
INSTRUCTION MANUAL

OIL SEALED ROTARY VACUUM PUMP

PKS-016

PKS-030

PKS-070B

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 this 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 this product in safe and effective way. Please read this manual beforehand to correctly use the Pump.

You are requested to install and operate this 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 this 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 this 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 this product might not be ensured if any of the devices put together did not conform to same regulations or this product itself was modified. ULVAC shall be not liable to guarantee performance and safety in such cases above. Any modification of this 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 this product before installing or removing this 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 this 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 this 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.

Please do not hesitate to contact our sales office or agency closest to you or the Components Division if you had any question or unclear on the use.



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 this product to make clear items to observe. Descriptions attached to the symbol are classified as illustrated below;

0.2 Meanings of Safety Symbol Marks



DANGER

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



WARNING

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



CAUTION

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

[IMPORTANT] description shall be given where there is particular information to notice for the operation or maintenance work of this 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 this product.

Use of this product and this Instruction Manual.



DANGER

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 this product.



DANGER

Use of the toxic, combustible or combustion susceptible gas other than inactive gas is not allowed as there is a risk of leakage of the gas from the Pump unit if it was exhausted by the vacuum pump.



DANGER

Use of the toxic, combustible or combustion susceptible gas and substance other than inactive gas is not allowed as there is a risk of causing fire or explosion inside the Pump unit if it was exhausted by the vacuum pump.



DANGER

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.



WARNING

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

**WARNING**

You are kindly requested to acknowledge that specifications and/or price of this 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 Instruction Manual cover and issue the revised version.

If you need the latest manual, please feel free to contact our Components Division.

**WARNING**

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

**WARNING**

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.

Please feel free to contact our sales office or agency closest to you or our Components Division.

Installation and storage



WARNING

- 1) 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.
- 2) Give the instruction them further to use the unloading machinery such as crane to take out this 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.
- 3) Only the technically entitled person should be in charge of conducting the unloading operation and operating the unloading machinery.
- 4) 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



WARNING

You have a risk of giving damage to your back as the load larger than safety standard shall be required to transfer this product.
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 and run the Pallet truck for its transfer.

Countermeasure to the earthquake



WARNING

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 and electric cables so that they absorber vibrations to prevent them from breaking and/or dismantling.

Inlet port piping <Mounting>**WARNING**

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

Outer port piping <Mounting>**WARNING**

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

Power supply wiring <Mounting>**WARNING**

- 1) Check and ensure that any of hazardous energy is blocked before starting the operation.
Entitled staff should conduct the wiring operation.
Erroneous wiring work might cause a fire.
- 2) 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 this product.
- 3) Ensure to have a correct grounding.
You have a risk of getting electrical shock in case of failure or electric leakage.
- 4) You are recommended further to install a dedicated earth leakage breaker.
- 5) It is imperative to put the Overload protection device.
Otherwise it would cause the motor burn out and/or fire.
- 6) Wire size, please determined by considering the voltage drop of the wire.
Typically, the voltage drop, please to be within 2% of the rated voltage of the motor.

Voltage drop calculation:

$$\sqrt{3} \times \text{wire resistance } (\Omega / \text{km}) \times \text{Wiring length (m)} \times \text{motor rated current (A)} \times 10^{-3}$$

※ motor rated current, refer to "Table 2".

Operation


This Pump is not pressure-proof.



WARNING

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.

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).

- 
- WARNING**
- 1) **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.**
 - 2) **Person other than Repair technician should not be in charge of dismantling, repairing or remodeling this product. You have a risk of getting injured or electrical shock by a fire or erroneous move.**
 - 3) **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.**
 - 4) **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.**

It is necessary to flow the cooling water during the operation. Be sure to check the water flow rate below.

(However only PKS-016 doesn't need to flow the cooling water.)



CAUTION

- **Flow rate PKS-030 : 3 to 6 L/min**
- PKS-070B : 5 to 9 L/min**
- **Water-Pressure : 0.3 MPa (gauge pressure) or less**
- **Differential pressure : 0.1 MPa (gauge pressure) or more**
- **Water temperature : 5 to 30 °C**



CAUTION

The water included little impurities (ex. Industrial Water) is recommended for cooling water. Depending on the water quality, the inside wall of cooling water tube is covered with water scale (CaCO₃ etc.) and cooling water flow rate may be decreased. Cooling water tube is corroded by Chlorine ion (Cl⁻) and cooling water leak may be caused. In case of using pure water, cooling water leak may be caused by metal component dissolution, too.

In these cases, the repair service may be for a fee.

Turbidity mg/L	pH -	Alkalinity CaCO ₃ mg/L	Hardness Mg, CaCO ₃ mg/L	Evaporation residue mg/L	Chlorine ion Cl ⁻ mg/L	Iron Fe mg/L	Manganese Mn mg/L
20 max.	6.5-8.0	75 max.	120 max.	250 max.	80 max.	0.3 max.	0.2 max.

Establishment: Japan Industrial Water Association



WARNING

- 1) 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 causing a fire.
- 2) 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.
- 3) 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.
- 4) Do not put a wall or obstacle in and around 0.1m of the air inlet of the motor (Motor edge face).
You have a risk of getting burned or fire caused by over heat.



WARNING

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.

Power Supply wiring <Dismounting>**WARNING**

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

Inlet port piping <Dismounting>**WARNING**

- 1) Do not dismounting the joint from the inlet port piping of the Pump immediately after you stop an operation. It has a risk of the cooling water is boiled and jetted. Be sure to take it off after the Pump has sufficiently cooled down.
- 2) The Inlet and outlet piping remains very hot while after having stopped the Pump.
Be sure to take it off after the Pump has sufficiently cooled down.
- 3) You had better check a Flow meter (e.g. HWFM) that can be visual recognition.

Outlet port piping <Dismounting>**WARNING**

- 1) Take off the piping following the Install Manual of the system.
- 2) The Inlet and outlet piping remains very hot while after having stopped the Pump.
Be sure to take it off after the Pump has sufficiently cooled down.
- 3) Make airtight completely the Pump exhaust outlet with a blank flange.






Transfer**WARNING**

You have a risk of giving damage to your back as the load larger than safety standard shall be required to transfer this product.
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 and run the Pallet truck for its transfer.

