ends of the connection tube and insert the tube as deeply as possible into the hole on the side of the pump head assembly . (Photo 5)
After inserting the tube, mount the protection pipe and connect the two pump head assemblies.

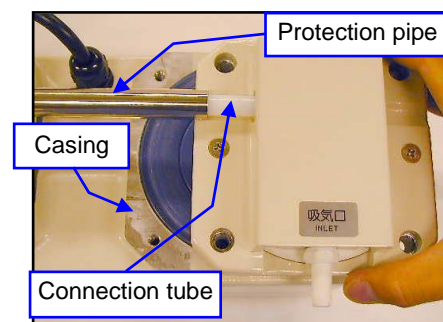


Photo 5

- (11) Place the connected pump head assemblies on the casing and secure them with eight hexagon socket head cap screws (M8×25).

Caution Tighten the hexagon socket head cap screws (M8×25) in an even, crisscross pattern with a torque of 18N·m.

2) Replacement of inlet and outlet valves

(It is recommended that the inlet and outlet valves be replaced together with the diaphragm.)

Tools used: 1, 2-①, 2-②, 3-①, 3-②, 4, 5, 6, 7, 8

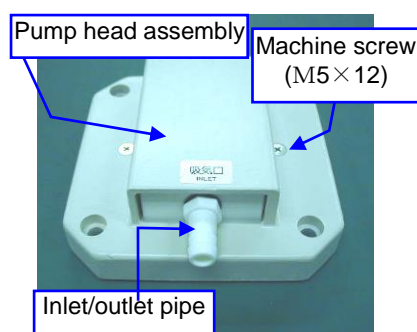


Photo 6

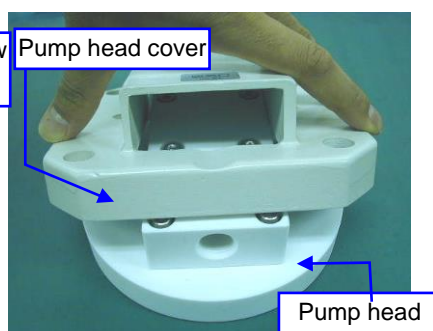


Photo 7

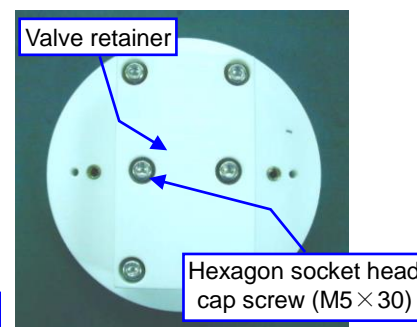


Photo 8

- (1) Remove the 1st stage side pump head assembly (inlet side) and 2nd stage side pump head assembly (outlet side) with the procedures of steps (1) and (2) of Section 1) “Replacement of diaphragm.”
- (2) Remove the inlet and outlet pipes, two machine screws (M5×12), and pull out the pump head from the pump head cover. (See photos 6 and 7).
- (3) Remove six hexagon socket head cap screws (M5×28) referring to Photo 8, separate the pump head from the valve retainer, and remove the old inlet and outlet valves.
- (4) Separate the other pump head in the same way and remove the inlet and outlet valves.
- (5) Clean the pump heads and valve retainers with a solvent.

(6) Mount new inlet and outlet valves with the procedures of steps ① through ⑭ as shown below.

- ① Check the first stage side (inlet side) and second stage side (outlet side) of the pump referring to photo 9.
- ② Check the type and configuration of the inlet and outlet valves referring to Photo 10.
(※ Face the glossy side of inlet valve A,B and outlet valve A are marked by felt pen.)

