

ULVAC

User's Manual

High Vacuum Diaphragm-Type Dry Vacuum Pump

DTC-120

DTC-120A, 120B, 120C (According to CE)



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 our product. This pump is designed solely for vacuum pumping, and it may malfunction or cause accidents if not handled appropriately. Read the manual thoroughly, and pay due attention to inspections, maintenance and safety.

Operator

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 “Using the pump safely” 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	-----	1
Inlet and outlet caps (Attached to inlet and outlet.)	-----	2
Power plug adapter (Attached to power cord.)	-----	1

- (3) Is there any damage to the pump?
- (4) Are any external screws or inlet and outlet pipes loose? Are any components missing?

Contact the company from where you purchased the pump or the sales department of the manufacturer if there are any problems with the pump.

Note

Do not hold the tube at the top of the pump or bend it while removing it from the packaging. The tube may be damaged, affecting the performance of the pump.



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 the 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 evacuate explosive gases.
- (2) In addition to the 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 the pump is used with toxic gases 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 department to overhaul the pump, always write the gas with which the pump has been used on the Usage Check Sheet and submit it. Note that if it has been used to evacuate toxic gases for any reason it will be contaminated. Please be aware that use with some gases will preclude overhaul.

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. Failure to do so may result in fire.
- (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 leakage, 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 may result in electric shock, injury, or fire.
- (16) Operating the pump with the outlet blocked, or with a device which prevents passage of gas to the 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 overhauled only by a repair technician trained by the manufacturer.
- (18) Always use a dust mask and gloves when replacing the diaphragm, valve and O-ring. Fine wear particles in the air may be inhaled into the human body.

Caution

Installation

- (1) To prevent back injuries, always use at least two people when lifting and moving the pump.
- (2) Microscopic particles resulting from wear of diaphragms are discharged from the outlet and contaminate the room. If necessary, connect a pipe from the outlet to the outside of the building.
- (3) Since this pump is precisely engineered, ensure that the following conditions be satisfied during storage, installation and operation.
 - i) Ambient temperature, relative humidity: 0~40°C, 85% (during operation)
 - ii) Other conditions for storage and operation
 - a) Level floor of sufficient strength
 - b) No condensation
 - c) Dust-free environment
 - d) Well ventilated
 - e) Free from explosive gases
 - f) Not subject to direct sunlight
 - g) No danger of fire
 - h) Maximum ambient temperature of 40°C during assembly of pump

Caution

Operation

- (4) Do not use the device for organ transplants or applications which involve contact with bodily fluids and living tissue.
- (5) Never touch the rotating section of the motor, shaft, coupling and cooling fan while the pump is in operation. Failure to do so 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) Do not touch the motor while the pump is in operation or when the pump is still hot immediately after it stops. Touching it may lead to burns.
- (8) Do not insert fingers or objects into, or peer into, the inlet or outlet during operation. Failure to do so may result in injury or malfunctions.

Maintenance and repair

- (9) In terms of disposal, follow the “legislation for disposal and cleaning of waste” and handle the product as “industrial waste.” Never incinerate.
If a product using fluoroplastic is incinerated, noxious fluorine gas is generated.
- (10) If the pump ceases operation, turn off the power (set switch to ○) immediately to prevent accidents, remove the power cord from the wall outlet, and contact the company from which you purchased the pump or the manufacturer for inspection and repair.
- (11) Leave the pump for at least 30 minutes until it has cooled down, and start 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 the tube at the top of the pump or bend it while removing it from the packaging. The tube may be damaged, affecting the performance of the pump.
- (3) Do not evacuate liquids or condensable gases. The pump will be damaged and will not operate correctly.
- (4) Do not evacuate air that includes dust or dirt. The pump will not operate correctly. If there is a possibility of dust or dirt in existence, mount a filter to the inlet port in order to prevent dirt and dust from entering and in order to protect the pump.
- (5) When evacuating vapor and corrosive gas which affects the human body, always install piping to the outlet port.



Applications

- (6) This pump is exclusively used for vacuum pumping. Operation for long periods at near-atmospheric pressures may result in a malfunction.
- (7) This pump is basically resistant to corrosion. However, it can be expected to corrode with molten alkali metallic (such as metallic sodium), fluorine under a high temperature, and certain fluorine compounds.
- (8) Do not allow the evacuation of liquid or condensable gas. The pump will be damaged and will not operate correctly.
- (9) Entry of gases containing dust or dirt may prevent normal operation of the pump.