0.4 Types and Descriptions of Warning Labels Displayed on The Pump 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		<ul style="list-style-type: none"> •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		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		<ul style="list-style-type: none"> •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. <ol style="list-style-type: none"> 1) explosive gas 2) flammable gas 3) gas which increases the susceptibility of substances to burn. <p>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.</p> <p>Indoor Use Only Mount at least 100mm from side walls.</p>
5		<ul style="list-style-type: none"> •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	<p style="text-align: center;">— 警告(WARNING) —</p> <p>工厂出货设定(INITIAL FACTORY SETTING/工場出荷時設定): 200-240V 50/60Hz 在其他电压场合使用时, 必须改变接线方式, 同时请参照说明书 TERMINAL BOX INTERNAL WIRING NEEDS TO BE CHANGED FOR OTHER VOLTAGE OPERATION AND SEE INSTRUCTION MANUAL 他の電圧で使用される場合は、お客様にて端子箱内配線 を切り替えてください。取扱説明書参照</p>	<p>Before wiring, please confirm the power-supply voltage you use.</p> <p>Please confirm the power-supply voltage you'll use and change crossline in the terminal box.</p> <p>Refer to “3.5 Electrical Connection”.</p>
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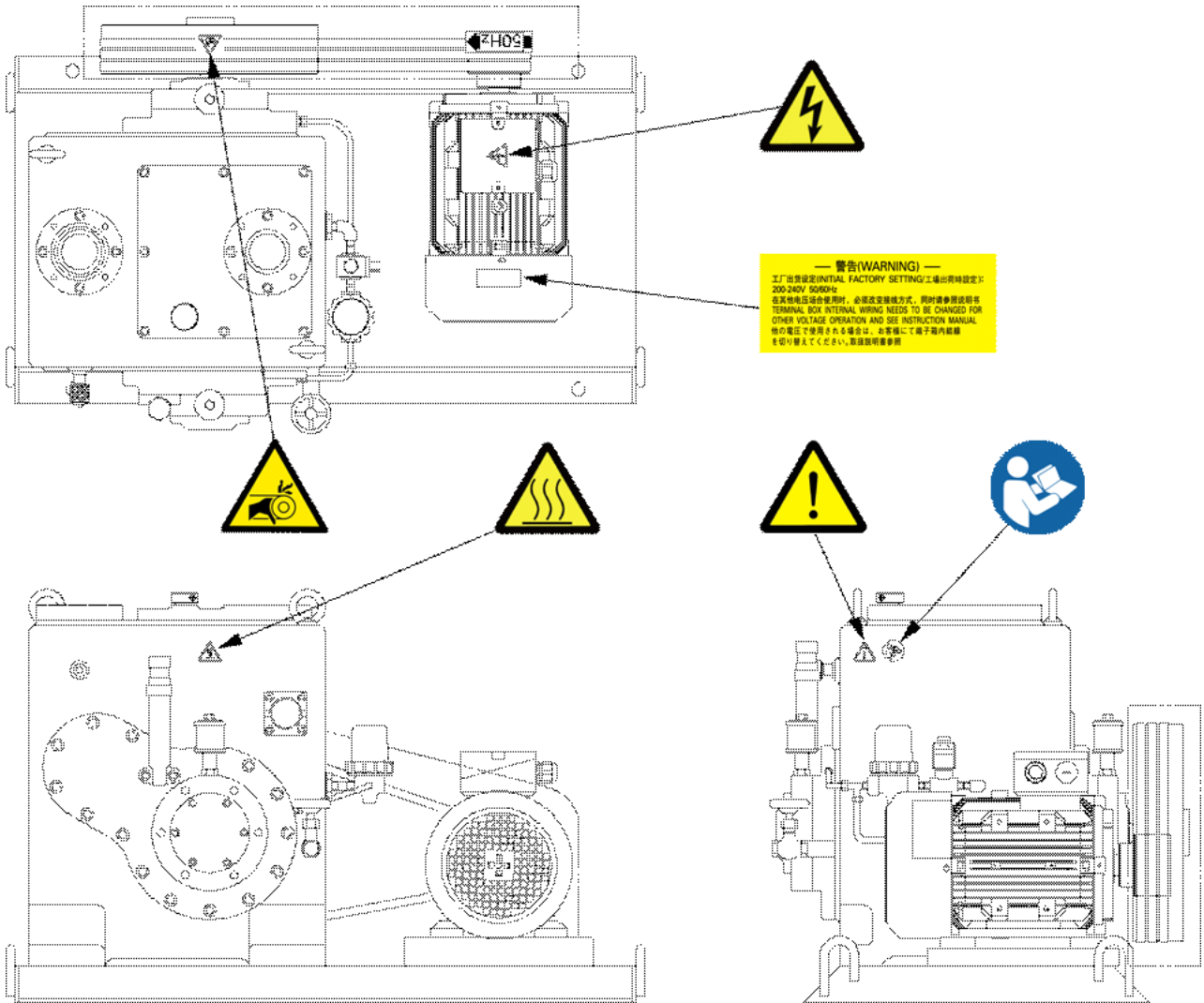


Fig. 1 Display positions of Labels (PKS-016)

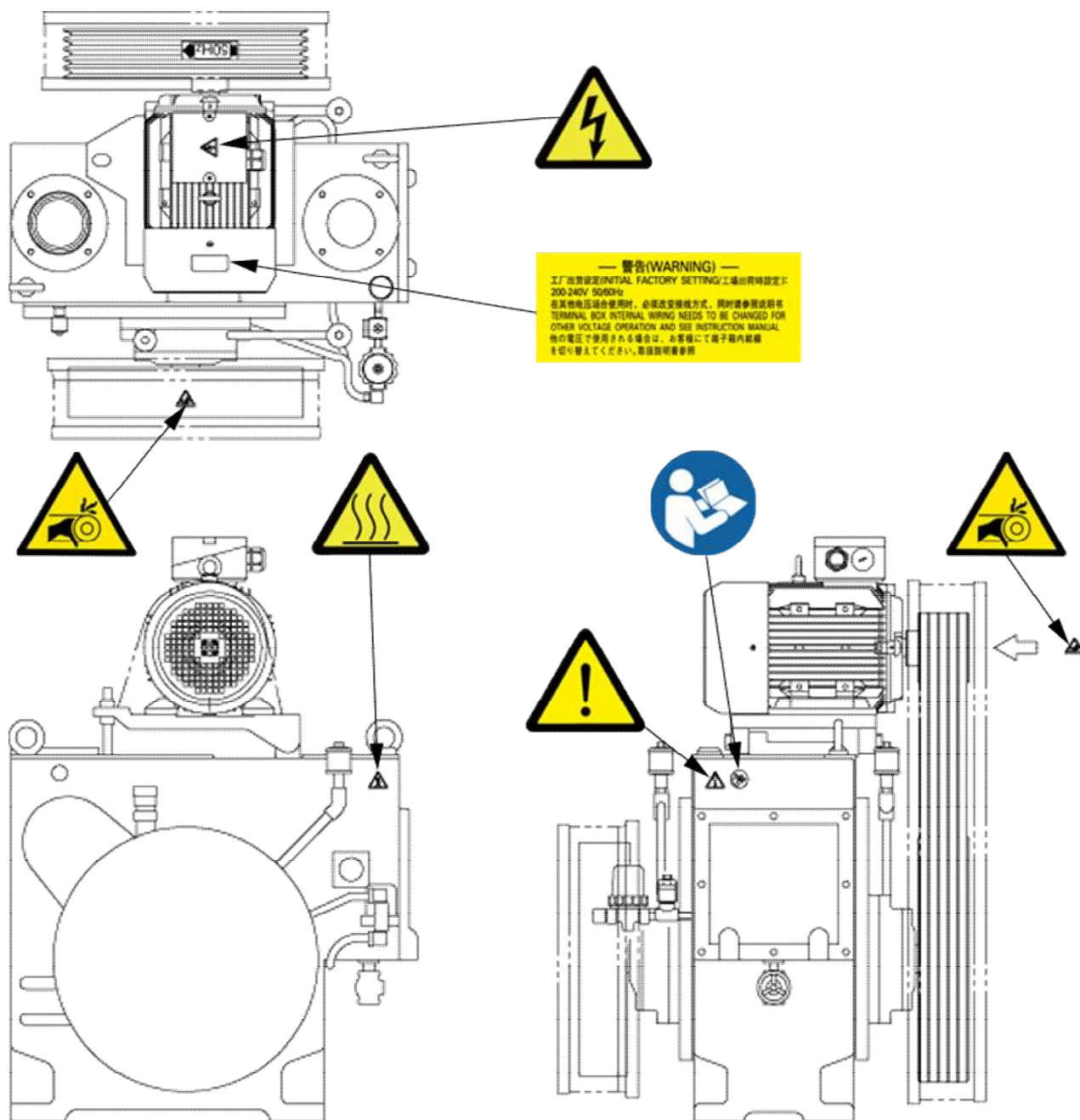


Fig. 2 Display positions of Labels (PKS-030)