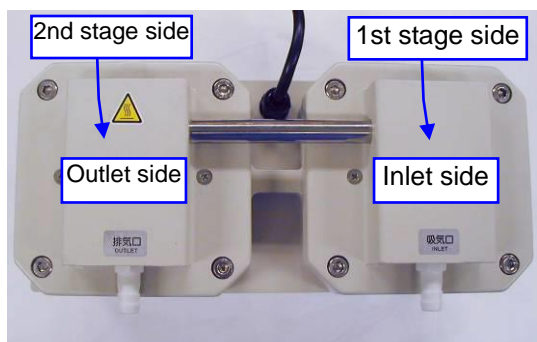


Photo 9

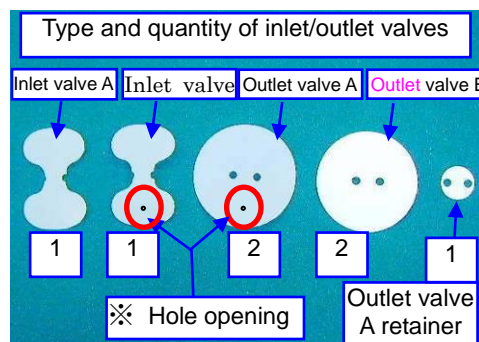


Photo 10

- ③ Prepare the first stage pump head, inlet valve A (1), outlet valve A (1), and outlet valve A retainer (1) referring to Photo 11.
- ④ Face the marke (felt pen) side of inlet valve A Downwards and place it according to the arrow ① of Photo 11.
- ⑤ Face the marke (felt pen) side of outlet valve A Upwards and place it with the hole opening at the left side according to arrow ② of Photo 11.
- ⑥ Place the outlet valve A retainer on outlet valve A that was mounted in step ⑤ according to arrow ③ of Photo 12.
- ⑦ Check again that inlet valve A (1), outlet valve A (1), and outlet valve A retainer (1) have been mounted on the first stage side pump head as shown in Photo 13.
- ⑧ Place the valve retainer on the pump head and tighten it in an even, crisscross pattern with a torque of 1.0 N·m. (See Photo 14)

Caution Exercise caution so that no scoring occurs on the inlet and outlet valves or the O-ring.

