

INSTRUCTION MANUAL MECHANICAL BOOSTER PUMP

PMB-040C PMB-060C

Before using this product, be sure to read this operation manual. Keep this manual with care to use at any time.

> ULVAC, Inc. Components Division http://www.ulvac.co.jp/

0. Before Using This Product

We thank you very much for purchasing our product.

You are kindly requested, upon delivery of the product, to check that the delivered product is exactly what you have ordered and it has no damage caused by transport or the like.

This manual gives description on operation and maintenance procedure appropriate to use the product in safe and effective way. Please read this manual beforehand to correctly use the Pump.

You are requested to install and operate the product in compliance with the laws and regulations relating to the safety, e.g. Fire Defense Law, Electric wiring regulation and so on in the country and region you use the product. Consequently you shall be requested to attend general safety lectures officially effective in the area, such as electrical safety, cargo handling safety and so on. Note that any person not attended such lectures shall be restricted from handling the product. Operators shall need to attend such kind of training and have special knowledge, skill and title regarding the electricity, machinery, cargo, vacuum and so on.

This product is designed to conform to regulations valid at the time of issue of this manual and its conformity is not ensured if any of regulations shall be changed in the future.

The performance and safety of the product might not be ensured if any of the devices put together did not conform to same regulations or the product itself was modified. ULVAC shall be not liable to guarantee performance and safety in such cases above. Any modification of the product by the user is out of the scope of guarantee by us and not be guaranteed in any manner.

Be sure to clear any energy sources, e.g. electricity, coolant and so on of the product before installing or removing the product.

Please note that any of the parts used in this product shall keep the performance at the time of the shipment but shall not survive eternally. Any of the parts cannot, under any application supposed under socially-accepted idea, help but inevitably deteriorate its performance and get easily result in causing trouble of the product. You are kindly requested consequently to take your application situation into consideration and help yourself to implement the protective maintenance so as to avoid troubles.

Through implementation of the protective maintenance, you shall reduce occurrence of the trouble due to wear and/or failure of the part and bring reducing the occurrence of the downtime caused by the product trouble and fire as well as a risk of affecting the another process.

We would like to ask you again to establish the protective maintenance plan as well as conduct the part replacement and overhaul in accordance with such a plan.

If you have any questions on handling the product, please contact the nearest sales office or agency.

	• Author's copyright of this instruction manual belongs to						
	Components Division of ULVAC, Inc.						
	It is prohibited to copy a part and/or this entire manual without authorization by Components Division of ULVAC, Inc.						
IMPORTANT	It is prohibited to use this instruction manual except for explanation when using the PMB-040C and PMB-060C, and other purpose Components Division of ULVAC, Inc. agreed.						
	 It is prohibited to hand over and disclose this instruction manual to third parties without agreement by Components Division of ULVAC, Inc. 						

0.1 Safety Symbol Marks

We display symbol marks regarding the safety in this manual and on the product to make clear items to observe. Descriptions attached to the symbol are classified as illustrated below;

0.2 Meanings of Safety Symbol Marks



●If the user makes a mistake in handling, it indicates an imminent possibility that the user is subject to death or heavy injury.



If the user makes a mistake in handling, it indicates a possibility that the user is subject to death or heavy injury.



●If the user makes a mistake in handling, it indicates a possibility that the user is subject to moderate injury or it leads to significant damage of the machine. It indicates a possibility that damage of the machine is caused and the normal operation is impaired.

IMPORTANT • Description shall be given where there is particular information to notice for the operation or maintenance work of the product.



Training for the electrical safety is required as there is a risk of electrical shock.



Check and ensure that the pump is sufficiently cooled down as this section keeps high temperature after having stopped the pump.

0.3 Safety Precautions

Descriptions are given as the method to keep away from danger and actions that must be restricted on the use of the product.

Use of this product and this Instruction Manual.

 Please read this Instruction Manual before starting installation, operation check or maintenance of this product to use it in long term. You are requested to fully understand the safety precautions, specifications and operation methods of the product.



IMPORTANT

•Toxic and combustible/combustion-supporting gases other than inert gas cannot be used as they leak from the pump body when evacuated by a vacuum pump.



Combustible/Combustion-supporting gases and materials other than inert gas cannot be used as they ignite/explode in a vacuum pump when evacuated by the vacuum pump.



Corrosive gas other than inert gas cannot be used as pump components may be corroded and damaged when evacuated by a vacuum pump.



Pump oil as well as the pump unit becomes toxic should the toxic gas was sucked in the vacuum pump. Pay attention to execute maintenance work.



●We would be obliged to refrain from handling and/or executing maintenance of the product if the detail of used hazardous substance was not disclosed or the product has exhausted such substance that the detoxification process is hardly conducted.



This Instruction Manual shall absolutely need to be delivered to the last user that uses the product.



characteristics of the product and description of the Instruction Manual are subject to change without prior notice for improvement.
Any change shall update the version number at the top right of the

•You are kindly requested to acknowledge that specifications and/or

Instruction Manual cover and issue the revised version. If you need the latest version, contact the nearest sales office or agency.



●To export this product abroad, you have to clear the examination in accordance with the Foreign Exchange law, Foreign Trade law and relevant decree, ordinance and order.

•Contact the nearest sales office or agency.

If you would like the latest version, contact the nearest sales office or agency.

Installation and storage

WARNING	 This product is packed with the wooden frame. Please ask the special agency for dismantling it. Advise the dismantling agent to wear leather gloves and use appropriate tools such as pinch bar as they have a risk of cutting the hand by nail or chip.
	Give the instruction them further to use the unloading machinery such as crane to take out the product of the wooded frame, lift it up with its top eyebolt and transfer it on lifting. Check the eyebolt whether it has no error before use.
	Only the technically entitled person should be in charge of conducting the unloading operation and operating the unloading machinery.
	There is a risk that the pump might drop or lay down when attempted unreasonable operation or machinery setup was not sufficient. You are strictly restricted to enter beneath the pump.

Transfer

	You have a risk of giving damage to your back as the load larger than safety standard shall be required to transfer the product.
WARNING	PMB-040C:970kg (Without Motor) PMB-060C:1100kg (Without Motor)
	Be sure to use the loading machinery (such as mobile crane) to lift up the Pump or load it on the pallet and fix it with Jack and run the Pallet truck for its transfer.
	Never try to enter beneath the pump unit when lifted it up. Use the accessory eyebolt to load/unload the unit.
	Do not put the folk of the fork lift or the like in the pump bottom (exhaust outlet) to lift it.
	Note to purge the oil to transfer the pump. If forced to transfer remaining the oil, be sure to keep the pump horizontal.
	Do not tilt the pump 10 degree or more while you charge the oil. The oil might run into the casing.

Countermeasure to the earthquake



There is a risk that the pump lays down or slides and breaks peripheral units if it was not correctly fixed. Be sure to give allowances to the vacuum piping, cooling water piping and electric cables so that they absorber vibrations to prevent them from breaking and/or dismantling.

Inlet / outlet port piping <Mounting>



Check and ensure that any of hazardous energy is blocked before starting the operation.

Coolant piping <Mounting>



Check and ensure that any of hazardous energy is blocked before starting the operation.

Power Supply wiring <Mounting>

 Cneck and ensure that any of nazardous energy is blocked before starting the operation. Entitled staff should conduct the wiring operation. Erroneous wiring work might cause a fire. Conduct the wiring operation correctly in compliance with laws and rules concerning the safety (e.g. Fire Defense Law, Electric Equipment Technology standard, Internal line cord) in the country and region you use the product. Ensure to have a correct grounding. You have a risk of getting electrical shock in case of failure or electric leakage. You are recommended further to install a dedicated Leak breaker. It is imperative to put the overload protection device. Otherwise it would cause the motor burn out and/or fire. Decide the electric wire size in consideration of a voltage drop of the electric wire. Under normal conditions, use electric wires with a voltage drop within 2% of the motor rated voltage. Voltage drop calculating formula 		
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		Voltage drop calculating formula
$\sqrt{3}$ × Electric wire resistance (Ω /km) × Wiring distance (m) × Motor rated current (A) × 10 ⁻³		$\sqrt{3}$ × Electric wire resistance (Ω /km) × Wiring distance (m) × Motor rated current (A) × 10 ⁻³
* For the motor rated current, see "Table 3."		* For the motor rated current, see "Table 3."

(Operation	
		●Do not run the pump on blocking the exhaust outlet or putting any device that might hamper gas passage onto the outlet. There is a risk that the pressure inside the vacuum pump rises up to cause break or oil leak of the casing or oil level gauge resulting in overload of the motor.
	WARNING	This product is not made as the withstand pressure structure. Ensured pressure value of the pump shall be 0.03MPa G (0.3kg/cm ² G) (Gauge pressure).



Do not operate the pump in hazardous area (where there is a risk of creating hazardous atmosphere by explosive gas). It might cause injury and/or fire.

Be sure to turn OFF the Power Supply to execute check and repair. You have a risk of getting electrical shock or injury by accidental sudden move.