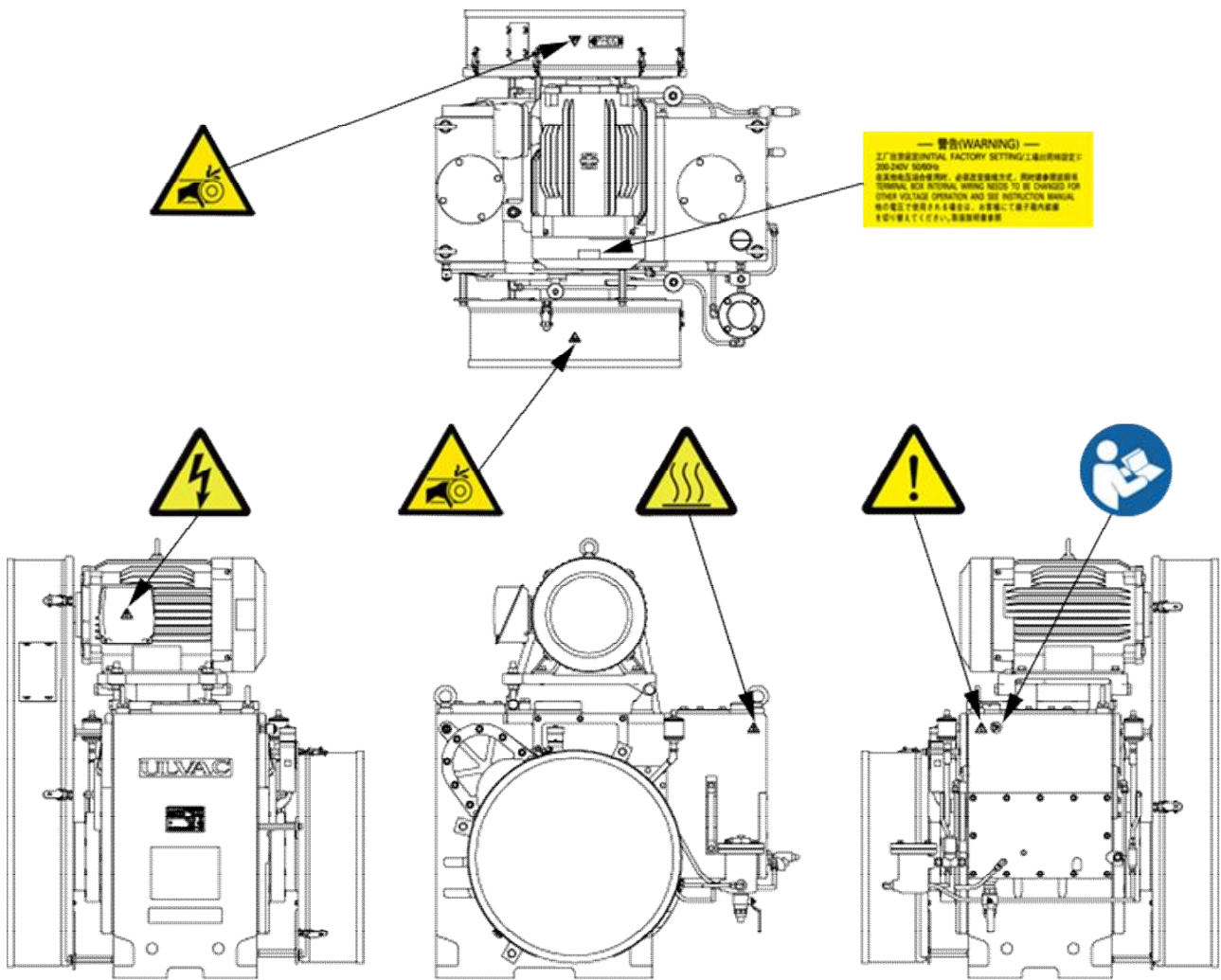


Fig. 3 Display positions of Labels(PKS-070B)

0.5 Acceptance and Storage of the Pump

0.5.1 Unpacking / Acceptance of the Pump



- 1) 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.
- 2) Give the instruction them further to use the unloading machinery such as crane to take out this 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.
- 3) Only the technically entitled person should be in charge of conducting the unloading operation and operating the unloading machinery.
- 4) 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.

Upon delivery of this 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 this product might be resolved with a charge.

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

Important

- 1) Whether the delivered is exactly the one you have ordered.
 - 2) Whether accessories (standard accessories, optional parts) are attached or not.
 - 3) Whether there is no break or damage through transport or not.
 - 4) 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.

0.5.2 Transfer



WARNING

You have a risk of giving damage to your back as the load larger than safety standard shall be required to transfer this product.

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 and run the Pallet truck for its transfer.

0.5.3 Ambient Condition for Storage, Install and Operation

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

- ① Ambient temperature and humidity for storage : -30°C to 60°C , less than 95%RH
- ② Ambient temperature and humidity for operation : 10°C to 40°C less than 80%RH ※1
- ③ Height (for both storage and operation) : Lower than 1,000 meters altitude
- ④ External vibration (for both storage and operation) : Vibration acceleration less than 114dB(0.5G)
- ⑤ Miscellaneous (for both storage and operation) :
 - 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 motor 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.

※1 Condition of “Ambient temperature and humidity for operation” is 4°C to 10°C less than 80%RH, if The Pump use ULVOIL R-42.



CAUTION

Do not give the Pump a shock or lay it down. It might impair the Pump operation.

Install the Pump horizontal to a place where there are less dust and humidity. When you fix the Pump to floor, fix the Pump to the floor with bolts at four places. Fix the Pump horizontally so that there is not a wobble.

0.6 Protective Device

This Pump is equipped with the Three-phase AC multi motor (AC200V~240V/380V~415V 50Hz, AC200V~240V/380V~480V 60Hz).

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 earth leakage breaker.



CAUTION

It is imperative to put the Overload protection device.
Otherwise it would cause the motor burn out and/or fire.

Table of Contents

0.	Before Using This Product.....	i
0.1	Safety Symbol Marks	ii
0.2	Meanings of Safety Symbol Marks	ii
0.3	Safety Precautions	iii
0.4	Types and Descriptions of Warning Labels Displayed on The Pump and Displayed Positions..	x
0.5	Acceptance and Storage of the Pump	xiv
0.5.1	Unpacking / Acceptance of the Pump	xiv
0.5.2	Transfer	xv
0.5.3	Ambient Condition for Storage, Install and Operation	xv
0.6	Protective Device	xvi
1.	For your Safety USE	1
1.1	This Product Intrinsic Hazardous Nature and Safety Measures	1
1.1.1	! Danger Leakage of dangerous gas and dangerous materials	1
1.1.2	! Warning Transfer of heavy material	1
1.1.3	! Warning Electric shock	2
1.1.4	! Warning Explosion	2
1.1.5	! Caution High temperature	2
1.1.6	! Caution Leakage of High-temperature cooling water	3
1.2	Safety Data Sheet (SDS)	3
2.	Pump Outline.....	4
2.1	Characteristics	4
2.2	Performance Specifications	5
3.	Mounting	13
3.1	Installation	13
3.2	Lubrication	14
3.3	Water Piping (PKS-030、PKS-070B)	15
3.4	Inlet port Piping	17
3.5	Outlet port Piping	18
3.6	Electrical Connection	18
3.7	Check and Replace V-belt	22
4.	Operation	24
4.1	Caution on Operation	24
4.2	Operation Start	25
4.3	Operation Stop	27
4.4	Gas Ballast Function	28
4.5	Vacuum Pump Oil For cold district	30
4.6	Oil mist trap (TM-2/TM-3/TM-4 (optional part))	30

5. Pump Performance	31
5.1 Ultimate Pressure.....	31
5.2 Pumping Speed	31
5.3 Power Requirements	31
6. Maintenance and Check	34
6.1 Maintenance.....	34
6.1.1 Operation in the winter (for vacuum pump oil : ULVOIL R-42)	34
6.2 Regular Check	34
6.2.1 Pump Oil Level Check.....	34
6.2.2 Vacuum Pump Oil Check	35
6.2.3 Oil Leak Check.....	37
6.2.4 Checking Gas Ballast Function	37
6.2.5 Checking Metal Mesh at the Suction Inlet	37
6.2.6 Checking Noise and Abnormal Vibration.....	37
6.2.7 Checking belt.....	38
6.2.8 Checking oil mist trap.....	38
6.2.9 Checking drain valve	38
6.3 Checkup after storage for a long period.....	38
6.4 Overhaul.....	39
6.5 Trouble shooting	40
7. Disposal	43
8. Warranty Clauses	44
8.1 Warrantable Items	44
8.2 Duration of guarantee.....	44
8.3 Warrantee scope	44
8.4 Response procedure	44
8.5 Disclaimer	45
8.6 Others.....	45
9. Main Replacement Parts	46

Tables and Illustrations


Fig. 1	Display positions of Labels (PKS-016)	xi
Fig. 2	Display positions of Labels (PKS-030)	xii
Fig. 3	Display positions of Labels (PKS-070B)	xiii
Fig. 4	Rotary vacuum pump dimensional drawing of PKS-016	7
Fig. 5	Rotary vacuum pump dimensional drawing of PKS-030	8
Fig. 6	Rotary vacuum pump dimensional drawing of PKS-070B	9
Fig. 7	Rotary vacuum pump outline drawing of foundation for PKS-016	10
Fig. 8	Rotary vacuum pump outline drawing of foundation for PKS-030	11
Fig. 9	Rotary vacuum pump outline drawing of foundation for PKS-070B	12
Fig. 10	Connection to vacuum chamber (example)	17
Fig. 11	Recommended connection diagram	19
Fig. 12	Electrical wiring diagram	19
Fig. 13	Oil tank structural drawing	29
Fig. 14	Pumping speed and Power Requirement curves about PKS-016	32
Fig. 15	Pumping speed and Power Requirement curves about PKS-030	33
Fig. 16	Pumping speed and Power Requirement curves about PKS-070B	33
Table 1	Specifications	5
Table 2	Rated current value about standard motor	20
Table 3	Terminal size about standard motor for connection	20
Table 4	Deflection volume and deflection load of belt	22
Table 5	Recommended the oil mist trap for Pump models	30
Table 6	Replacement timing of vacuum pump oil	36
Table 7	How to distinguish breakdown and countermeasure for the Pump	40
Table 8	Trouble shooting	40
Table 9	Main replacement parts list	46

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 Leakage of dangerous gas and dangerous materials

Factors	Avoidance methods and measures
 Leakage of poisonous and combustible gas	Do not exhaust any hazardous gas such as toxic and combustible.
Getting injured on touching any toxic pump oil, pump, generated material or sucked substance at the occasion of check or disposal.	<ol style="list-style-type: none"> 1) When you check the Pump, please wear a brace that supports the toxic substances that exhaust the Pump. 2) To overhaul or dispose, ask the special agency to do the detoxification process. 3) Ask the disposal agency licensed by the administration for disposal.