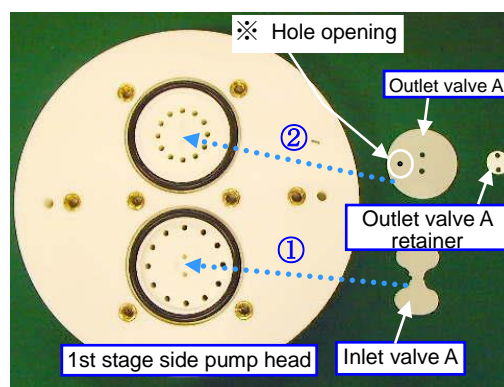


Photo 11

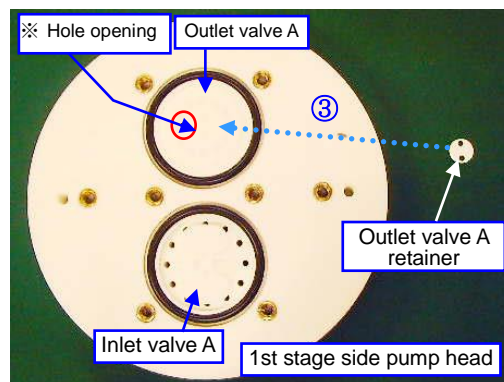


Photo 12

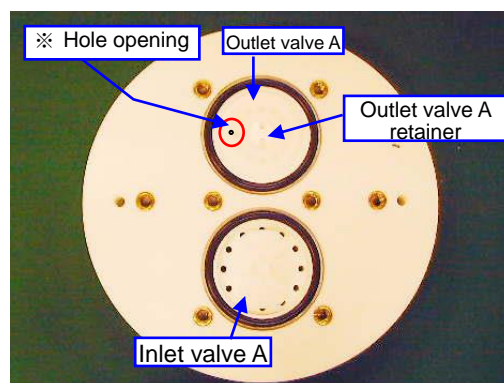


Photo 13

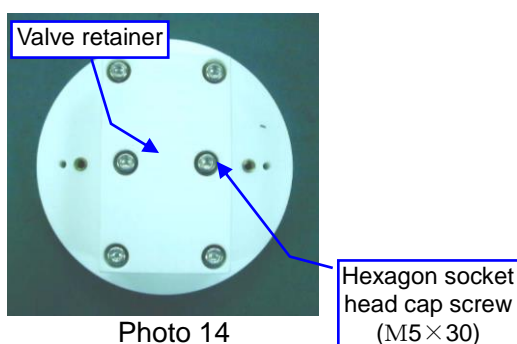


Photo 14

- ⑨ Prepare the second stage side pump head, inlet valve B (1), outlet valve A (1), and outlet valves (2) referring to Photo 15.
- ⑩ Face the marke (felt pen) side of inlet valve B Downwards and place it with the hole opening at the right side according to the arrow ④ of Photo 15.
- ⑪ Place the two outlet valves B on top of the other according to arrows ⑤ and ⑥ of Photo 15.
(There is neither a front nor a back side.)
- ⑫ Face the marke (felt pen) side of outlet valve A Upwards and Place it on the two outlet valves B that were mounted in step ⑪ according to the arrow ⑦ of Photo 16.
(There is neither a front nor a back side.)
- ⑬ Check again that the inlet valve B (1), outlet valve A (1), and outlet valves B (2) have been mounted On the second stage side pump head as shown in Photo 17.
- ⑭ Place the valve retainer on the pump head and tighten it in an even, crisscross pattern with a torque of 1.0 N·m. (See Photo 18)

Caution Exercise caution so that no scoring occurs on the inlet and outlet valves or the O-ring.