- Person other than repair technician should not be in charge of dismantling, repairing or remodeling the product. You have a risk of getting injured or electrical shock by a fire or erroneous move.
- ●Do not touch the motor, vacuum pump or piping during the pump operation and just after stopped it while the pump unit keeps high temperature. You have a risk of getting burned.
- Should you found any malfunction or error, just turn OFF the Power Supply to prevent accident and ask the agency or closest Service Center for check and repair.



- Do not attempt to put your hand or article in the opening of the motor; you have a risk of getting electrical shock, injury or casing a fire.
- Do not touch any rotary section such as the motor, main spindle or spindle joint during operation of the Vacuum pump; it shall bring in injuries.
- Strictly refrain from putting any combustible substance in and around 1m of the motor and vacuum pump; there is a risk of getting a fire.
- Do not put a wall or obstacle in and around 0.3m of the air outlet of the motor (Motor edge face). You have a risk of getting burned or fire caused by over heat.

Ensure to flow the cooling water during operation. Required Cooling water shall be;

Cooling water volume : 10 L/min or more Cooling water temperature : 5°C ~ 30°C



It is recommended to use water with a low number of impurities (e.g. industrial water; see the table below) as the cooling water for this product. Depending on the water quality, the cooling water system of this product may cause scale, such as calcium carbonate, inside it, reducing the cooling water flow. In addition, it may be corroded from the inner wall by chlorine ions, resulting in cooling water leakage. And if pure water is used, metal may be eluted, resulting in cooling water leakage. Note in advance that in such a case, repair may be borne by you.

Shortage of the cooling water might give damage on the bearing, gear and rod sealing, which results in contact of the rotor and casing and operation stop.

[Fo	or reference] The stand	lard quality	of water s	upply in the	Japanese	industrial w	vater works
	Turbidity	рН	Alkalinity	Hardness	Evaporation	Chlorine ion	Iron	Manganese
	Mg/L		CaCO₃	Mg. CaCO₃	residue	CI-	Fe	Mn
				mg/L	mg/L	mg/L	mg/L	mg/L
	20 or less	6.5 – 8.0	75 max.	120 max.	250 max.	80 or less	0.3 or less	0.2 or less

Established by: Japan Industrial Water Association (Industrial water quality standard setting committee)



Be sure to lubricate the machine.

If the lubrication oil came down lower than limit level during operation, it might give damage on the bearing, gear and rod sealing and result in leak, noise, motor overload and operation stop.

Power Supply wiring <Dismantling>



Be sure to cut off the electricity before starting install or dismantling operation.

Cooling water piping <Dismantling>



Inlet / outlet port piping <Dismantling>



•Take off the piping following the Install Manual of the system.

- The Inlet and outlet piping remains very hot wile after having stopped the Pump. Be sure to take it off after the Pump has sufficiently cooled down.
- •Fully seal off the air intake and exhaust ports of the removed pump with blind flange etc.

Transfer

	You have a risk of giving damage to your back as the load larger than safety standard shall be required to transfer the product.
	PMB-040C:970kg (Without Motor)
WARNING	PMB-060C:1100kg (Without Motor)
	Be sure to use the loading machinery (such as mobile crane) to lift up the Pump or load it on the pallet and fix it with Jack and run the Pallet truck for its transfer.
	Never try to enter beneath the pump unit when lifted it up. Use the accessory eyebolt to load/unload the unit.
	Do not put the folk of the Fork lift or the like in the pump bottom (exhaust outlet) to lift it.
	●Note to purge the oil to transfer the pump. If forced to transfer remaining the oil, be sure to keep the pump horizontal. Do not tilt the pump 10 degree or more while you charge the oil. The oil might run into the casing.

0.4 Types and Descriptions of Warning Labels Displayed on This Machine and Displayed Positions

Warning labels are attached on the warning locations in this system.

Be sure to check them before starting operation of the Pump.

1		Before use, read through the instruction manual and fully understand its contents.
2		 You may get an electric shock in the area around a portion with this warning label. Before maintenance or wiring, be sure to turn off the primary power supply. Be sure to close the lid of the terminal box before operating this unit. Never open it during operation.
3	<u>SSS</u>	During operation or for a while after operation stops, do not touch the unit as each portion is at a very high temperature If a human body touches the unit, it may get burned.
4		 This product is not made as the withstand pressure structure. Ensured pressure value of the Pump shall be 0.03MPaG (0.3kg/cm2G) (Gauge pressure). Do not run the Pump on blocking the Exhaust outlet or putting any device that might hamper gas passage onto the outlet. There is a risk that the pressure inside the vacuum pump rises up to cause break the casing or Oil level gauge resulting in overload of the motor. Following gases cannot be evacuated because these gases may cause the pump inner pressure to increase due to internal combustion. 1) explosive gas 2) flammable gas 3) gas which increases the susceptibility of substances to burn. Long term storage of the Vacuum pump without operation might possibly cause trouble in operation caused by rust if you kept the Pump long time without operating it, ask a closest Service Center for the check. Indoor Use Only Mount at least 100mm from side walls.
5		 There is a moving part around the section that this warning label is put. Do not open a panel or a safety cover during operation. You should turn off the power line of the moving part If the power of this Pump doesn't supply, the moving part may have a possible to move the moving part. Be sure to be caught in this Pump.

6 50Hz

This indicates the rotation direction of the belt. In this machine, the motor pulley becomes different when moving at 60Hz and when moving at 50Hz. Confirm the description of frequency on the label.





0.5 Acceptance and Storage of the Pump

0.5.1 Unpacking/Acceptance of the Pump



Upon delivery of the product, check first that the delivered is exactly what you have ordered and there is no break or damage through transport or the like. Claim after use of the product might be resolved with a charge.

Although we pay full attention on shipping, you are kindly requested to check the following upon unpacked the product.

	Whether the delivered is exactly the one you have ordered.
	Whether accessories (standard accessories, optional parts) are attached or not.
IMPORTANT	Whether there is no break or damage through transport or not.
	Whether any bolt or nut got loose or taken off through transport or not.
	Should you found any trouble, please do not hesitate to contact our
	Sales division or your agency.

Part name	Specification	Quantity	Remarks
Oil one time portion	ULVOIL R-72	1 set	For the consumed amount, refer to the specification table.
V belt	5V-1120	2 pcs	-
Belt cover (Bolt for mounting)	-	1 set	-
Anchor bolt	Pump, motor base, belt cover	12 pcs	-
Motor (with key)	-	1pce	Attached only when the motor is placed an order.
Motor base (with bolt for motor fixation)	-	1pce	Attached only when the motor is placed an order.
Mater pulley	50Hz spec.	1pce	Fither of them only
	60Hz spec.	1pce	Either of them only
Instruction manual	English	1 сору	
Nylon tube	1/4B	1 set	For connecting oil pot
Oil pot	With joint	1pce	-

Table. 1 Standard accessories

0.5.2 Transfer

	●You have a risk of giving damage to your back as the load larger than safety standard shall be required to transfer the product.
	PMB-040C:970kg (Without Motor) PMB-060C:1100kg (Without Motor)
	Be sure to use the loading machinery (such as mobile crane) to lift up the Pump or load it on the pallet and fix it with Jack and run the Pallet
	truck for its transfer.
WARNING	Never try to enter beneath the pump unit when lifted it up. Use the accessory eyebolt to load/unload the unit.
	Do not put the folk of the Fork lift or the like in the pump bottom (exhaust outlet) to lift it.
	Note to purge the oil to transfer the pump. If forced to transfer
	remaining the oil, be sure to keep the pump horizontal. Do not tilt the pump 10 degree or more while you charge the oil. The oil might run
	into the casing.

0.5.3 Ambient Condition for Storage, Install and Operation

As precise clearances are provided with this machine, be sure to fulfill the following for its storage, install and operation;

- (1) Ambient temperature and humidity for storage
- (2) Ambient temperature and humidity for operation
- (3) Height (for both storage and operation)
- (4) External vibration (for both storage and operation)
- (5) Miscellaneous (for both storage and operation)

: -10°C to 60°C, less than 95%RH

(No freeze/condensation)

- : 5°C to 40°C, less than 80%RH
- (No condensation)
- : Lower than 1,000 meters altitude
- : Vibration acceleration less than114dB (0.5G)
- a. There shall be no corrosion behavior or explosive gas.
- b. There shall be no freeze or dew formation.
- c. There shall be no dust.
- d. It shall be in house.
- e. Another pump shall not be put on the pump.

The Pump shall not be laid down nor put touching its pulley edge face or oil gauge edge face with the ground.

f. There shall be no direct sun beam.

g. Heat source shall be put away from the pump.



Securely fix this machine with bolts.

0.6 Protective Device

This machine has a three-phase current motor.

This motor is not equipped with the protective device. Put an overload protective device to connect through the motor with the Power Supply.

Refer to "3.5 Electrical Connection" to select the overload protective device.

It is recommended to put together another protective device such as a leakage breaker.