Operation

- (10) Use the pump within an ambient temperature range of 0 to 40°C. Use at high ambient temperatures will dramatically reduce the life of the pump.
- (11) Back pressure at the outlet while the pump is starting may overload the motor.
- (12) Do not touch the thermal protector while the pump is in operation or when the pump is still hot immediately after it stops. Touching it may lead to burns.
- (13) To maintain the performance of the pump, clean the inside of the pump after use. Have the pump evacuate clean air for three to five minutes and operate under a non-loaded condition.

Maintenance and repair

- (14) Since this pump is precisely engineered, it requires skill in its assembly. If a repair technician is unavailable, replacement of all consumables should be left to the manufacturer's service department.

1. Product Outline

1.1 Purpose of use and prohibitions

This product is a diaphragm-type dry vacuum pump which employs reciprocating motion of a rubber film (diaphragm) for evacuation.

The pump is designed to be highly-resistant to corrosion by adopting PTFE (corrosion-resistant resin) at sections which are exposed to gas.

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

Prohibitions

Warning

- (1) This pump is exclusively used for vacuum pumping, 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 basically resistant to corrosion. However, it can be expected to corrode with molten alkali metallic (such as metallic sodium), fluorine under a high temperature, and certain fluorine compounds.
- (4) Do not attempt to evacuate gases or liquids which include dust, dirt, condensable gases, etc.
- (5) Do not operate the pump for long periods at near-atmospheric pressure.

1.2 Specifications

Table 1.1 Product Specifications (50/60 Hz)



Model		DTC-120				
Vacuum rate (L/min.)	50 Hz	120				
	60 Hz	140				
Ultimate pressure (kPa)		1.0				
Motor		Standard	Semi-standard			
		1 φ, 100V AC ± 10% (50/60 Hz)	1 φ, 115V AC ± 10% (60 Hz)	1 φ, 200V AC ± 10% (50/60 Hz)	1 φ, 220V AC ± 10% (50/60 Hz)	1 φ, 230V AC ± 10% (50 Hz)
		400 W, 4P, condenser-run, with thermal protector (automatic reset-type) provided.				
Rated current (A)	50 Hz	5.3		2.8	3.0	2.4
	60 Hz	6.0	5.4	2.9	3.0	
Speed (rpm)	50 Hz	1400		1400	1350	1400
	60 Hz	1630	1650	1630	1650	
Inlet/outlet pipe		O.D. φ 16 × I.D. φ 12 (PF1/2)				
Weight (kg)		27.5				
Ambient temperature (°C)		0 ~ 40				
External dimensions (mm)		180 mm (W) × 411 mm (L) × 300 mm (H)				
Excess-voltage category		II				
Pollution degree		9				
Installation category		Class I				

Note: The values marked with ※ are explained later.

Note: For motors of 100V, 200V and 230V AC, products which are adaptable to CE are available as semi-standard products. The models of these products are DTC-120A, -120B and -120C respectively.

1.3 Protective device (Thermal protector)

- 1) This pump incorporates an automatic reset-type thermal protector 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 (e.g. earth leakage breaker, motor breaker) are also used.

 Warning	See Warning (8) on page 04.
 Caution	See Caution (6) on page 06.