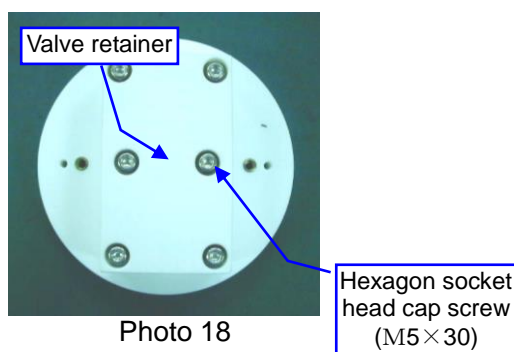


Photo 18

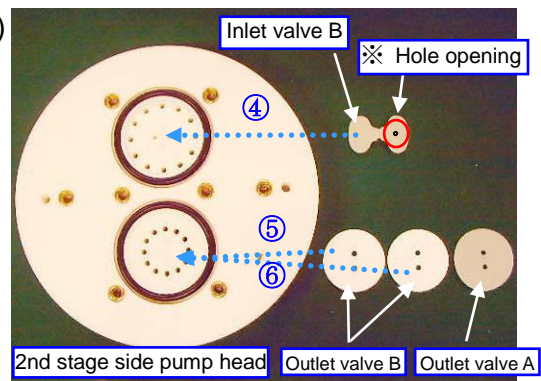


Photo 15

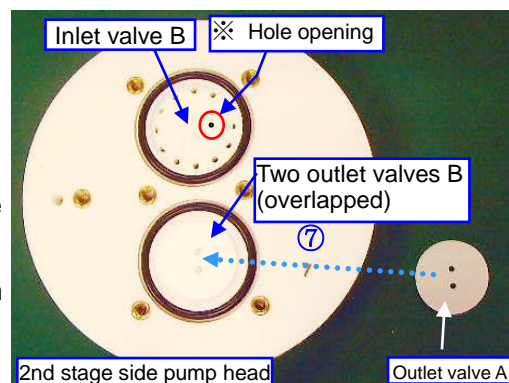


Photo 16

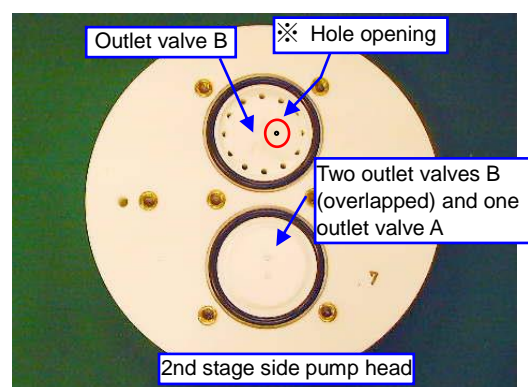


Photo 17

- (7) Mount the pump head covers to both the first and second stage side pump heads, secure them with two machine screws (M5×12), and mount the inlet and outlet valves.
- (8) Apply a small amount of vacuum grease to an area of 5 mm from both ends of the connection tube and insert the tube as deeply as possible into the hole on the side of the pump head assembly. After inserting the tube, mount the protection pipe and connect the two pump head assemblies. (Photo 19)
- (9) Place the connected pump head assemblies on the casing and secure them with the eight hexagon socket head cap screws (M8×25).

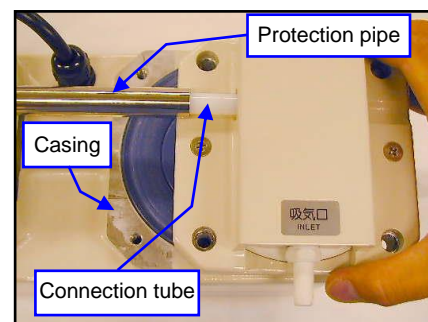


Photo 19

Caution Tighten the hexagon socket head cap screws (M8×25) in an even, crisscross pattern with a torque of 18N·m several times.

3) Replacement of O-ring

(It is recommended that the O-ring be replaced together with the diaphragm.)

Tools used: 1, 2-①, 2-②, 3-①, 3-②, 4, 5, 6, 7

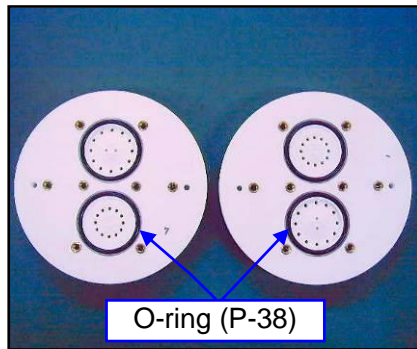


Photo 20

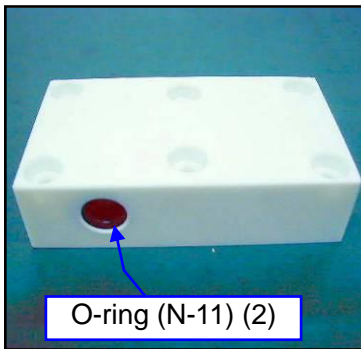


Photo 21

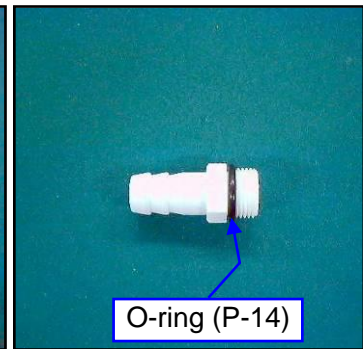


Photo 22

- (1) Remove the inlet and outlet valves, the pump head, and the valve retainer with the procedures of steps (1) through (4) of Section 2 “Replacement of inlet and outlet valves.”
- (2) Remove the O-rings from the inlet and outlet valves (P-14), the pump head (P-38), and from the valve retainer (N-11). (Photos 20, 21, 22)
- (3) Clean the inlet and outlet pipes, pump head, and valve retainer with a solvent.
- (4) Apply a small amount of vacuum grease to the new O-rings and put them in place.

Caution In the case of N-11, two O-rings are provided for each location (four in total).

- (5) Mount each part with the procedures of steps (6) [14] through (9) of Section 2 “Replacement of inlet and outlet valves.”