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Request Form for Repair/Inspection of ULVAC Components /Certificate of Contamination SERVICE CENTER

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1. For Your Safety Use

1.1 This Product Intrinsic Hazardous Nature and Safety Measures

Before operating or checking this machine, thoroughly read this paragraph, and after fully understanding about latent danger and on how to avoid danger, perform the work.

1.1.1 ⚠ Danger Injuries by dangerous gas and dangerous materials.			
Factors	Avoidance methods and measures		
	Do not exhaust any hazardous gas such as toxic and combustible.		
	Before making an inspection etc., wear personal protective equipment suitable		
Leakage of poisonous and	for toxic substances for use.		
combustible gas	●To overhaul or dispose, ask the special agency to do the detoxification process.		
toxic pump oil, pump, generated material or sucked substance at the occasion of check or disposal.	Ask the disposal agency licensed by the administration for disposal.		

1.1.2 / Warning Transfer of neavy materia	1.1.2 🥂 Warnii	g Transfer of heavy material
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Factors	Avoidance methods and measures	
Getting injured on transferring the pump.	 Only technically entitled person should be in charge of loading/unloading and operating machines. There is a risk that the Pump might drop or lay down when attempted unreasonable operation or machinery setup was not sufficient. You are strictly restricted from entering beneath the 	
Pump weight (without motor) PMB-040C:970 kg PMB-060C:1,100 kg	Pump.	

1.1.3 🕂 Warning Electric shock		
Factors	Avoidance methods and measures	
	Be sure to cut the electricity to do electrical connection.	
Getting electrical shock on touching the current-carrying part of the motor.	●Be sure to establish a ground.	
	Be sure to close the cover of the terminal box of the motor before operating the pump and do not open the cover while driving.	
	Be sure to cut the electricity to do checking or installation.	
	Never attempt to put in the hand or bar into the opening of the Motor.	
Motor terminal mount gets burnt.	 Tighten close the terminal. Check the tightening once a month. (Refer to "3.5 Electrical Connection") 	

1.1.4 **Warning** Explosion

Factors	Avoidance methods and measures
Pressure inside the pump rises up and the pump explodes.	 Ensured pressure value of the Pump is 0.03MPaG (0.3 kg/ cm²G) (Gauge pressure). Check the Exhaust side pressure of the pump. If it was over 0.03 MPa G (0.3 kg/cm²G) (Gauge pressure) take away anything in and around the exhaust outlet that hampers gas passage.

1.1.5 Caution High temperature				
Factors	Avoidance methods and measures			
	The Pump gets high temperature during operation.			
Getting burnt on touching the high temperature part.	As the surface temperature is high, you have a risk of getting burnt by accidentally touching it with the hand or the like. Refrain from touching the pump during operation. Wait until the temperature sufficiently cools down after having stopped the pump to conduct check or something.			

1.1.6 Caution Leakage of hot cooling water			
Factors	Avoidance methods and measures		
Kept operating without supplying the cooling water. Boiled hot vapor jet out the cooling water outlet.	 Put a Flow meter in the line to set the interlock so that the Pump stops when cooling water was blocked out. If you kept operating without supplying the water, immediately stop the Pump and keep away from it. 		
	Stop the Pump and ensure that the Pump temperature got cooled down to take out the Pump and check it		

1.2 Chemical Material Safety Data Sheet(SDS)

Chemical material used for this Pump;				
	ULVOIL R-72 (Mineral oil)			
	The Chemical Material Safety Data Sheet introduces the chemical material potential to use or touch on operating this machine.			
	Please contact our Sales division if you are in need			
	Read it with attention to acknowledge the toxic characteristics described on the SDS.			
	Please do not use the chemical material except the above-mentioned			
	chemical material (vacuum pump oil).			
	SDS is posted as referential to ensure safe operation of the hazardous and/or toxic chemical material.			
	●If you handle pump oil, you should understand that it is necessary to take appropriate measures depending on the actual conditions in each use case etc. in reference to this on your own responsibility before use. Therefore, the SDS itself is not a security assurance statement.			

2. Pump Outline

2.1 Total configuration

The Mechanical booster pump is used combined with the backing pump to enhance the exhaust speed around the pressure range $8.0 \times 10^2 \sim 6.7 \times 10^{-1}$ Pa where the backing pump exhaust speed is likely to lower.

The mechanical booster pump includes two rotors having a cocoon-shaped cross section and a casing that encloses them. These rotors are designed to rotate in the opposite directions without contacting each other while maintaining a very small clearance between them by a timing gear. The rotors and the casing are constructed in such a manner that the rotors can rotate while maintaining a small clearance between the rotor and the casing.



Fig. 2 Pumping mechanism of mechanical booster pump

With this type of pump, there is no fear of the rotors and casing being worn out because they do not contact each other during rotation. Since no lubricating oil is used in the rotor chamber, stable pumping performance can be obtained even for water vapor and solvent vapor.

2.2 Performance Specifications

Specifications				
Model		PMB-040C	PMB-060C	
Pumping S	peed m³/h		3800	6200
Maximum i	ntake pressure Pa *1.6	3	8.0 ×	< 10 ²
Ultimate Pr	essure Pa *2.6		6.7 × 10 ⁻¹	6.7 × 10 ⁻¹
Backing Pu	Imp		PKS-070 1	PKS-070 2
			Totally-enclosed Fan-cooled Footed Induction Motor	
	Energy efficiency class		IE	3
	Power kW(Number of po	oles)	15(4)	18.5(4)
Motor *3	200V class motor	50Hz	20	00
Rated Voltage V		60Hz	200/220/230	
	400V class motor	50Hz	400	
Rated Voltage V 60Hz		60Hz	400/440/460	
Oil Standard oil Oil requirement L		ULVOIL <mark>R-72</mark>		
		8		
Weight (Without motor, dry) kg		970	1100	
Inlet *4		VG250 equivalency	VG300 equivalency	
Outlet *4		VF150 equivalency	VF200 equivalency	
Packing		Fluorocarbon rubber		
Utility				
Cooling method		Water cooling		
Cooling water volume L/min		10		
	Primary side pressure MPa		0.1 – 0.3	
Cooling	Inlet/outlet differential pressure		0.05	
water	MPa			
Cooling water temperature *5		ıre *5 ℃	5 - 30	

Table. 2 Specifications

Note: This catalog uses the International System of Units. The conversion into the non-International System of Units is as follows: $6.7 \times 10-1$ Pa = 5×10^{-3} Torr

- *1. Continuous operation time from the maximum suction pressure to 400Pa should be within 20minutes.
- *2. Measure with a Pirani gauge (approx. 6.7×10^{-2} Pa for MacLeod vacuum gauge).
- *3. You can select a 200V or a 400V class motor. However it does not apply to different voltage motors and the explosion-proof motors. Confirm the motor's name plate.
- *4. JIS B 2290:1998 Flange for vacuum devices Appendices (for reference) Flange for maintenance
- *5. Please use it in the environment of no be dewy when the temperature of cooling water is low.
- *6. This value changes depending on the performance of the backing pump. The above data is obtained when the pump is used in combination with a standard backing pump.



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Fig. 5 Foundation Drawing Model PMB-040C



Fig. 6 Foundation Drawing Model PMB-060C

2.4 Pump Performance

2.4.1 Ultimate pressure

The ultimate pressure of the mechanical booster pump depends on that of the backing pump. Take special care when using the backing pump other than the standard combination. In the event of an abnormal ultimate pressure, it is also necessary to check the ultimate pressure of the backing pump alone.

In addition, for pumps that exhaust a large amount of moisture or that have been left with the intake and exhaust ports open in the atmosphere for a long period of time, their ultimate pressure may not drop to the specified value immediately after the startup due to moisture adhering inside the pump. In many cases, they recover their normal conditions after the no-load running for a whole day and night under that condition as the adsorbed substances are evaporated again.

2.4.2 Pumping speed

The pumping speed of the mechanical booster pump changes depending on the inlet pressure. Also, the pumping speed of the mechanical booster pump fluctuates depending on the difference of the inlet port/the outlet port pressure of the mechanical booster pump during operating.

An increase of pumping speed of the backing pump allows the inlet port/the outlet port pressure difference to lessen.

As a result, the pumping speed of the area on the atmospheric pressure side becomes larger due to the pressure which the maximum speed of the mechanical booster pump comes out. Reversely, upon the pumping speed of the backing pump being small, the pumping speed of the mechanical booster pump becomes small.

When the mechanical booster pump is used in combination with a backing pump other than the standard one (rotary pump or water sealing pump), it is necessary to examine its pumping performance to see if the required pumping speed and ultimate pressure can be obtained.



Fig. 7 Pumping speed curves

2.4.3 Power Requirements

The power requirement of the mechanical booster pump varies with the intake pressure and the performance of the backing pump.

With the standard backing pump, the motor is overloaded at an intake pressure of more than the maximum intake pressure (Refer to the "Table. 2 Specifications") and the pump generates a large amount of heat, causing motor burn-out and pump seizure. Therefore, do not carry out operation at a pressure higher than the maximum intake pressure.