1.1.2 ! Warning Transfer of heavy material

Factors	Avoidance methods and measures
 Getting injured on transferring Pump wight (without an AC motor) PKS-016 : 225 kg PKS-030 : 380 kg PKS-070B : 900 kg	<ol style="list-style-type: none"> 1) Only technically entitled person should be in charge of loading/unloading and operating machines. 2) 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.


1.1.3 ! Warning Electric shock

Factors	Avoidance methods and measures
 <p>Getting electrical shock on touching the current-carrying part of the motor.</p>	1) Be sure to cut the electricity to do electrical connection. Never fail to take the earth connection.
	2) Ensure to close the cover of motor terminal box and never open it during operation.
	3) Be sure to cut the electricity to do checking or installation.
	4) 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 “3.6 Electrical Connection”)


1.1.4 ! Warning Explosion

Factors	Avoidance methods and measures
 <p>Pressure inside the Pump rises up and the Pump explodes.</p>	<p>Ensured pressure value of the Pump is 0.03MPaG Check the Exhaust side pressure of the Pump. If it was over 0.03 MPaG (0.3 kg/cm²G) (Gauge pressure) take away anything in and around the exhaust outlet that hampers gas passage. When utilizing the oil mist trap, perform the periodic maintenance so that no -resistance can be realized in passage of gas.</p>

1.1.5 ! Caution High temperature

Factors	Avoidance methods and measures
 <p>Getting burnt on touching the high temperature part.</p>	<p>1) The Pump gets high temperature during operation.</p> <ul style="list-style-type: none"> • pump r.t. + approx. 30°C (final press.) r.t. + approx. 60°C (gas ballast) • motor r.t. + approx. 55°C
	2) 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.
	3) Do not touch on the pump and motor when you adjust the gas ballast valve.

1.1.6 ! Caution Leakage of High-temperature cooling water

Factors	Avoidance methods and measures
 <p>Heated cooling water up to high-temperature is boiled and jetted out of the inlet and outlet from cooling water piping.</p>	<p>1) Install a flow meter in the cooling water passage. Set up an interlock so that the Pump may stop certainly when cooling water doesn't flow.</p>
	<p>2) If the Pump is run without flowing the cooling water, you ought to stop the Pump immediately and don't come near the Pump.</p>
	<p>3) Demount the Pump after the Pump lowered temperature, and inspect it.</p>

1.2 Safety Data Sheet (SDS)

<p>IMPORTANT</p>	<p>Chemical material used for this Pump;</p> <p>(1) ULVOIL R-72 (Standard) (2) ULVOIL R-42 (For cold district in winter, In the case of ambient temperature 4-10°C)</p>
	<p>The 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).</p>

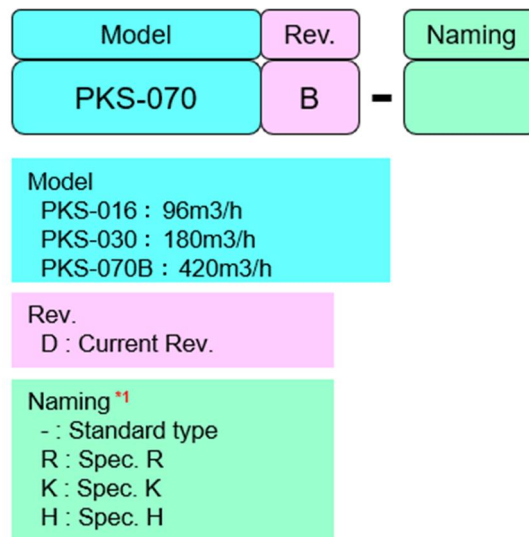


SDS is posted as referential to ensure safe operation of the hazardous and/or toxic chemical material. Any person in charge of operating the Pump oil shall be requested to be responsible to cause means appropriate to actual operation of the machine referring to it.
Note that the SDS itself shall be never a safety certificate in any manner

2. Pump Outline

2.1 Characteristics

The PKS series models are extremely durable, and the single-stage design of the rotary plunger vacuum pumps. The Pumps are also excellent in corrosive properties-proof and wear resistance because high-grade cast iron is being used. The Pumps possible to pump down water vapor by use of gas ballast valve.



- *1 Standard type doesn't have the Naming. Spec. R / Spec. K / Spec. H is selectable as option.
 Depending on the selected type, there is the option that can not be selected in pump head option and external option.
- *2 Multiple voltage motor is not available with Explosion-resistant motor.

2.2 Performance Specifications

Table 1 Specifications

Model		PKS-016	PKS-030	PKS-070	
Designed pumping speed L/min (m ³ /h)	50Hz	1600	3000	7000	
	60Hz	1600	3000	7000	
Ultimate pressure *1 Pa	Gas ballast port close*2	2.7			
	Gas ballast port open*2	400			
Maximum water vapor pressure Pa		650	900	6000	
Maximum water vapor tolerance kg/hr		5	7	12	
Motor	Type		Totally enclosed fan cooled Three-phase induction motor		
	Efficiency class		IE3		
	Power kW(Poles)		2.2 (4)	3.7 (4)	11 (6)
	Voltage	50Hz	200V~240V/380V~415V		
60Hz		200V~240V/380V~480V			
Power supply capacity	kVA	50Hz	10	15	
		60Hz			65
Oil type		ULVOIL R-72			
Oil capacity L*3		6.5	8	20	
Revolution r/min	50Hz	425	400		
	60Hz	425	400		
Oil temperature during operation (Gas ballast close*2) °C		Room temperature + 50 to 60			
Cooling type		Air	Water		
Cooling water	Amount L/min		—	3 to 6	5 to 9
	Pressure MPa(gauge press.)		0.3 or less		
	Differential Press. MPa(gauge press.)		0.1 or more		
	Temperature °C		5 to 30		

Inlet	VG50	VG80	VG100
Outlet	VF50	VF80	VF100
Weight (without motor) kg	225	380	900
External dimensions W × D × H mm	587 × 860 × 572	713 × 675 × 973	971 × 983 × 1193
Accessories	Oil(Amount of 1 pump), Quick manual, Motor-pulley,V-belt		
Standard oil mist trap(Optional)	TM-2	TM-3	TM-4, TM-4S
Option	Oil mist trap, Various oil, Explosion-proof motor Improved explosion resistance motor, Voltage specified motor, special type for special application (Spec. R / Spec. K / Spec. H)		

*1 The Pump is being used standard oil (ULVOIL R-72), and ultimate pressure is measured with Pirani gauge.

*2 The measured value of the ultimate pressure would be lowered to a half-digit with a Mcleod gauge than with a Pirani gauge.

*3 The Oils for a rotary vacuum pump have some character about steam pressure, viscosity and so on. You ought to use the standard oil of our designation in order not to lower some performances.