4) Replacement of bearings

Contact our service department.

6.5 Troubleshooting List

Table 6.3 Troubleshooting List

| Problem | Causes | Solutions | Reference |
|---|---|--|-----------|
| Problems with starting and rotation of pump | (1) Not connected to power supply. | (1) Connect power supply. | 3-4. |
| | (2) Switch is OFF. | (2) Set switch to I. | |
| | (3) Problem with power supply voltage. | (3) Ensure that voltage variation is within +/-10%. | |
| | (4) Problem with pump wiring. | (4) Rewire the pump. Contact the manufacturer. | 4-2. |
| | (5) The breaker has operated. | (5) Investigate the reasons for operation. | |
| | (6) The thermal protection relay has operated. | (6) Switch power OFF, and eliminate the cause of operation of the relay. Contact the manufacturer. | 4-3. |
| | (7) Low ambient temperature. | (7) Ensure that ambient temperature is 0~40 °C. | 4-3. |
| | (8) Intake-side pressure is lower than atmospheric pressure | (8) Set the intake-side pressure to atmospheric pressure | 4-3. |
| | (9) Low voltage. | (9) Adjust the power supply voltage, and check the power supply cable. | 6-4. |
| | (10) Fault in power supply. | (10) Replace or repair. | |
| | (11) Problem with power supply switch. | (11) Replace or repair. | 6-4. |
| | (12) Broken wire in power cord. | (12) Replace or repair. | |
| | (13) Problem with motor. | (13) Replace or repair. | 6-4. |
| | (14) Damaged condenser, or connection problem. | (14) Replace or repair. | |
| | (15) Locked connecting rod. | (15) Disassemble pump head and check interior. | 6-4. |
| | (16) Problem with bearings. | (16) Replace or repair. | |
| | (17) Miscellaneous damage to pump components. | (17) Disassemble and repair (replace damaged components). | 6-4. |
| Pressure does not diminish | (1) Pump is too small for capacity of vacuum vessel. | (1) Select another pump. | 5-1. |
| | (2) Pressure measurement is incorrect. | (2) Measure the pressure correctly. | |
| | (3) Vacuum gauge is unsuitable. | (3) Measure with a calibrated vacuum gauge suitable for the pressure range. | 5-1. |
| | (4) The inlet piping is too small in diameter, or too long. | (4) Connect piping of an inside diameter greater than the inlet diameter, or reduce the distance between the pump and vacuum vessel. | |
| | (5) Ambient temperature unsuitable. | (5) Ensure that ambient temperature is 0~40 °C. | 6-4. |
| | (6) Leaks in inlet piping. | (6) Clean and replace. | |
| | (7) Leaks from piping or connections. | (7) Check for leaks in piping, check diameter and length of piping, and repair. | 6-4. |
| | (8) Foreign matter inside pump. | (8) Remove foreign matter, disassemble and clean, and replace components. | |
| | (9) Foreign matter inside pump. | (9) Disassemble and repair (replace valves and diaphragm etc). | 6-4. |
| | (10) Problem due to ingestion of liquid or | (10) Replace. | |
| | (11) Damage to diaphragm. | (11) Replace. | 6-4. |
| | (12) Miscellaneous damage to pump components. | (12) Disassemble and repair (replace damaged components). | |
| Pump surfaces are abnormally hot (more than room temperature + 30 °C) | (1) Continuous operation with high pressure gas. | (1) Do not run the pump continuously at near-atmospheric pressure. | |
| | (2) High temperature gas. | (2) Fit cooling equipment (eg. gas cooler) to the inlet. | |
| | (3) Problem with power supply voltage. | (3) Ensure that voltage variation is within +/-10%. | |
| | (4) Motor has seized. | (4) See the section on problems with pump rotation. | |

7. In Conclusion

Please contact the manufacturer's sales division if you have any questions.