2. Dimensions

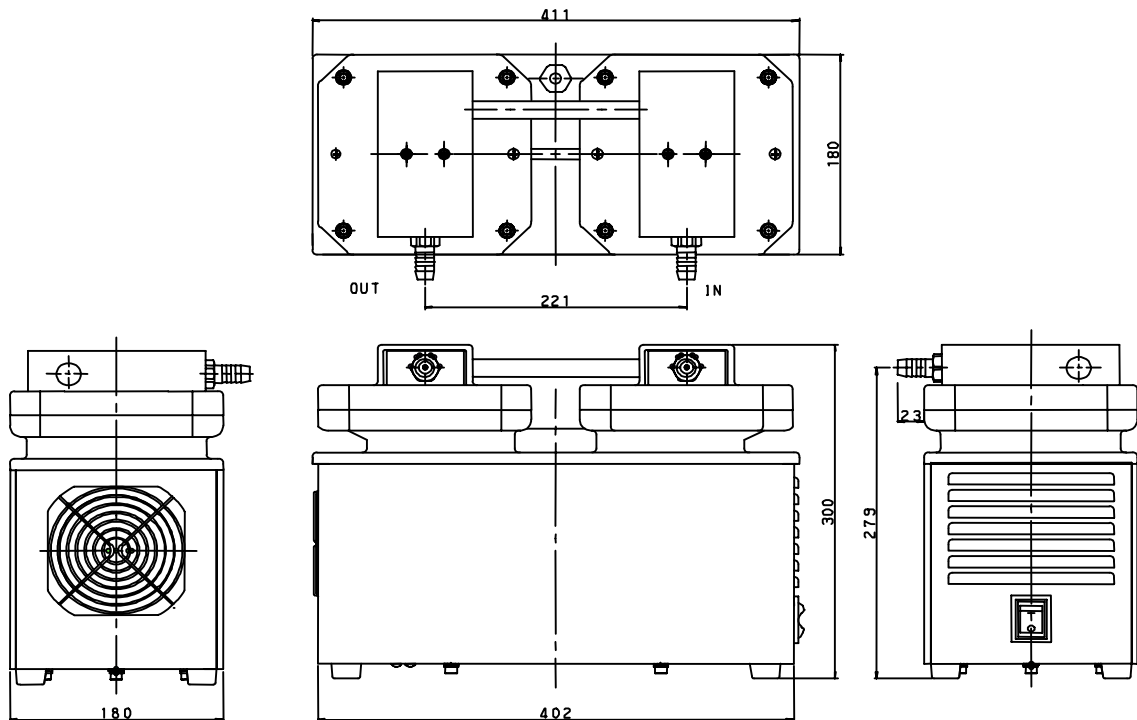





Fig. 2.1 DTC-120 series dimensions

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) and (13) on page 04.
 Caution	See Caution (1), (2) and (3) on page 05.
 Note	See Note (1), (2), (3), (4) and (5) on page 07.

3.2 Environmental conditions for installation, storage and operation

Since this pump is precisely engineered, ensure that the following conditions be satisfied during storage, installation and operation.

- 1) Ambient temperature, relative humidity: 0~40°C, 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) Free from explosive gases
 - 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, dirt and humidity. This location should be selected in consideration of ease of installation, removal, inspection and cleaning. Particular attention should be paid to ambient temperature when building the pump into equipment. Use a rubber vibration isolator to separate the pump from the equipment and 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 pipes
- 2) Check that the pump switch is OFF (set to O), and insert the plug into the 100 V wall socket.
Note: Use a power plug which is sufficient for the rated voltage and current.
Note: Extension cords should be triplex, 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 evacuated 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 10 mm inside diameter.
- 3) Ensure that piping connected to the outlet does not cause back pressure. The maximum back pressure should be 0.03 MPa (gauge pressure).
- 4) When evacuating a vessel, ensure that a shut-off valve is placed between the pump inlet pipe and the vessel (see Fig. 3.1).

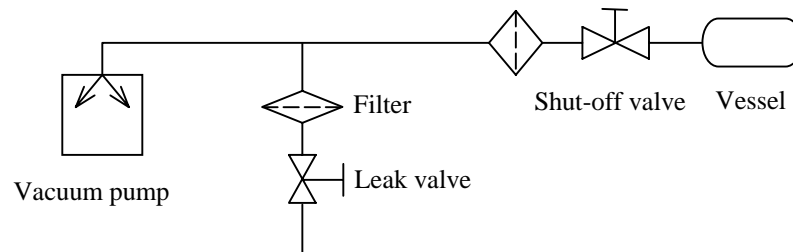






Fig. 3.1 Example of piping Used When Evacuating a Vessel

3.6 Storage

Turn the switch OFF (set to O), disconnect the power plug, put the rubber caps on 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) and (2) on page 04.
 Warning	See Warning (8), (14), (15) and (16) on pages 04 and 05.
 Caution	See Caution (4), (6) and (7) on page 06.
 Note	See Note (6), (7), (8), (9), (10), (11), (12), (13) and (14) on page 07.

- 1) To maintain the performance of the pump, clean the inside of the pump after use. Have the pump evacuate clean air for three to five minutes and operate under a non-loaded condition.
- 2) For special applications, contact us.

4.2 Operation of the thermal protector

- 1) When the thermal protector has actuated, turn off the pump (set to ○), disconnect the power cord, and contact the manufacturer. Since the motor is very hot, do not touch it.
- 2) When the cause of the malfunction is eliminated, confirm that the motor has cooled down, and then start operation.