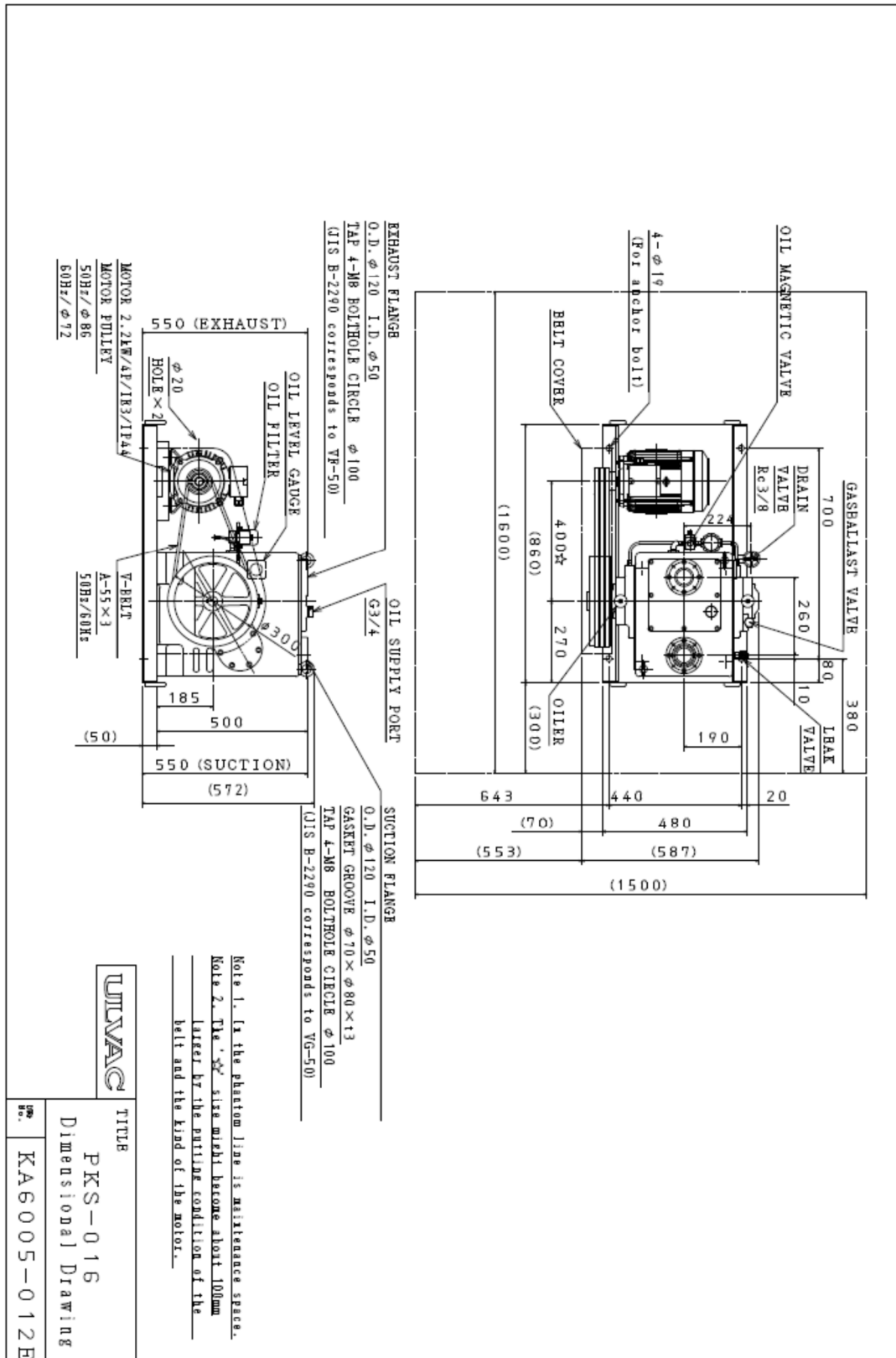


Fig. 4 Rotary vacuum pump dimensional drawing of PKS-016

- 1) The smallest space for maintenance surround with two-dotted line.
- 2) The "☆" marked size is different depending on the tension condition of the V-belt.
 See the margin of the about +100mm.

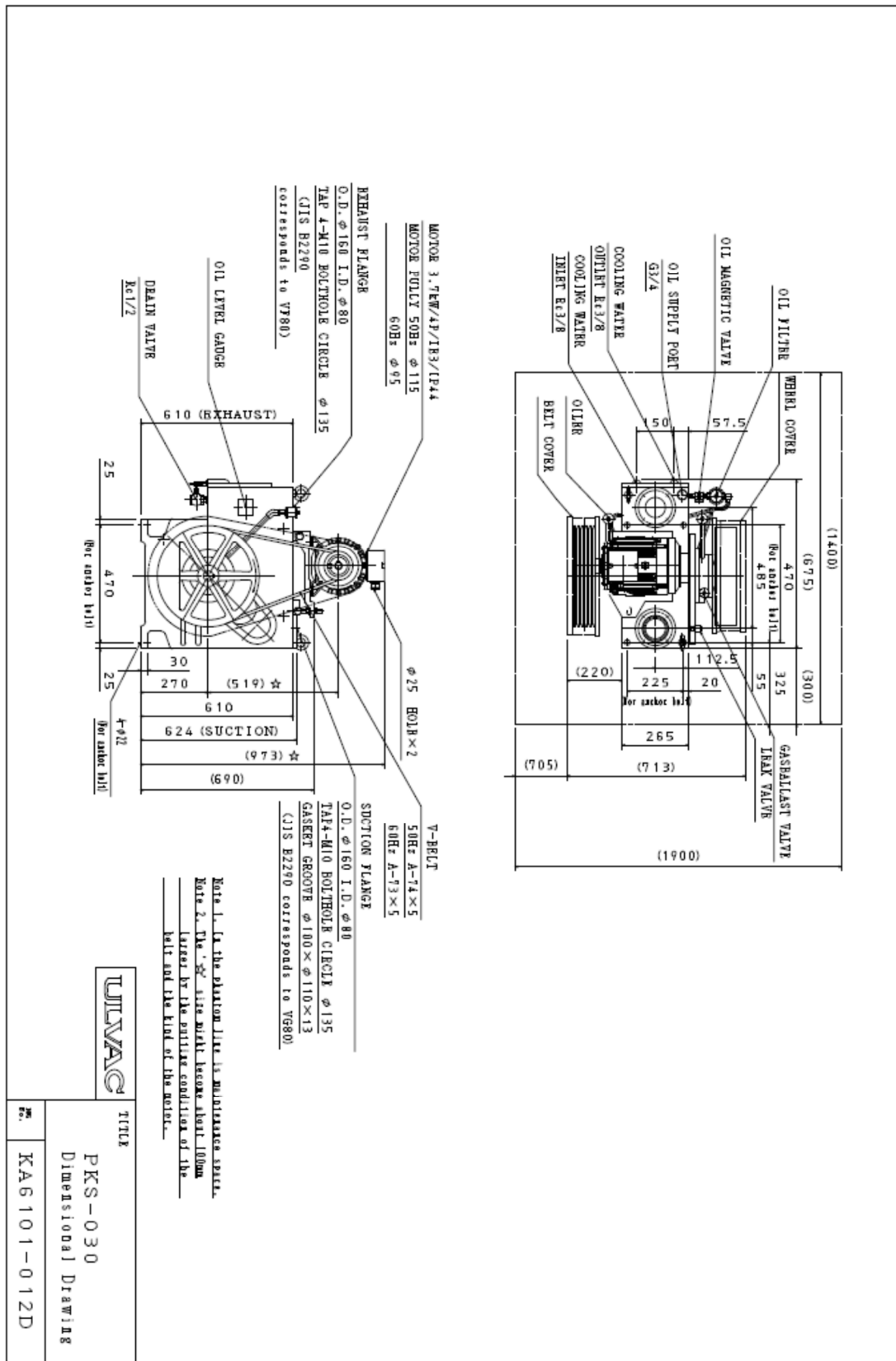


Fig. 5 Rotary vacuum pump dimensional drawing of PKS-030

- 1) The smallest space for maintenance surround with two-dotted line.
- 2) The "☆" marked size is different depending on the tension condition of the V-belt.
See the margin of the about +200mm.