Warranty

- (1) The warranty for this pump (this equipment) extends for a period of one year from the date of shipment.
- (2) Any malfunctions or defects which occur under normal usage conditions during the warranty period will be repaired free of charge.

Note, the warranty stated here is an individual warranty covering the pump. In addition, the scope of the warranty coverage concerning repairs is limited to the repair and/or replacement of parts.

Normal usage conditions refer to the following:

- a) Ambient temperature and humidity during operation: 0- 40°C, below 85% RH
 - b) Operation in accordance with the user manual
- (3) Repair fees will incur during the warranty period for the following cases:
 - a) Malfunctions due to a natural disaster or fire.
 - b) Malfunctions caused by special atmospheric conditions, such as salt damage, inflammable gas, corrosive gas, radiation or pollution.
 - c) Malfunctions caused by usage conditions that differ from those stated in the user manual (performance specifications, maintenance and inspection, etc.).
 - d) Malfunctions caused by modifications or repairs carried out by a party other than the manufacturer, or by a service company not approved by the manufacturer.
 - e) Malfunctions caused by noise (electric disturbance).
 - f) Malfunctions that occur when not using a rated power supply.
 - g) Malfunctions that occur when there is an abnormal rise in internal pressure due to the pump exhaust outlet being blocked during operation, etc.
 - h) Malfunctions that occur, when the pump is damaged as a result of being dropped or falling, etc.
 - i) Malfunctions which are determined by the manufacturer's technical personnel to be caused by conditions that do not comply with the usage conditions for this vacuum pump.
 - j) Malfunctions due to the replacement of consumables.
 - (4) Disclaimer
 - a) We shall not be liable for any malfunctions of our products caused by the customer, regardless if the malfunction does not fall within the warranty period, nor shall we be liable for any loss of opportunity for the customer's clients or for compensation for any damages to other products, labor costs, production loss, transportation expenses and other related work.
 - b) We shall not be liable for any claims and patent infringements, including secondary damages, filed a claim by a third party against the customer.

Usage Status Check Sheet (for use in Instruction Manual)

- * For the purpose of safety control of repair personnel, fill in within the heavy line frame and attach the sheet to the item of which repair is requested.
- * In case this sheet were not attached or filled in, your request of repair and service may not be accepted.
- * In accordance with the Private Information Protection Law, the provided information will be used only for determining the cause of failure and whether detoxifying washing should be conducted. It will never be provided to any third person.

Model Name: _____ Manufacturer's Serial No.: _____

1. Inhaled Gas * Please be sure to fill in.

(1) Whether there is harmful effect on human bodies Yes No (Sing your name below.)

(2) Whether there is unusual smell Yes No

(3) Type and Name of Gas: _____

* Industrial Safety and Health Law designates particular substances as the materials to be notified.

2. Usage Status

Operation Method: Approx. () hours per day, () years and () months

☐Continuous Operation ☐Intermittent Operation

Usage: _____

3. Failure Status ☐Unusual Noise ☐Abnormal Pressure ☐Abnormal Actuation ☐Oil Leakage

Other Symptoms: _____

4. Detail of Request ☐Repair (Overhaul) ☐Regular Checks

5. Others: _____

Company Name: _____ Personnel in charge: _____

Address: _____

Tel: _____ Fax: _____ E-mail: _____

Agent Name: _____ Personnel in charge: _____

Address: _____

Tel: _____ Fax: _____

* In case you do not have any direct transaction with us, please be sure to fill in the agent name.

6. Confirmation

The gas and substance used in this pump or unit is harmless to human bodies, or it is not contaminated by any substance harmful to human bodies.

Signed _____ (seal) Date: _____

* Please send the parcel to our Service Division. (See attached contact information.)

* In order to avoid a trouble during transportation, please evacuate oil from any oil pump before shipping.

アルバック機工株式会社

<https://ulvac-kiko.com>

製品情報・サービス拠点・お問い合わせはこちらから



<https://showcase.ulvac.co.jp/ja/>

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