The performance of the Mechanical booster pump shall largely depend on the Backing pump performance as described above. You should be careful on selecting the type of the Backing pump.

3. Mounting

WARNING	WARNING	 You are requested to install and operate the product in compliance with the laws and regulations relating to the safety, e.g. Fire Defense Law, Electric wiring regulation and so on in the country and region you use the product. Consequently you shall be requested to attend general safety lectures officially effective in the area, such as electrical safety, Cargo handling safety and so on. Note that any person not attended such lectures shall be restricted from handling the product. Operators shall need to attend such kind of training and have special knowledge, skill and title regarding the electricity, machinery, cargo, vacuum and so on.
		Before installation or removal, separate the product from all energy sources (such as electricity and cooling water).

3.1 Installation/Storage Conditions

Install the machine horizontal to a place where there are less dust and humidity. Make a layout taking into consideration of works such as setting, removal, check, cleaning and so on. Refer to "0.5 Acceptance and Storage of The Pump" as for the detail.



Operating the pump on laying it down or putting it reverse would give damage to the pump. Ensure to install the pump horizontal to the ground level as illustrated on the "Fig. 3 to Fig. 6".

3.2 Installation

Refer to the necessary minimum space (Fig.3 \sim Fig.4) in maintenance. If the pump is not frequently removed, surely install the pump at level by the anchor bolts. Refer to the foundation drawing (Fig.5 \sim Fig.6).



Loose installation of the pump might cause free-running of the machine that might cause break of peripheral devices. Be sure to correctly install the pump.

3.3 Inlet port Piping/ Outlet port Piping

- (1) Wash sufficiently inside the Vacuum chamber, pipes, Vacuum valve and so on to connect them to the Pump. If dirty unit were connected, it would cause a trouble such like raise the ultimate pressure or extend the depression time to the specified pressure. Wear a pair of gloves to touch any vacuum section. Do not touch with the bare hand.
- (2) Pay attention not to give damage to the Flange sheet face, Gasket slot or gasket itself.

3.3.1 Inlet port Piping

JIS B 2290:1998 Vacuum technology-Flange dimensions; Attachment book (Reference) Flange dimensions for maintenance

- Use the JIS vacuum flange (VF250) to connect the pipe to the inlet of PMB-040C. Use the JIS vacuum flange (VF300) to connect the pipe to the inlet of PMB-060C.
- (2) Use a pipe with bellows so as not to transfer the pump vibration to the Vacuum chamber.
- (3) Put the Vacuum valve, Vacuum gauge and Leak valve between the Vacuum chamber and the Pump

3.3.2 Outlet port Piping

JIS B 2290:1998 Vacuum technology-Flange dimensions; Attachment book (Reference) Flange dimensions for maintenance

- (1) Use the JIS vacuum flange (VG150) to connect the pipe to the outlet of PMB-040C. Use the JIS vacuum flange (VG200) to connect the pipe to the outlet of PMB-060C.
- (2) Put a pipe having bellows between the backing pump and outlet of the PMB-040C/PMB-060C.
- (3) Do not connect directly the backing pump inlet with the outlet of the PMB-040C/PMB-060C.



Toxic and combustible/combustion-supporting gases other than inert gas cannot be used as they leak from the pump body when evacuated by a vacuum pump.



Combustible/Combustion-supporting gases and materials other than inert gas cannot be used as they ignite/explode in a vacuum pump when evacuated by the vacuum pump.



Corrosive gas other than inert gas cannot be used as pump components may be corroded and damaged when evacuated by a vacuum pump.



If the pipe connected to the outlet had a small diameter or attached foreign substance inside, it might raise the pressure inside the pipe and impair the pump operation. A caution shall be required.



Take a countermeasure to avoid any direct load to the Pump flange such like to choose the pipe with bellows to connect with the inlet and outlet.



away from the Pump unit. Be sure not to take it off unless necessitated so to check it.



- The exhaust ports are provided in two places: the bottom and side parts. Before use, connect either one to the backing pump. Be sure to close the other. A flange and an O-ring to close it are provided at the exhaust port (bottom).
- The flange and the rubber plate provided at the exhaust port (side) are intended for storage and transportation.

3.4 Cooling Water Piping

Install the piping in reference to Figs. 3 and 4. Do not confuse between the cooling water inlet and outlet.

water inlet.

- Be sure to feed cooling water by the amount or more specified in "Table 2: Specifications."
 If the amount of water becomes lower than the specified value especially during the operation at a high suction pressure, the pump temperature may increase and it damages the pump.
 It is recommended to set up a flowmeter for cooling water and provide an interlock that stops the pump when the amount of water becomes lower that the specified value.
 CAUTION
 When the operation stopped in winter, the water piping and the pump have a risk of breaking by freeze-up of the water inside. Open the cooling water outlet during operation stop and storage to discharge
 Output
 Description
 Output
 Description
 Description
 - If you use several pumps, be sure to connect the cooling water pipes parallel. Cooling capacity might come down if connected them serial and cause the failure.

the water inside by blowing in the pneumatic air through the cooling

- ●You should put a filter at the front stage if you are obliged to use the water containing much impurity such like water stain, iron and the like.
- If the source is at a distance from the exhaust port or if the piping has a difference in height (the drainage is lifted to a point higher than the pump), a sufficient flow rate may not be provided. In such a case, keep the sufficient flow rate in such a way as to change the piping layout, make the piping thicker, or increase the supply pressure within the specification range.



CAUTION

- Be sure to put in the Insert if you use any plastic made product such as nylon tube. Such a tube is likely to cause deformation or get rigid as secular distortion and might cause a water leakage.
- •Keep the environment that does not cause dew formation when the cooling water temperature was lower.

The machine is designed not to cause any leakage under restricted condition and demonstrated by the Leak test. However, it still has a risk of leaking under any abnormal condition other than specified, for example abnormal water pressure rise. In such a case, the leakage shall remain unstopped unless the supply from the system stops. You should refrain from installing electrical equipment or wiring beneath the pump and on the floor around the pump.



 It is recommended to install a water leakage sensor on the floor under the pump and incorporate it in the interlock system of the device.
 When a water leakage is detected, immediately close the supply valve for the cooling water.

After closing the valve, attach a "CLOSED" tag to the handle.

Install a flowmeter at the cooling water source for devices etc. with which you can see it is flowing to allow you to check whether or not the cooling water is flowing.



●It is recommended to use water with a low number of impurities (e.g. industrial water; see the table below) as the cooling water for this product. Depending on the water quality, the cooling water system of this product may cause scale, such as calcium carbonate, inside it, reducing the cooling water flow. In addition, it may be corroded from the inner wall by chlorine ions, resulting in cooling water leakage. And if pure water is used, metal may be eluted, resulting in cooling water leakage. Note in advance that in such a case, repair may be borne by you.

Shortage of the cooling water might give damage on the bearing, gear and rod sealing, which results in contact of the rotor and casing and operation stop.

[For reference] The standard quality of water supply in the Japanese industrial water works

-		-						
	Turbidity	pН	Alkalinity	Hardness	Evaporation	Chlorine ion	Iron	Manganese
	Mg/L		CaCO₃	Mg. CaCO₃	residue	CI-	Fe	Mn
				mg/L	mg/L	mg/L	mg/L	mg/L
	20 or less	6.5 - 8.0	75 max.	120 max.	250 max.	80 or less	0.3 or less	0.2 or less

Established by: Japan Industrial Water Association (Industrial water quality standard setting committee)

3.5 Electrical Connection





●Be sure to follow the safety laws and regulations in the country and the region you use this product (e.g. fire laws and electrical wiring regulations) when installing and operating it.





Fig. 8 Recommended circuit diagram

Model	Motor power kW	Voltage	(*1) - Frequency	Rated current A	Starting current A	Molded Case Circuit Breaker A	Thermal relay A	(*2) Power cords mm²
			200V -	58.8	484		58.8	
			50Hz					
		200\/	200V -	55.6	408		55.6	
		class	60Hz			125		30
		motor	220V -	52.0	449	120	52.0	00
		motor	60Hz					
			230V -	50.6	469		50.6	
PMB-040C	15		60Hz					
1 1010-0400	10		400V -	29.4	242		29.4	
			50Hz			- 100		
		400V class motor	400V -	27.8	204		27.8	22
			60Hz					
			440V -	26.0	224		26.0	
			60Hz					
			460V -	25.3	235		25.3	
			60Hz					
			200V -	74.0	668	125	74.0	30
			50Hz					
		200\/	200V -	69.0	524		69.0	
		class	60Hz					
		motor	220V -	65.0	576	120	65.0	50
		motor	60Hz					
			230V -	64.0	603		64.0	
	18 5		60Hz					
1 1010-00000	10.5		400V -	37.0	334		37.0	
			50Hz					
		4001/	400V -	34.5	262		34.5	22
		class	60Hz			100 32.5		
		motor	440V -	32.5	288		32.5	22
		motor	60Hz					
			460V -	32.0	301		32.0	
			60Hz					

Table. 3 Electric capacity of standard motor and selection criteria for protector	
rubici o Elocario oupuolity of standard motor and selocitori onterna for protoctor	

*1: 200V class motor and 400V class motor can be selected.