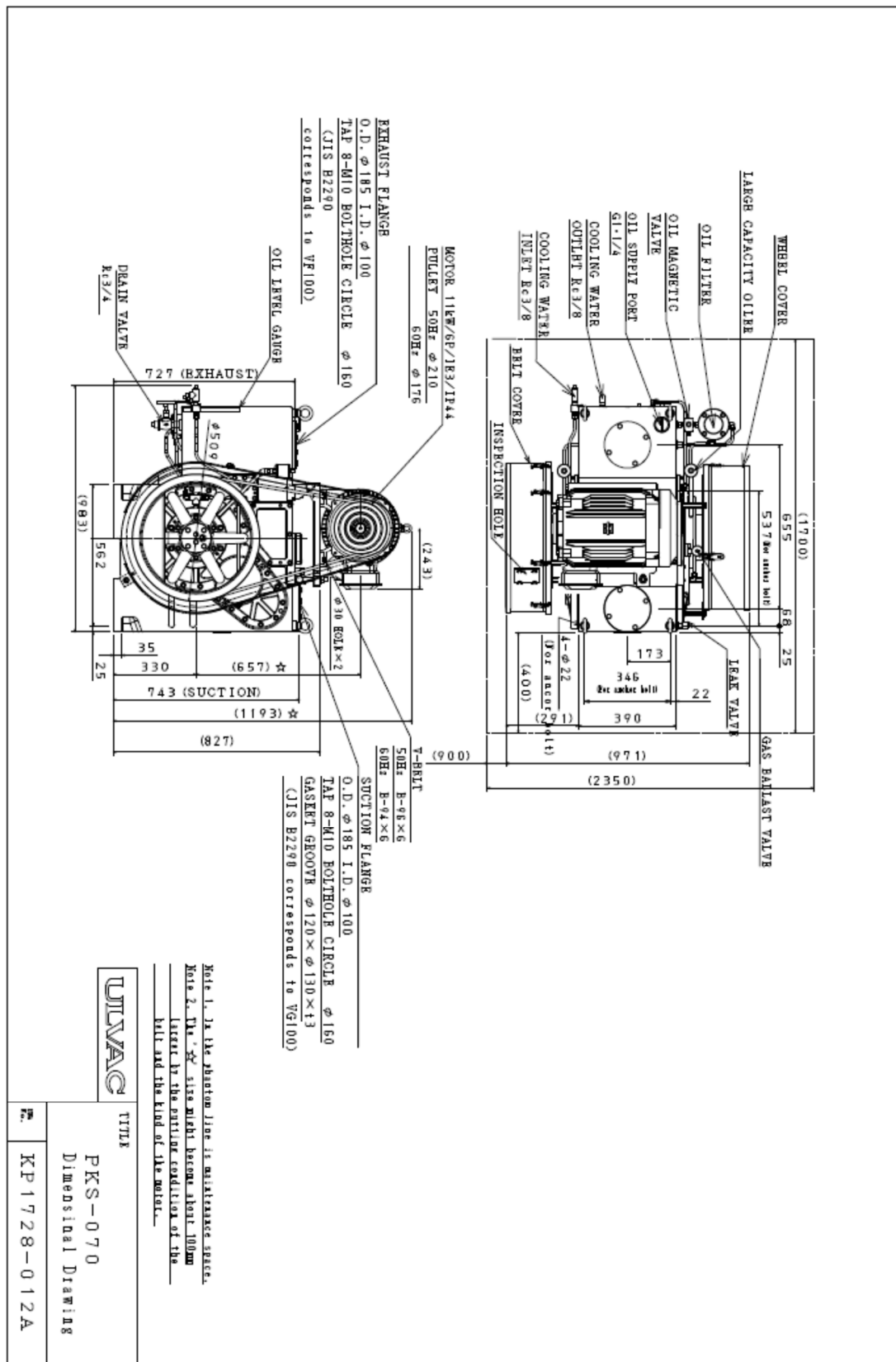
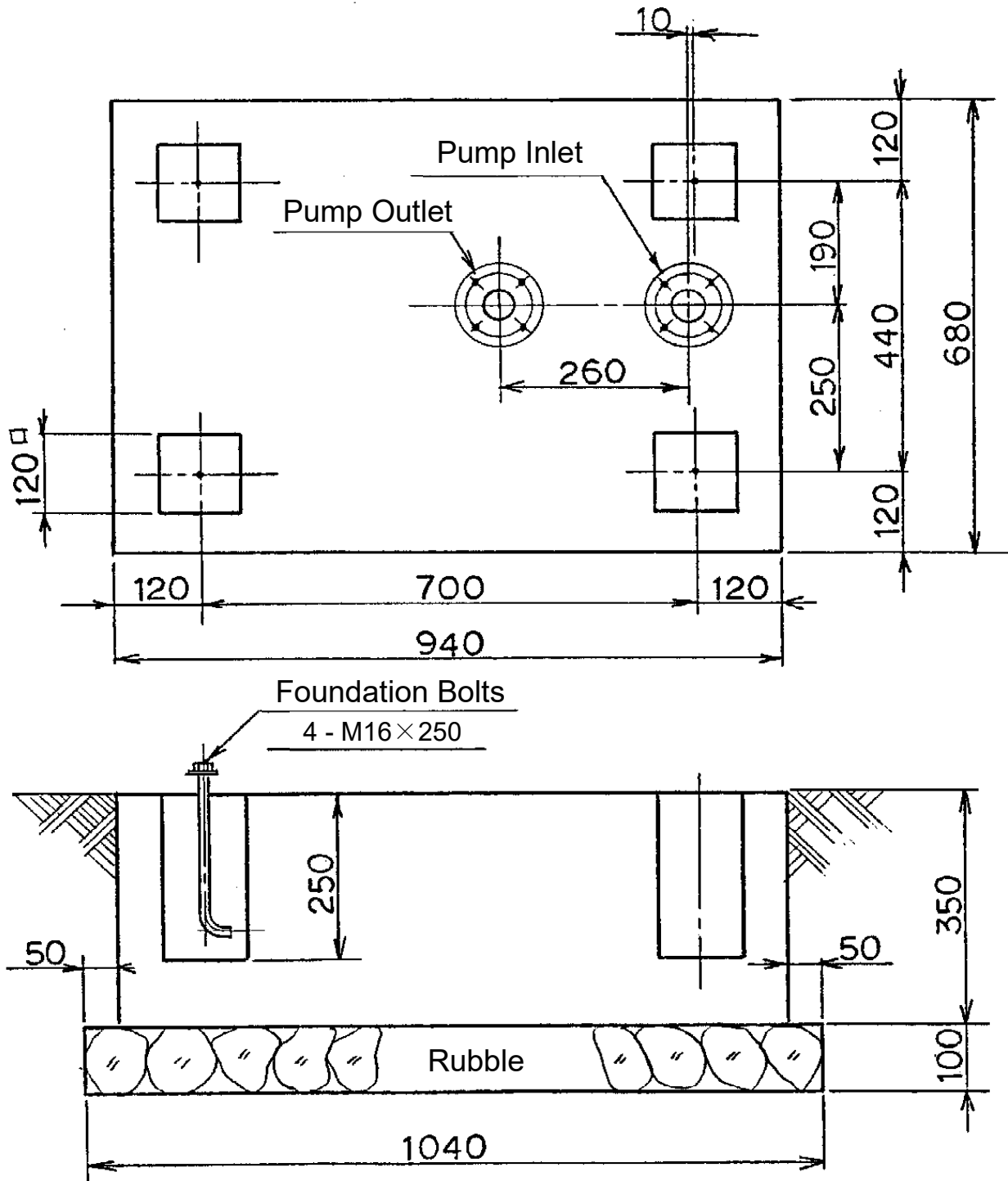


Fig. 6 Rotary vacuum pump dimensional drawing of PKS-070B

- 1) The smallest space for maintenance surround with two-dotted line.
- 2) The "☆" marked size is different depending on the tension condition of the V-belt.
See the margin of the about +200mm.