 Caution	See Caution (5) on page 05.
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4.3 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.

- 1) Turn the switch on and off two or three 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.
- 2) With the inlet open to atmosphere, run the pump for a few minutes to warm it.
- 3) Commence normal operation once the pump has warmed.

5. Pump Performance

5.1 Ultimate pressure

The term “ultimate pressure” 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 (i.e. the non-load condition)”.

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

The ultimate pressure 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 Vacuum rate

The vacuum rate of the pump depends on the type and pressure of the gas to be evacuated. When air is evacuated, the vacuum rate usually reaches the maximum, and it gradually decreases when the pressure reduces.

As the pipe diameter becomes smaller and its length becomes longer, the resistance of the piping system increases, while the vacuum rate decreases.





The nominal vacuum rate of this pump is the maximum rate when dry air is evacuated.

5.3 Power required

The power required to operate the pump is the total of the power required to overcome the rotational resistance of the pump (mechanical work) and the power required to compress the air (compression work), and is at a maximum at an inlet evacuation pressure of around 2.7×10^4 to 4×10^4 Pa. At pressures below this range the compression work is considerably reduced and power is consumed in mechanical work.

6. Maintenance, Inspection and Repair

6.1. Cautions for maintenance, inspection and repair

 Danger	See Danger (3) on page 04.
 Warning	See Warning (4), (17) and (18) on pages 04 and 05.
 Caution	See Caution (8) and (9) on page 06.
 Note	See Note (10) and (11) on page 06.

Maintenance and repair by the customer's repair technician is limited to the following procedures. Do not perform repair beyond the following or modification of equipment which is not included in our standard options.

- 1) Replacement of diaphragm
- 2) Replacement of valve
- 3) Replacement of O-ring

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 evacuated normally.

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

6.3 Regular inspections

Inspect consumables every 3,000 hours after starting the use of the pump, and replace them in accordance with the "Replacement guide." Refer to "6.4 Replacement of consumables" for procedures. Request replacement by the manufacturer's service department if a repair technician is not available.

<Consumables List>

Table 6.1 Consumables List

Components	Quantity	Material	Average life
Diaphragm	2	Main unit: Synthetic rubber (EPDM) Section exposed to gas: Teflon	6,000 hours
Valve (without hole)	3	Teflon	6,000 hours
Valve (with hole)	2	Teflon	6,000 hours
Valve retainer	1	Teflon	6,000 hours
O-ring (P-48)	4	Synthetic rubber (FPM)	6,000 hours
O-ring (P-18)	2	Synthetic rubber (FPM)	6,000 hours
O-ring (P-15)	4	Synthetic rubber (FPM)	6,000 hours
Bearing	1 set	---	15,000 hours

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

Adhering to the instructions mentioned in “4.1 Cautions for operation” and performing operations with less load applied to the pump tend to lead to the service life of the pump being extended.

(“Running the pump at minimal load” is operation at the ultimate pressure (with the inlet closed)).

Bearings are replaced by the manufacturer’s service department.

<Replacement guide>

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

Diaphragm: Replace if Teflon has worn, separated, or deformed, or if rubber has hardened or cracked.

Valve: Replace if deformed, hardened, or cracked.

O-ring: Replace if hardened, cracked, or stretched.

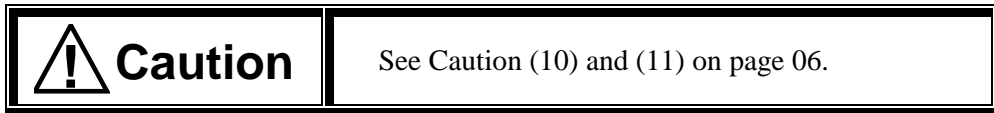
Bearing: Ask the manufacturer to repair if abnormal noises, or abnormal motor vibration, is noted.

<Locations for maintenance and inspection>

Table 6.2 Locations for maintenance and inspection

Period of operation	Inspection item	Inspection details	Method of inspection
3,000 hours	Diaphragm	Teflon: Wear, separation Rubber: Deformation, hardening, crack	Visual check
	Valve	Deformation, hardening, or cracks	Visual check
	O-ring	Hardening, cracks, or extension	Visual check
	Bearing	Abnormal noises	Auditory check

6.4 Replacement of consumables



- (1) The pump should be overhauled only by a repair technician trained by the manufacturer.
- (2) The pump becomes very hot after operation. After stopping the pump, leave it for 30 minutes to cool, and replace and clean consumables only after the pump has cooled down to a safe temperature.
- (3) Always use a dust mask and gloves when replacing diaphragms, valves and O-rings. Fine wear particles in the air may be inhaled into the human body.