*2: Reference values based on allowable current value of 2PNCT





Do the Direct-in start connection. The Star delta connection might have a trouble in starting.

3.6 Lubrication

3.6.1 Lubrication to the lubrication chamber.

Supply the lubrication oil by specified volume through the oiling port on the Gear cover and the pulley cover (Refer to Fig.3, Fig.4).

It takes approximately one minute that the lubrication oil fully spreads out. Check the oil volume by the Oil level gauge after the lubrication got stabled and add the oil if it was under the specified level as far as the oil gets stabled on the upper limit level.

	Place	In oiling	During operating
Cover oil gauge on the gear side		Put the oil up to the upper limit level.	Oil level shall be available between level lines of 2 pieces of the oil gauge.
Cover oil gauge on the pulley side		Put the oil up to the upper limit level.	Oil level shall be available in the range of up and down 5mm centering on the red round mark of the oil gauge.

Table. 4 Oil level gauge



Perform lubrication from the filler opening located at the respective upper part of the cover on the gear side and on the pulley side. The gear side and the pulley side do not connect to each other.

•Be sure to supply oil separately.

Put the oil up to the respective upper limit of the oil level gauges located at two locations.



Read "1. 2 Chemical Material Safety Data Sheet" previously before starting lubrication.

Please obtain the latest version of Material Safety Data Sheet (SDS) from our Sales Department.

Weal protective gears such as rubber gloves, protective goggle and so on.

Should the oil touched to your hand are entered in your eye, immediately follow the emergency treatment described on the SDS.



Ensure to use the vacuum pump oil designated by ULVAC. Operation using oil other than designated shall be out of our scope of guarantee as it might impair the pump performance and shorten the life cycle.



 To lubricate, be sure to stop running the pump and return the Mechanical booster inside to the atmospheric pressure.
 Chamber containing the oil becomes vacuum during operation.
 Taking off the plug during operation would cause a large leak and give damage to the Pump unit.



- Running the unit with the lubrication filled over the upper limit on the room temperature (around 20°C) might cause the oil flowing in the casing. Discharge the oil if over lubricated so as to match the upper level.
- ●Be sure to check the oil level under operation stop on the room temperature (around 20°C.)

Oil level might get higher during operation due to the oil temperature rise and oil rowing, but it makes no problem.



Note to purge the oil to transfer the pump. If forced to transfer remaining the oil, be sure to keep the pump horizontal. Do not tilt the pump 10 degree or more while you charge the oil. The oil might run into the casing.



3.6.2 Lubrication to the mechanical seal

There is a mechanical seal inside the cover on the pulley side. If you supply lubricant to the cover on the pulley side, the mechanical seal is also lubricated.

In order to prevent the oil shortage of the mechanical seal, when operating the pump after stopping the pump for more than 3 months or after having relocated the pump, be sure to lubricate to the mechanical seal.

Lubricate 500ml or so by providing oil again after once discharging the inside oil.



Fig. 9 Lubrication to mechanical seal



Be sure to pour oil.

If the oil level becomes lower than the lower limit during the operation, the bearings, gears, shaft seals, etc. are damaged, causing leakage, abnormal noise, overloaded motors, or a shutdown.

3.7 Oil Pot

The mechanical seals structurally cause a slight oil leakage under normal conditions. Approx. one month after the startup is the running-in period of the sealing surfaces of the mechanical seals and the amount of leakage may increase temporarily.

In addition, during the running-in period the mechanical seals may cause a metallic noise of high frequency.

Receiving spilt oil in the oil pot prevents environmental pollution. Connect between the oil pot and the pump body using the attached nylon tube and secure it using cable ties etc. so that the oil pot is positioned below the body.

If the amount of oil leakage from the mechanical seals reaches 0.3 ml/hour or more after the use for a certain period of time, the mechanical seals may deteriorate. In such a case, the mechanical seals need to be replaced. Contact the nearest service center.



Fig. 10 Oil pot

3.8 Check and Replace V-belt



•When performing the work of the inspection/replacement of the belt, perform the work after turning off the power switch without fail.

The measures such as lockout/tag out should be executed not so as to turn the power switch by mistakes during working.

The belt to connect the main body of pump and a motor to is made by rubber. When the belt tension continues driving in an insufficient state...The belt is shorten the life-time by the wear. The motor is shorten the life time by overheat. The pump is not start or not perform pumping speed.

Initial wear

Early operation, the belt tension decreases by the extension and fall in the pulley groove. Re-tension the belt 24 hours later after initial start. And 1week later, re-tension the belt.



F1

Maintenance the belt

Please check the belt tension at once in a half year. If necessary, please re-tension the belt. In addition, please change the belt, if there is an abnormality in it.

Measure the tension of the belt

- 1) Shut down the pump, and be sure to turn OFF the power supply.
- 2) Remove the belt cover.
- 3) Set the Ring for Deflection to "Table 5. Reference value of deflection volume".
- 4) Set the Ring for Load to 0N.
- 5) Push the center of the belt, between the motor pulley and the pump pulley, down deflection with tension meter.
- 6) Read the load after pushing. It is normal that the load is "Table 5. Range of deflection load".
- 7) If the tension of belt is right, attach the belt cover.



Fig. 11 Belt tension measurement

			When tightening the new belt	When re-tightening	
Model	Operating frequency	Reference value of flexible volume mm	Range of flexible load N/1 pce	Range of deflection load N/1 pce	
	50Hz	16.2			
	60Hz	10.5	57.8~63.7		
	50Hz	16.0			
	60Hz 10.9	10.9			

Replace and Re-tension the belt





Regulate tension of the belt once a month after starting the operation.

4. Operation

4.1 Precautions for Operation

WARNING	 Never run the vacuum pump on blocking up the exhaust outlet, putting any device that hampers the gas passage. There is a risk that pressure in the pump rises, and the main body of the pump and the oil level gauge might explode, or the motor become an overload. This product is not made as the withstand pressure structure. Ensured pressure value of the pump shall be 0.03MPaG (0.3kgf/cm²G) (Gauge pressure). If any valve was put to a pipe after the Exhaust outlet, check and ensure that it is open.
	 Be sure to flow the coolant water during operation, Required coolant volume shall be; Cooling water level : 10 L / min or more Cooling water temperature : 5°C ~ 30°C
CAUTION	Shortage of the cooling water might give damage on the bearing, gear and rod sealing, which results in contact of the rotor and casing and operation stop.
	Be sure to pour oil
	If the oil level becomes lower than the lower limit during the operation, the bearings, gears, shaft seals, etc. are damaged, causing leakage, abnormal noise, overloaded motors, or a shutdown.
	●When newly filling the mechanical booster pump with lubrication oil or leaving the mechanical booster pump for a long time with lubrication oil remaining inside, be sure to perform deaeration of lubrication oil before operation.
	If you operate this product without deaeration of the lubrication oil, a large amount of bubbles may occur and enter the casing.
	During a trial run, the mechanical seals may cause a metallic noise of high frequency. This is caused by a shortage of oil on the mechanical seals.
	In this case, stop the pump and, according to "3.6.2 Lubrication to mechanical seal," pour oil. Then, a few minutes later, start it again.
	 Depending on the use conditions, the pump oil may deteriorate in a extremely short period of time. It is recommended to perform the first replacement of the pump oil within ten days and, after checking the degree of contamination of oil, decide the oil replacement cycle.



•When using the automatic vacuum breaker (Time lag electromagnetic leak valve which introduces the air in the pump by the valve opening in $3 \sim 5$ sec. after stopping the motor for the pump drive), do connection so that it gangs with the motor.

4.2 Startup

4.2.1 Test run

Follow the procedure (1) - (5) below to start operation of the Pump unit.

(1) Check the piping.

Check and ensure that the piping and cable connection is completed (Refer to the "3.3 Inlet port Piping/ Outlet port Piping Air " and the "3.5 Electrical Connection").

- (2) Check the "3.7 How to tighten and how to remove the belt".
- (3) Check the lubrication oil level (Refer to "3.6 Lubrication").
- (4) Check the Cooling water (Refer to "3.4 Water Piping").Ensure that the Cooling water is flowing.Check and ensure also that there is no cooling water leakage.
- (5) Check the lubrication oil discharge operation and direction of rotation.
 - a. Close the air intake either by closing the valve on the inlet side of the mechanical booster pump or by attaching a blind flange to the air intake.
 - b. Run the backing pump to exhaust inside the Mechanical booster pump. This time, confirm that the pressure of the inlet or outlet of the booster pump comes down around the ultimate pressure of the backing pump (1.3-13.0Pa for the standard backing pump) and keep exhausting three minutes or more only by the backing pump under that state. Exhausting three minutes shall delete the air component in the lubrication oil in the Mechanical booster pump.