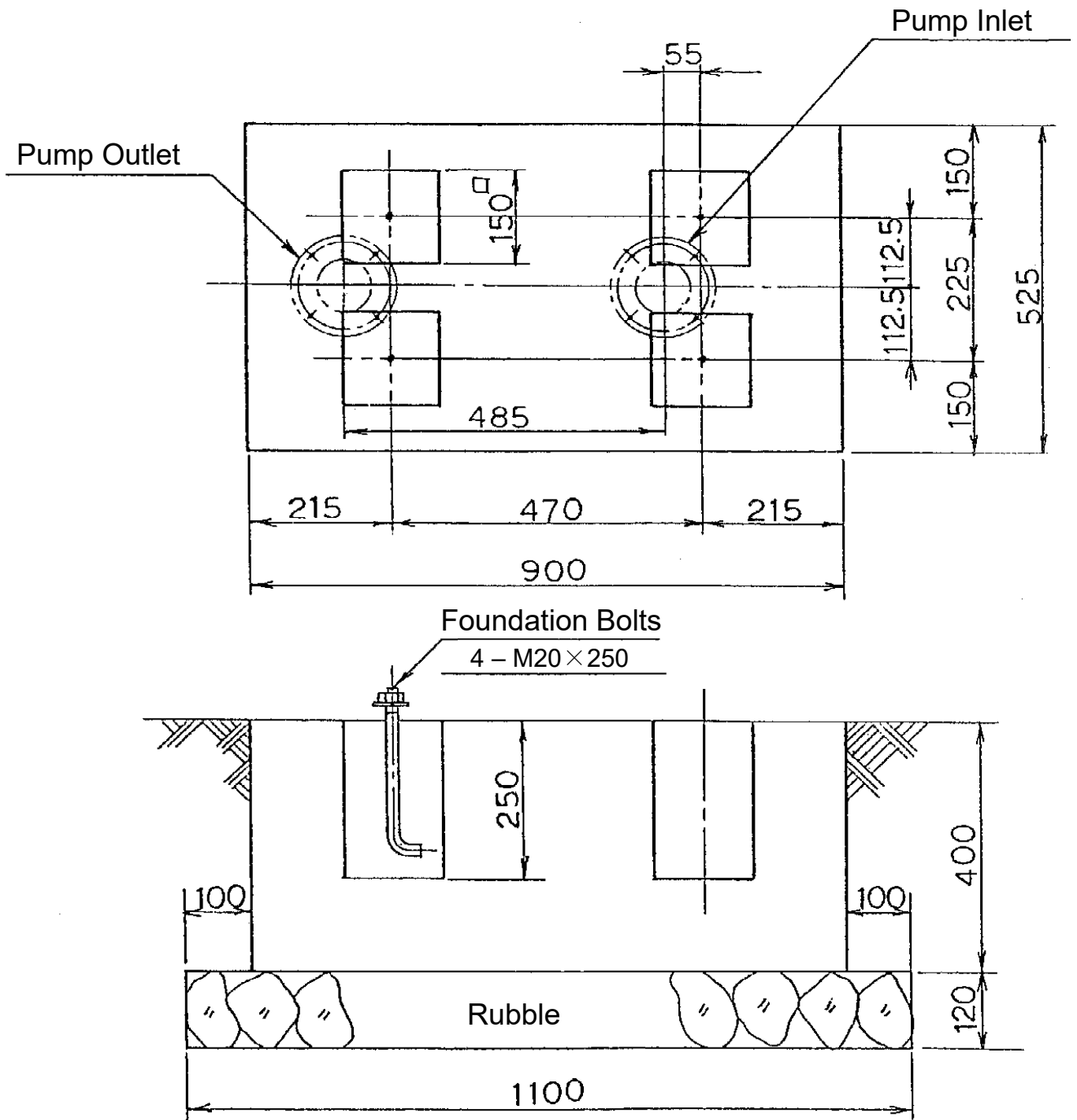
Pump Weight : 225 kg (without motor)
 Foundation Weight : ~550kg ~ 1.4t/m²
 Concrete Composition Ratio : Cement : Sand : Grave I(1 : 2 : 4)



This figure indicates the rough standard. It is necessary to change this by the foundation strength.

Fig. 7 Rotary vacuum pump outline drawing of foundation for PKS-016

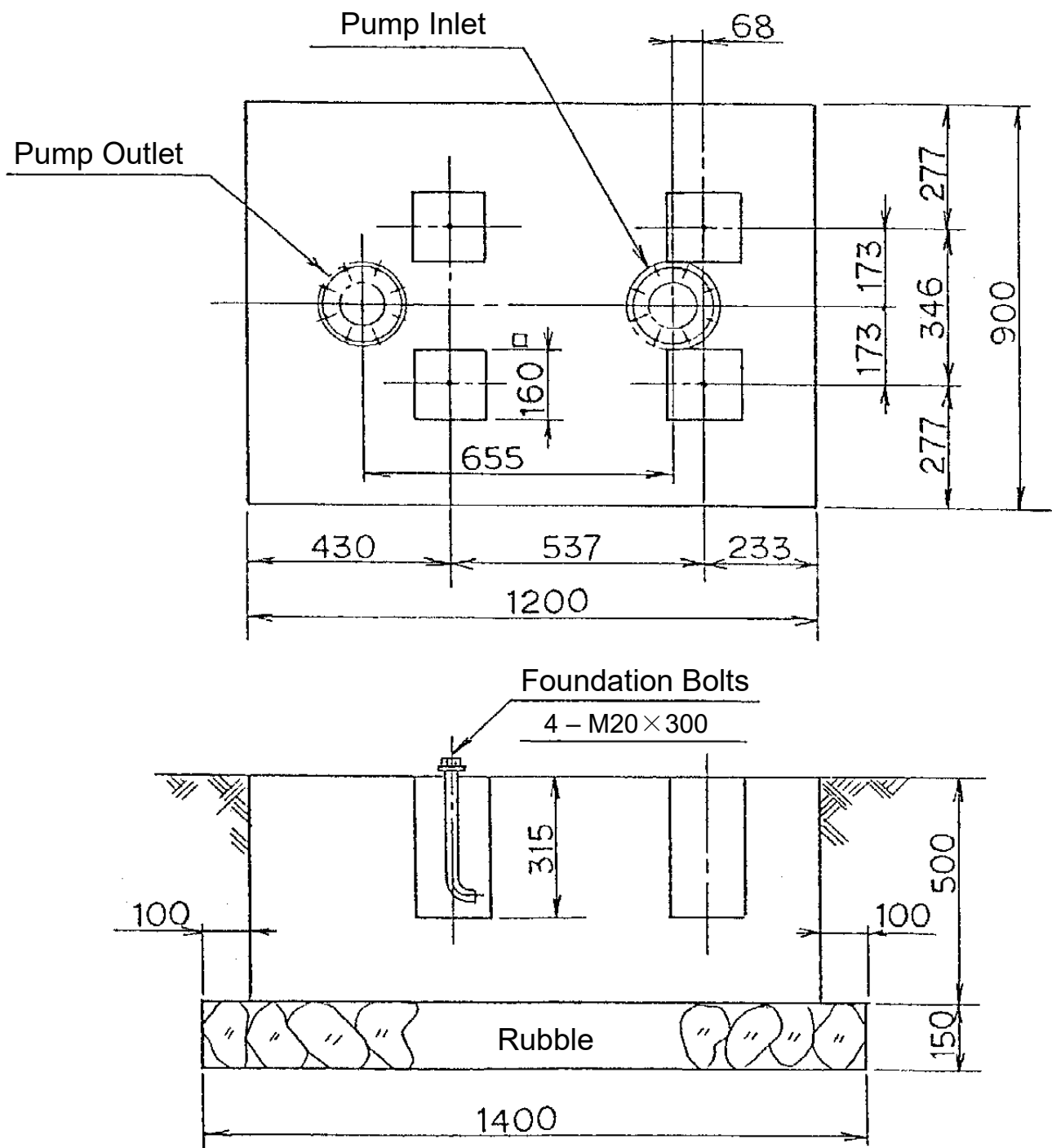
Pump Weight : 380 kg (without motor)
 Foundation Weight : ~450kg ~ 1.7t/m²
 Concrete Composition Ratio : Cement : Sand : grave I(1 : 2 : 4)



This figure indicates the rough standard. It is necessary to change this by the foundation strength.

Fig. 8 Rotary vacuum pump outline drawing of foundation for PKS-030

Pump Weight : 900 kg (without motor)
 Foundation Weight : ~13000kg ~ 1.9t/m²
 Concrete Composition Ratio : Cement : Sand : grave I(1 : 2 : 4)



This figure indicates the rough standard. It is necessary to change this by the foundation strength.

Fig. 9 Rotary vacuum pump outline drawing of foundation for PKS-070B

3. Mounting



1) You are requested to install and operate this 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 this 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 this 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.

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

3.1 Installation

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. Please read “Fig. 3 to 6” about the space for maintenance before installation.

In case you don't remove and install frequently, please install certainly as levelly as possible using basic bolts. The lifetime and reliability of the Pump would be improved. Please read “Fig. 7 to 9” about outline drawings of foundation before installing.

The motor upper margin of PKS-030 and PKS-070B see the margin of +200 mm more than the total height of the dimensional drawing of “Fig.5 to 6”.

As for the environmental condition, please refer to “0.5.3”.



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. 2 and Fig. 3”.

3.2 Lubrication

Remove the oil filling plug, and fill the Pump with oil until oil level should be between the two level lines on the oil level gauge.