Use the following tools, and refer to the photographs, when replacing consumables. Contact the manufacturer's service department if the necessary tools are not available.

Tools to be used

- 1) Phillips screwdriver: No. 2
 - 2) Hexagon wrench: Width across flat: 4 mm, 6 mm
 - 3) Torque wrench: Width across flat of hexagon socket: 4 mm, 6 mm
(The tightening torque is to be set to 0, 2, 6, 16 and 18 N·m.)
 - 4) Torque driver: Phillips screwdriver No. 2
(The tightening torque is to be set to 1 N·m.)
 - 5) Spanner: Width across flat: 4 mm (or equivalent monkey wrench)
 - 6) Vacuum grease: Used for replacing O-rings.
 - 7) Solvent: Use a solvent, such as ethyl alcohol, which has no effect on rubber components.
 - 8) Paper: Material which can wipe away stains such as waste paper.
 - 9) Dust mask and gloves
- ※ Wipe stains away with tools 7 and 8 when replacing consumables.

1) Diaphragm (It is recommended that both diaphragms be replaced at the same time.)

Use tools 1, 2, 3, 5, 7, 8 and 9. Note: Always wear gloves.

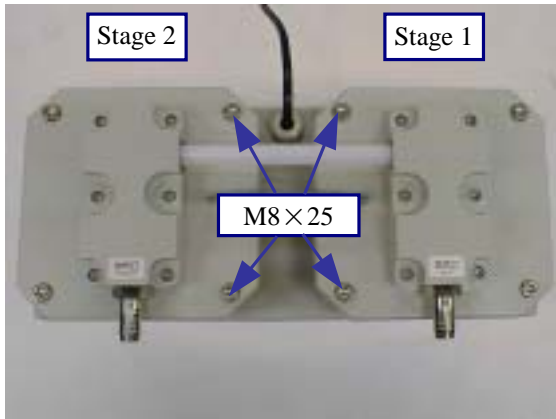


Photo 1

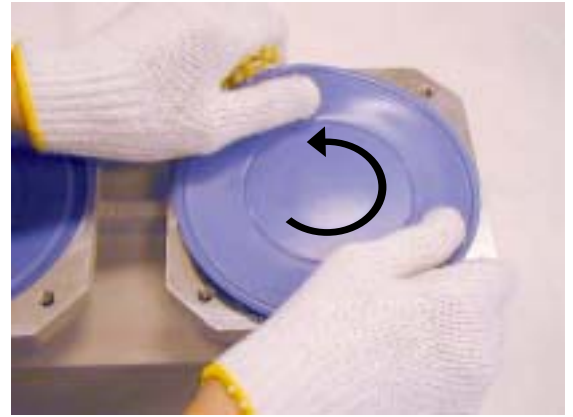


Photo 2

(1) Remove the eight M8 x 25 hexagon socket head cap screws shown in Photo 1.

(2) Lift the edge of the stage 1 diaphragm as shown in Photo 2, turn it counterclockwise, and remove it.

Note: The diaphragm is more easily removed by two persons.

Note: Be careful not to drop the spacer on the rear side of the diaphragm into the casing.