If the pressure does not decrease, leakage of piping, failure of backing pump, etc. are conceivable, so please check.

- c. Flow cooling water, and operate it for 3 seconds or so while seeing the belt. If the belt moves in the arrow direction which is attached on the belt cover, it is normal rotation. (Fig. 1 Warning Label)
 If it rotated reverse, check the motor wire connection. The Motor is a three-phase induction motor that would rotate reverse if two of three input wires were connected reverse.
- d. After checked the direction of rotation, run the Mechanical booster pump three minutes or more to conduct the lubrication deaeration and lubrication circulation inside the Pump unit.

4.2.2 Exhaust start

- (1) Flow the Cooling water.
- (2) Close the main value of the Mechanical booster pump and start running the backing pump to exhaust inside pipes.
- (3) Open the mechanical pump on the suction side of the mechanical booster pump, and exhaust inside the vacuum vessel.
- (4) Start the operation upon the vacuum chamber was exhausted to the pressure lower than the maximum inlet pressure of the Mechanical booster pump.

4.3 Exhaust stop/Operation Stop





•Be sure to close the vacuum valve and stop the Pump operation to open the Leak valve. Failure to follow this operation might cause the oil invasion in the casing from the lubrication chamber or otherwise give damage to the Pump. Further the oil might flow back to the Vacuum tank if used the oil rotation pump as the Supplementary pump.

If failed in closing the Vacuum valve, the vacuum might leak from the Exhaust system through the Pump.



If there are valves on the side of the air intake or exhaust ports of the mechanical booster pump, you can close these valves to keep the inside of the mechanical booster pump in a vacuum.



●Discharge the water in the Pump unit and Cooling water piping in case where the environment temperature comes down below 5°C under the state that the operation is stopped (Supply the compressed air of 0.3MPaG (gauge pressure) through the cooling water inlet without closing the outlet.).

Residual water, if any, might freeze up and cause crack of the pump unit and/or Cooling water pipe.



•When turning off the power once and then restarting the pump, check that the rotor stops and then turn on the power supply.

- (1) Close the main valve (inlet side)of the Mechanical booster pump and stop it.
- (2) The Mechanical booster pump shall keep running a while by the Rotor inertia. Check and ensure that the rotation stopped through the belt to stop the backing pump.
- (3) Open the Suction leak valve upon stopped the backing pump to make atmospheric pressure inside the Mechanical booster pump and backing pump.
- (4) Wait until the Pump cools down as far as you can touch by hand to stop flowing the Cooling water.

5. Maintenance and Check

5.1 Maintenance

Conduct the maintenance regularly in appropriate check interval. Maintenance period shall differ depending on the operation purpose. Set the interval once a day at first. Once a week from next week if you had no problem, then conduct once a month for example. We recommend you, however, to conduct visual checks and check on the utility every day to see the system condition.

You should check following points at least once per three days while you continue operation. In the high load operating (Includes the operation at 400Pa~maximum inlet pressure), raise the frequency of confirmation.

- (1) Whether the amount of oil in the vacuum pump within the appropriate range.
- (2) Whether the Vacuum pump oil is discolored or not.
- (3) Whether there is no oil leak from the pump.
- (4) Whether there is no oil leak from the Mechanical seal.
- (5) Whether the cooling water flows by specified volume.
- (6) Whether there is no water leak.
- (7) Whether there is no foreign noise.
- (8) Whether there is anything strange in the Motor current value.

5.2 Regular Check

Although you have to consider checkpoints depending on the use of the Pump, you should check the following regularly; it is helpful to avoid trouble and extend the pump life cycle.



- Check before operation that all dangerous energy supplies are shut off before operation.
- Never turn on the power supply during the check. Otherwise you may get injured.

The pump temperature is high immediately after it stops. Wait for a while before checking the level until the pump temperature decreases. Otherwise you may get burned.

5.2.1 Pump oil level check

Set the oil level so that it is within the appropriate range of the oil level gauge during the operation.

5.2.2 Pump oil check

The vacuum pump oil is not only contaminated by suction gas but also gradually deteriorated by a temperature rise during the pump operation.

Check the degree of contamination and the viscosity of the oil, and periodically replace the oil. If any substance of low boiling point thing (such as water and organic solvents) mixes with the pump oil or any slime foreign substance (sludge) is accumulated at the bottom of the pump case, the ultimate pressure is not recovered by one replacement but needs several times of oil replacement.

In addition, if the product is operated with a large amount of moisture mixed in the pump oil, the ultimate pressure becomes high first and then the movement of the mechanical friction parts of the pump becomes worse.



Depending on the use conditions, the pump oil may deteriorate in a extremely short period of time.

It is recommended to perform the first replacement of the pump oil within ten days and, after checking the degree of contamination of oil, decide the oil replacement cycle.

5.2.3 Replacement of pump oil



•This pump cannot be used with harmful gas or combustible gas.

●If this product is accidentally used to exhaust harmful gas or combustible gas, the pump body and, of course, the pump oil also become harmful. Take due care.





Ensure to use the vacuum pump oil designated by ULVAC. Operation using oil other than designated shall be out of our scope of guarantee as it might impair the pump performance and shorten the life cycle.





Depending on the use conditions, the pump oil may deteriorate in a extremely short period of time.

It is recommended to perform the first replacement of the pump oil within ten days and, after checking the degree of contamination of oil, decide the oil replacement cycle.

Proceed as follows (Refer to "3.6 Lubrication").

- Shut down the pump and open the drain port to drain the oil in the Lubrication chamber. Upon completion of draining the oil, close the drain port again and run the pump under no load for approx. 5 seconds to drain the oil adhered to the pump parts.
- (2) Close the drain port and fill fresh oil through the oil filling port.Pour oil until the oil level comes the upper line of the oil level gauge.
- (3) If the oil is severely contaminated, fill fresh oil and run the pump for several minutes under no load to clean the pump interior. Repeat this operation several times depending on the degree of oil contamination.
- (4) After changing the oil with fresh oil, run the pump to warm it up and then check the ultimate pressure.
- (5) If the specified ultimate pressure cannot be attained by oil change, sludge or other deposit may have collected on the bottom of the pump case. In that event, overhaul is required. Contact your local ULVAC organization or representative.

5.2.4 Oil leakage check

In the event of an oil leakage from the shaft-seal part or the pump body, it need to be repaired. The O-rings used in this machine are described at the end of this document. Contact the nearest service center.

5.2.5 Checking mechanical seal for oil leakage

The mechanical seals structurally cause a slight oil leakage under normal conditions. Approx. one month after the startup is the running-in period of the sealing surfaces of the mechanical seals and the amount of leakage may increase temporarily.

If the amount of oil leakage from the mechanical seals reaches 0.3 ml/hour or more after the use for a certain period of time, the mechanical seals may deteriorate. In such a case, the mechanical seals need to be replaced. Contact the nearest service center.

5.2.6 Checking cooling water

Check whether or not a specified amount of cooling water flows. Check the cooling water for leakage.

5.2.7 Checking wire net at air intake

The air intake may be clogged by dust etc. included in gas to be sucked from the vacuum chamber, degrading the pump performance. If the wire net is contaminated, clean it.

In addition, take special care in early stages of starting the device as weld scale in the piping may fall.

5.2.8 Checking abnormal noise/vibration

Checking the areas around the pump

- (1) Is there any looseness of the bolts and nuts used to fix the pump?
- (2) Is there any looseness in the fixed pipes connected to the air intake/exhaust ports?
- (3) Does any leakage occur from the piping or the valves?

Checking the pump

See "5.5: Trouble check list."

If the trouble persists even after checking the content of the list, contact the nearest service center.

5.2.9 Checking inside of casing

Stop the mechanical booster pump once every three months, remove the piping of the air intake, and check the inside. Check that there is no deposit inside the casing (the rotor and casing surfaces). Especially when organic gas etc. is exhausted, substances in the gas condense and attached to the rotor surface, reducing its clearance and then making the rotation impossible.

5.3 Checkup after Storage for a Long Period

Long term storage of the Vacuum pump without operation might possibly cause trouble in operation caused by rust.

If you kept the Pump long time without operating it, ask a closest Service Center for the check.

5.4 Overhaul

The check items are as described above but, if the pump is extremely contaminated or its performance becomes extremely worse depending on the use conditions, it is recommended to periodically overhaul the pump.

An overhaul is necessary to maintain the performance (including safety) and also continue production on schedule.

Please contact the Service Center close to you listed at the end of the document as for the overhaul.

Do not forget to fill and submit the Contamination certificate enclosed in the end of the document.



In the case where details on hazardous substances in use are not disclosed or where any substance which is difficult to detoxify is exhausted, we may refuse to do maintenance or other requests on our site.

	●You are requested to conduct the overhaul once a year. If there found remarkable Pump contamination or performance deterioration due to the operation condition, you are recommended to conduct the overhaul earlier than one year period.
CAUTION	You shall be in need of replacing such parts as listed on the "9. Main Displacement parts" at minimum. Do not forget to fill and submit the Contamination certificate

5.5 Trouble shooting

Trouble		Causes	Processing Method	Reference
	1	Abnormal phase voltage.	Are all three phases of power supply normal? Check the power supply.	3.5
	2	Motor connection is wrong.	Check the connection.	3.5
	3	Safety circuit such as the NFB and Electromagnetic breaker are not correctly set.	Make the Safety circuit conform to the Motor specification.	3.5
	4	Are the no-fuse breaker and electromagnetic switch normal? Failure of safety circuit.	Check the no-fuse breaker and electromagnetic switch.	3.5
	5	Are the no-fuse breaker and electromagnetic switch normal? Trip of safety circuit.	Remove the cause by which the safety circuit has tripped, and then press the reset button. Check whether or not the set value of the safety circuit is appropriate.	3.5
	6	The motor pulley and the pump pulley are not rotating.	Check whether electricity is coming.	3.5
	7	Run only by the Motor. Is the Rotation and/or current value correct?	Check motor Replace the Motor	3.5
The pump does not	8	Lubricating oil is below the level line.	Check for oil flow into the rotor casing. Replenish oil.	3.6
rotate	9	Oil viscosity got higher. Lubricant oil discolored.	Change oil.	3.6
	10	The belt is loosening.	Re-tighten the belt.	3.8
	11	Is the rotor rotating smoothly?	Disassemble and repair the pump. (Cleaning and clearance adjustment)	5.2 5.4
	12	Foreign substance entered in the pump, and the surface of the rotor was scratched.	Conduct the overhaul (replacement of the Casing, Rotor, Cover and so on.)	5.2 5.4
	13	Reactive agent accumulated inside the Pump while the Pump was stopped after having exhausted the reactive gas.	Conduct the overhaul (cleaning inside the Pump, removal of reactive agent and so on.)	5.2 5.4
	14	The pulley key is loosening.	Correct the loosening.	5.2 5.4
	15	Is operating pressure appropriate? Pressure is above the maximum pumping pressure.	Check pressure on intake and exhaust sides. Check the backing pump.	2.2 2.4
	16	Is the rotor rotation resisted? Rotors do not rotate by inertia.	Overhaul	5.2 5.4

Table. 6 Troubleshooting

Trouble		Causes	Processing Method	Reference
	1	There is a leak in the pipe connecting with the Pump.	Use a Leak detector or the like to find out the leak position and stop it.	3.3
	2	Pressure measurement method is wrong.	Measure correctly the pressure.	_
	3	Vacuum gauge is not appropriate.	Use the Vacuum gauge that matches the measurement pressure range and correctly calibrated one to measure the pressure.	-
	4	Leak valve is open	Close the valve.	3.3
	5	Motor rotation direction is reverse.	Do the connection again to correct the rotation direction.	3.5
	6	The application frequency of the motor pulley does not accord with power supply frequency.	Replace with a motor pulley of appropriate frequency.	0.5.1
	7	Metal mesh at the Suction inlet is clogged.	Remove the pipe above the inlet and wash the mesh.	5.2
	8	Pump exhaust capacity is smaller compared to the Vacuum chamber capacity.	Select another Pump type.	2.2
The pressure	9	Pipe connected to the Suction inlet is thin or connection distance is long.	Connect a pipe wider than inlet diameter and shorten the connection distance between the Vacuum chamber.	-
decline, and the pumping speed is	10	Casing inside and/or the Rotor surface is dirty / wet. There are attached substances, or wet.	Overhaul(Cleaning, clearance adjustment)	5.4
SIOW.	11	Mechanical seal Air leak	Replace the Mechanical seal.	5.4
	12	Is the ultimate pressure of backing pump normal? Pressure is above the prescribed value.	Change the backing pump oil.	2.2
	13	Coolant is not circulating.	Confirm that coolant is flowing.	3.4
	14	 Oil is deteriorating, smearing. a. Water system is being exhausted. b. Dust is being suctioned. c. Solvent vapor is being suctioned. d. Foreign object enters in. 	 Replace with new oil. Overhaul (Inside cleaning) a. Put the trap into the front stage of the pump. b. Put filters/traps into the front stage of the pump. c. Put the trap by use application into the front stage of the pump. d. Put filters into the front stage of the pump. 	3.6
	15	New oil pump was just entered.	Perform no-load operation for a while.	3.6
	16	Not using the ULVAC genuine oil.	Conduct the overhaul of the Pump and replace the oil with the ULVAC oil.	3.6

Trouble	Causes		Processing Method	Reference
	1	Motor rotation direction is reverse.	Do the connection again to correct the rotation direction.	3.5
	2	Cooling water does not flow. (Specified volume is not flowing.)	Keep flowing the cooling water by the specified volume.	3.4
	3	Oil is not filled. Oil is under the lower limit of the Oil level gauge.	Overhaul (Replacement of the pump part)	3.6
	4	Belt cover bolts is loose.	Tighten the bolts.	2.3 3.2
	5	The anchor bolt is loosening.	Ensure that the pump be installed at level as much as possible.	2.3 3.2
Unusual	6	The belt is loosening.	Re-tighten the belt.	3.8
make.	7	The pulley is loosening.	Re-tighten the pulley.	Ι
	8	Any sound (clattering) synchronized with rotating speed? Clattering is heard.	Disassemble and repair the pump.(Re-adjust timing.)	5.4
	9	Is rasping noise always heard? Roaring noise is heard.	Disassemble and repair the pump. Replace bearing and gear.	5.4
	10	Metal noise of high frequency	Stop the Pump, lubricate the Mechanical seal.	3.6.2
	11	Shortly after the startup, a mechanical (rasping) noise and vibration occur.	These are temporary phenomena that stop after the pump warms up and reaches its steady state. So it is not a fault.	_
The	1	The pump continuously runs at a high suction pressure.	The continuous operating time from the maximum inlet pressure to 400Pa should be within 20 minutes. Check the backing pump.	2.2
on the pump	2	Capacity of the backing pump is short.	Replacement of the backing pump.	2.2
abnormally high.	3	The oil is not supplied by the specified volume. (Less oil volume would lower the cooling effect of the Pump.)	Supply the oil by the specified volume.	3.6

Trouble	Causes		Processing Method	Reference		
The temperature on the pump surface is abnormally high.	4	Suction gas is hot.	Install a cooling device such as the Gas cooler on the suction side.	_		
	5	Oil is stained. Replace to new oil.		3.6		
	6	Cooling water does not flow. (Specified volume is not flowing.)Keep flowing the cooling water by the specified volume.		3.4		
	7	Area around the Pump is enclosed. Make the ventilation available.		2.3		
	8	Is rotor rotation resisted? Rotors do not rotate by inertia.	Overhaul.	5.4		
	1	Deterioration of the O-ring of the cover.	Overhaul.	5.4		
Oil looks to	2	Oil inlet is loose. Tighten again the Oil inlet.		_		
Oil leaks to the outside of the pump	3	Oil leak from the Mechanical seal.	0.3 ml/hr or more: Replacement of mechanical seal	al 3.7		
			0.3 ml/hr or less: There is no problem. Continue to use.	5.7		
Water leak outside the Pump.	1	Coolant joints and so on got loose, or not tighten.	Check and repair Joints and so on.	3.4		
Rotation is	1	The motor pulley and the pump pulley are not rotating.	Confirm whether electricity is coming.	3.5		
uneven, and so it was	2	Belt is loosening.	loosening. Re-tighten the belt.			
going not to rotate gradually.	3	The pulley key is loosening.	Correct the loosening.	_		
	4	Oil is dirty.	Replace to new oil.	3.6		
The motor current value is abnormal.	1	Foreign substance entered inside the Pump impaired the Motor rotation.	Overhaul, removal of foreign substance inside the Pump.	5.4		
	2	Isn't the use pressure is the maximum inlet pressure or more?	Pressure confirmation for the inlet side and the exhaust side Inspection for the backing pump	2.2 2.4		
Initially, performance was being satisfied, but the vacuum degree became decreased		Foreign substance entered in the pump, and the surface of the rotor was scratched.	Conduct the overhaul (replacement of the Casing, Rotor, Cover and so on.)	5.2 5.4		

6. Removal / Transport

6.1 Operation Procedure

	This pump cannot be used with harmful gas or combustible gas. However, if it is accidentally used to exhaust harmful gas, the pump body and, of course, the pump oil also become harmful. Take due care.
	Before removing the pump used to exhaust particular gas, sufficiently replace it with nitrogen gas. In addition, any persons other than qualified particular gas handlers are not allowed to remove the pump.
DANGER	Attach a label indicating the name of the gas in use to an easy to see position on the pump.
	You have a risk of giving damage to your back as the load larger than safety standard shall be required to transfer the product.
	PMB-040C:970kg(Without Motor) PMB-060C:1100kg(Without Motor)
	Be sure to use the loading machinery (such as mobile crane) to lift up the Pump or load it on the pallet and fix it with Jack and run the Pallet truck for its transfer.
WARNING	Never try to enter beneath the Pump unit when lifted it up. Use the accessory eyebolt to load/unload the unit.
	Do not put the folk of the Fork lift or the like in the Pump bottom (exhaust outlet) to lift it.
	●Note to purge the oil to transfer the pump. If forced to transfer remaining the oil, be sure to keep the pump horizontal. Do not tilt the pump 10 degree or more while you charge the oil. The oil might run into the casing.