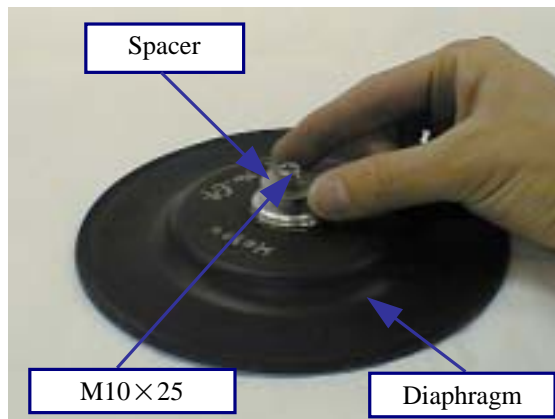


Photo 3

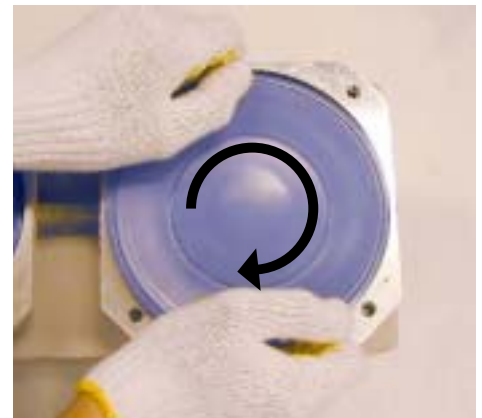


Photo 4

(3) Apply vacuum grease lightly to the hexagon socket set screw (M10 x 25; Photo 3) on the rear side of the new diaphragm (to prevent scoring by the screw).

(4) Referring to Photo 4, rotate the diaphragm clockwise and tighten the screw by approximately 5 to 10 degrees after it stops rotating.

Note: Take care not to overtighten the screw.

Note: Confirm that the peripheral liner has been attached to the casing. Be careful not to drop the spacer on the rear side of the diaphragm into the casing.

(5) Replace the stage 2 diaphragm as described in steps (2) and (3).

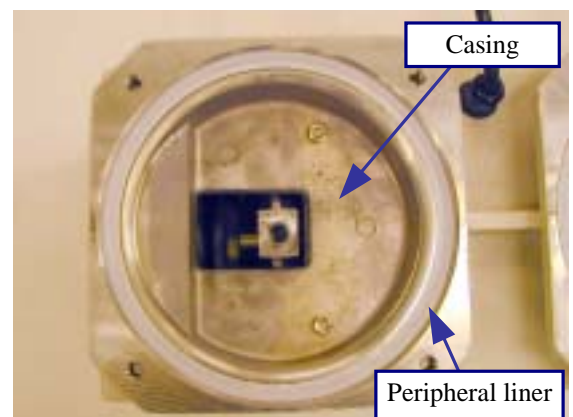


Photo 4-1

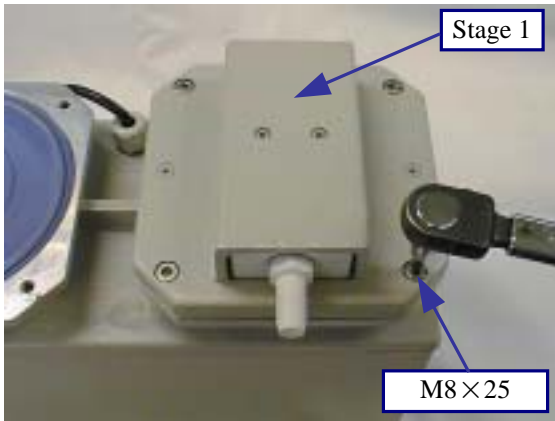


Photo 5

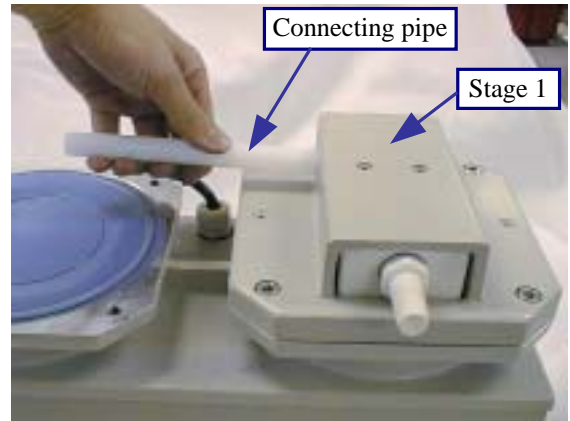


Photo 6

- (6) Referring to Photo 5, tighten the four hexagon socket head **cap** crews (M8×25) diagonally and evenly with a torque wrench (16 N·m) to fix the stage 1 pump head.
- (7) Referring to Photo 6, mount the connecting pipe to the stage 1 side.
Note: Always mount the connecting pipe from the stage 1 side and push it in until it stops.
- (8) Referring to Photo 7, mount the stage 2 pump head.
- (9) Tighten the four hexagon socket head cap screws (M8×25) diagonally and evenly with a torque wrench (16 N·m) to fix the stage 2 pump head.
- (10) After step (8), close the inlet, turn on the switch (pressed to the I side), and tighten the hexagon socket head cap screws (M8×25) diagonally and evenly with a torque wrench (18 N·m) two hours later.



Photo 7