- (1) Stop the pump, and set the inside of the pump to the atmospheric pressure.
- (2) Shut the electricity supply and remove the cable connection.
- (3) Remove the Cooling water piping.
- (4) Discharge the lubrication oil from the cover of Gear side and the Pulley side.
- (5) Remove the Suction/exhaust piping and put Blind flanges to the Pump inlet and outlet to seal them up.

7. Disposal

Make sure to keep in compliance with the laws and regulations established by the local governments to dispose the Vacuum pump. You should ask the dedicated disposal agency for the disposal particularly if the Pump has exhausted any toxic gas.

Note that you are requested to bear the cost and charges relating to the disposal.



- You should ask a special disposal agency for the disposal particularly if the Pump has exhausted any toxic gas hazardous to the human body. The Pump oil as well as the Pump unit gets hazardous.
- Dispose of the vacuum pump oil in accordance with the "Precautions for disposal" column in the chemical material safety data sheet.
 For the chemical material safety data sheet, contact our sales department for the latest version.

8. Warranty Clauses

This product was shipped after rigid company inspection. However, in case any failure occurs under ULVAC's responsibility, such as defect in manufacturing and damage during transportation, Buyer shall inform ULVAC, Inc. or the local ULVAC representatives. ULVAC will repair or exchange it at free of charge.

8.1 Warrantable Items

(1) MECHANICAL BOOSTER PUMP PMB-040C/060C

8.2 Duration of Guarantee

- (1) Domestic business in Japan: one year after shipping date from ULVAC.
- (2) Direct export transaction: one year after date of B/L

8.3 Warrantee Scope

- (1) For domestic transaction:
 - Products damaged at the time of delivery due to transportation.
 - Products that do not satisfy the basic specifications even under normal conditions, such as the operating temperature range and the power supply in use.
- (2) Direct export transaction:
 - Products damaged at the time of delivery due to transportation
 - However, for direct export transactions, the warranty coverage of the trade terms and conditions specified at the time of individual trades (such as the INCOTERMS) shall be followed.
 - Products that do not satisfy the basic specifications even under normal conditions, such as the operating temperature range and the power supply in use.

8.4 Response Procedure

(1) For domestic transaction:

We send you a substitute or repair the product you send back to us or the nearest ULVAC TECHNO's office. If you need support on site, consult the nearest sales office or agency separately.

(2) Direct export transaction:

We send you a substitute or repair the product you send back to us or the nearest service center. The return shipping cost shall be borne by you.

8.5 Disclaimer

- (1) Failure occurred after expiration of warranty period
- (2) Failure caused by force majeure, such as fire, storm and flood damage, earthquake, lightning strike, war etc.
- (3) Failure occurred due to carelessness handling or faulty usage.
- (4) Products remodeled, disassembled or repaired without ULVAC's acceptance
- (5) Failure occurred under abnormal environment, such as intense electromagnetic field, radiation, high-temperature, high-humidity, flammable gases, corrosive gases, dust etc.
- (6) Any secondary loss due to trouble with the product.
- (7) Any secondary loss you suffer due to any complaint about violation of patents from a third party to us.
- (8) The reason of the failure deemed below the specified usage condition by ULVAC technical staff.
- (9) Consumable parts (refer to "9. Main Displacement Parts")

8.6 Others

- (1) In case, special agreement or memorandum for specifications is made individually.
- (2) Buyer shall inform ULVAC when this product is exported out of Japan. In the meantime, Buyer shall take necessary procedures according to Foreign Exchange and Foreign Trade Law.
- (3) As for the question and consultation, Buyer shall check the model and serial number and ask the local representative or ULVAC, Inc.
 - http://www.ulvac.co.jp/eng/support/index.html
- (4) The contents of this document is subject to change without notice in future.

9. Main Displacement Parts

Part name		Location	PMB-040C	PMB-060C	Material
Bearing (*1)		Pulley side	2	2	SUJ2
Bearing ^(*1)		Gear side	2	2	SUJ2
Spacer		Bearing case	1set	1set	SUS
Mechanical seal		Mechanical seal	1	1	-
Lip seal		Shaft	4	4	PTFE
Shaft sleeve		Shaft	4	4	S45C
O-ring (*2)	G175	Bearing case	4	4	Fluor rubber
O-ring (*2)	G110	Mechanical seal	1	1	Fluor rubber
O-ring	Gs465	Side cover	2	2	Fluor rubber
O-ring (*2)	G85	Shaft	8	8	Fluor rubber
O-ring ^(*2)	P22.4	Filler port, drain port	4	4	Fluor rubber
O-ring (*2)	G90	Oil level gauge	2	2	Fluor rubber
O-ring ^(*2)	V275	Inlet port	1	_	Fluor rubber
O-ring ^(*2)	V325	Inlet port	_	1	Fluor rubber
Oil level gauge (with gasket)		Cover for pulley side	2	2	Glass

Table. 7 Main displacement parts list

*1: The model depends on the production timing. Confirm the serial number (e.g. 1-40001/1-60001) and contact the nearest sales office or agency.

*2:JIS standard

APPENDIX 1 TECHNICAL NOTE

The following is a short note of the knowledge required in using a mechanical booster pump.

APPENDIX 1.1 Designing Pumping System

The mechanical booster pump cannot be started at the atmospheric pressure and must always be used in combination with a backing pump (Dry pump/Oil rotary pump). Therefore, the vacuum chamber and the piping must be rough-pumped by the methods shown in the below figure and the mechanical booster pump must be started after the pressure has lowered to its operating range. The rough-pumping methods include those shown by (1) and (2) in Fig.12.

The method (1) carries out rough-pumping through the mechanical booster pump. This method is used when the vacuum chamber is small in size, that is, when a long time can be spent for rough-pumping. Since the mechanical booster pump does not operate when rough-pumping is under way, the gas to be exhausted is discharged through the clearances between the rotors in the mechanical booster pump. This increases the pumping resistance (decreases conductance) and a long rough-pumping time is required.

In the method (2), a rough-pumping path is provided in the mechanical booster pump. This method is used when the vacuum chamber is large in size, that is, when it is desired to shorten the rough-pumping time.

Rough-pumping is carried out with the main valve and the roughing valve opened and, when the specified pressure is attained, the mechanical booster pump is actuated and the roughing valve is closed for high vacuum pumping.



Fig. 12 Evacuation by mechanical booster pump (example)

APPENDIX 1.2 Automatic Operation

The mechanical booster pump PMB-040C, PMB-060C has a certain operating pressure range. When starting it, therefore, it is necessary to monitor the vacuum gauge.

In automatic operation, it is necessary to install a vacuum switch for pressure detection. When the pressure on the intake side becomes lower than the maximum intake pressure, the vacuum switch is actuated to start the mechanical booster pump. In the method (2), it can be interlocked with the vacuum switch by making the roughing valve a compressed air driven type.

The vacuum switch is available in two types: mechanical and electrical. It is installed on the vacuum chamber or near the intake port of the mechanical booster pump.



When using the vacuum pump other than the standard backing pump as the backing pump, since the maximum intake pressure becomes different from the described value, be careful for it.



•When the difference is not available in between the pressure in the vacuum vessel and the pressure of inlet port of the mechanical booster pump, it is okayed to mount the vacuum switch on the vacuum vessel.



Form: A00315268-02-00

ULVAC Components / Certificate of Decontamination

This is a certificate of decontamination for repair and inspection request of ULVAC Components. All material must be certified as decontaminated and this certificate must be submitted to your closest local ULVAC service center or sales office prior to shipment.

Please consult with your closest local ULVAC service center or sales office if our components are used with toxic gases or contaminated with reactive products or substances produced by reaction.

Product model: Model: Serial No.: Application: Remarks:

Contaminant (Check an applicable box.)

I guarantee that above returned item(s) is not contaminated with harmful substances.

Above returned item(s) is contaminated with the following harmful substances.

	Name of contaminant (molecular formula)	Characteristics
1		
2		
3		
4		
5		

To: ULVAC

Attn:

	Date:	/	/	(YYYY/MM/DD)
Your company				
Division				
Contact				
Phone				
Fax				
E-mail				

Please pack returned item(s) carefully before shipment. Any accident occurred during transportation to us and during disassembly caused by contaminant is under your responsibility. It is also to be understood that ULVAC may decline to repair returned item(s) depending on the type of contaminant and degree of contamination, and return it to you.

To be filled in by ULVAC Request for SDS: Yes/No	Received by	
ULVAC job No.		