Fill the Pump with oil regularly so that the pump lifetime is to become longer. It has a risk of being lowered performance and broken down, when the Pump is run under the following conditions.

- 1) Oil level is lower than limit level
- 2) Oil color is getting cloudy black

The bearings in the pump are also lubricated by the vacuum pump oil. You should check the oil level of the Oiler in Bearing-case upper part. The pump needs to be filled the oil when the oil is not enough. You should fill the oiler with oil until 80% of all. If you should not fill the oil up to 100%, it is possible to be overflowed the oil out of the oiler due to the thermal expansion.



CAUTION

The oil level could be lowered after filling up to the regulated amount after overhaul or storage for a long period with be drained. You should fill the oil again until the regulated amount with watching the oil level at the oil level gauge.



CAUTION

The oil could not be flowed into a Bearing-case after overhaul or oil level was lowered completely. Please remove a plug in the bearing case upper part and fill the oiler with the oil. The oil is overflowed out of the plug hole after replacing the air with oil in the Bearing-case. Please tighten the plug, and fill the oiler with the oil until 80% of all.



CAUTION

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.



CAUTION

- 1) Read “1. 2 Chemical Material Safety Data Sheet” previously before starting lubrication. Please obtain the latest version of Safety Data Sheet (SDS) from our Sales Department.
- 2) Wear protective gears such as rubber gloves, protective goggles and so on. Should the oil touched to your hand or entered in your eye, immediately follow the emergency treatment described on the SDS.

3.3 Water Piping (PKS-030、PKS-070B)

Remove the R3/8 screw-plug, and connect the joint and the nylon hose on to the Rc3/8 female screw hole.

Please refer to “Fig. 5 and 6” about water cooling piping inlet and outlet.



CAUTION

- 1) Be sure to flow the cooling water with the volume indicated on the Table. 1 or more. The Pump temperature would rise up if the water flow rate becomes less than specified particularly on high inlet pressure operation and cause the pump failure. You are recommended to put a Flow meter for the cooling water and cause the interlock so that the Pump stops if the cooling water flows less than specified flow rate.
- 2) 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 the water inside by blowing in the pneumatic air through the cooling water inlet.



CAUTION

The water included little impurities (ex. Industrial Water) is recommended for cooling water. Depending on the water quality, the inside wall of cooling water tube is covered with water scale (CaCO₃ etc.) and cooling water flow rate may be decreased. Cooling water tube is corroded by Chlorine ion (Cl⁻) and cooling water leak may be caused. In case of using pure water, cooling water leak may be caused by metal component dissolution, too.

In these cases, the repair service may be for a fee.

Turbidity mg/L	pH -	Alkalinity CaCO ₃ mg/L	Hardness Mg, CaCO ₃ mg/L	Evaporation residue mg/L	Chlorine ion Cl ⁻ mg/L	Iron Fe mg/L	Manganese Mn mg/L
20 max.	6.5-8.0	75 max.	120 max.	250 max.	80 max.	0.3 max.	0.2 max.

Establishment: Japan Industrial Water Association



- 1) 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.
- 2) We recommend you to put the Leak sensor on the floor beneath the Pump and engage it with the interlock system of the equipment. Close the Coolant supply valve (HWSV) immediately you noticed the leakage. Put the [Closed] tag onto the handle after having closed the valve.
- 3) Put a Flow meter applicable to visually check the flow onto the cooling water supply source to make it possible to check the flow.



- 1) 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.
- 2) 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.
- 3) An enough cooling water flow might not be able to be secured when there is a vertical interval in piping. In such a case, cause a measure to ensure the flow volume, such as to change the piping layout, put a larger pipe or raise the supply pressure within the specification range.

3.4 Inlet port Piping

- 1) Wash sufficiently inside the Vacuum chamber, pipes, Main 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) Connect the inlet of pump to pipes that are larger than the internal diameter of the pump inlet.
- 3) Use a pipe having bellows between the Vacuum chamber and inlet of the Mechanical Booster Pump so as to avoid any direct load to the Pump flange and not to transfer the Pump vibration to the Vacuum chamber.
- 4) Put the Main valve, Vacuum gauge and Leak valve between the Vacuum chamber and the Pump. When the Pump stop operation, close the main valve and keep the equipment side at a vacuum condition. And open a leak valve in order to release the pressure of the Pump until atmospheric pressure so that the oil in the Pump won't flow backward. It would be convenient at an unexpected stop, if the main valve is used for a pneumatic valve or electromagnetic valve, and leak valve is used for an automatic vacuum breaking valve.

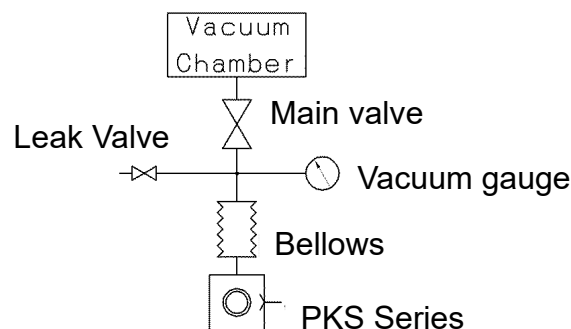


Fig. 10 Connection to vacuum chamber (example)



- 1) Wash sufficiently inside the Vacuum chamber, pipes, Main valve and so on to connect them to the Pump.
- 2) You should put the Leak valve closer as possible to the Main valve in order to prevent the oil from rising up to the Vacuum chamber when the Pump stopped. If you use it together with the mechanical booster pump, be sure to put the valve above the Pump.
- 3) Metal mesh on the Suction inlet is put to keep foreign substances away from the Pump unit.

3.5 Outlet port Piping

Use the flange for connection between the Pump Outlet and the piping.

It is recommended to provide an oil mist trap to reduce oil consumption and to trap oil mist.



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.

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.



1) Be sure to use pipes made of metal (electricity-conducting material). Ensure also to take grounding. Should you use the pipes such as non-electricity-conducting materials, it would be an ignition source due to discharging static electricity when the exhaust gas pass in the piping, and it could have a risk of fire.

2) In the case of the process flowing combustible gas/susceptibility of substances to burn gas, you are requested to introduce the diluent gas. Flow the diluent gas from the intake side so that the gas concentration to be exhausted becomes lower than the explosion limit.

3.6 Electrical Connection

Conduct the electrical connection referring to the Fig. 11, Fig.12 and Table.2.

Without changing motor, it is possible to run the Pumps both with 200V and 400V class utilities by changing wire connection in the motor terminal box because multi voltage motor, for both 200V and 400V classes, is used for this pump.



The motor is set up the connection matched to voltage for each destination at factory shipment.

Before starting the pump, check first that the connection is matched to used voltage.

IMPORTANT



- 1) Remove V-belt before working the electrical connections.
- 2) Confirm screws which are keeping tight in the motor part.
- 3) Refer to the arrow mark on Pulley-cover. Ensure rotation direction of the motor as same as the arrow mark (clockwise from the load side).
- 4) Be sure also to put a safety circuit such as MCCB(Molded Case Circuit Breaker), MC(Magnetic Contactor) and THR(Thermal Relay) for the electrical connection.

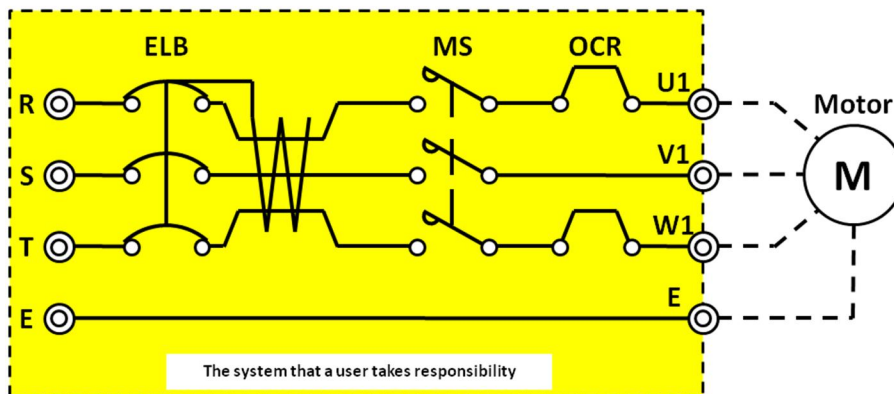


Fig. 11 Recommended connection diagram

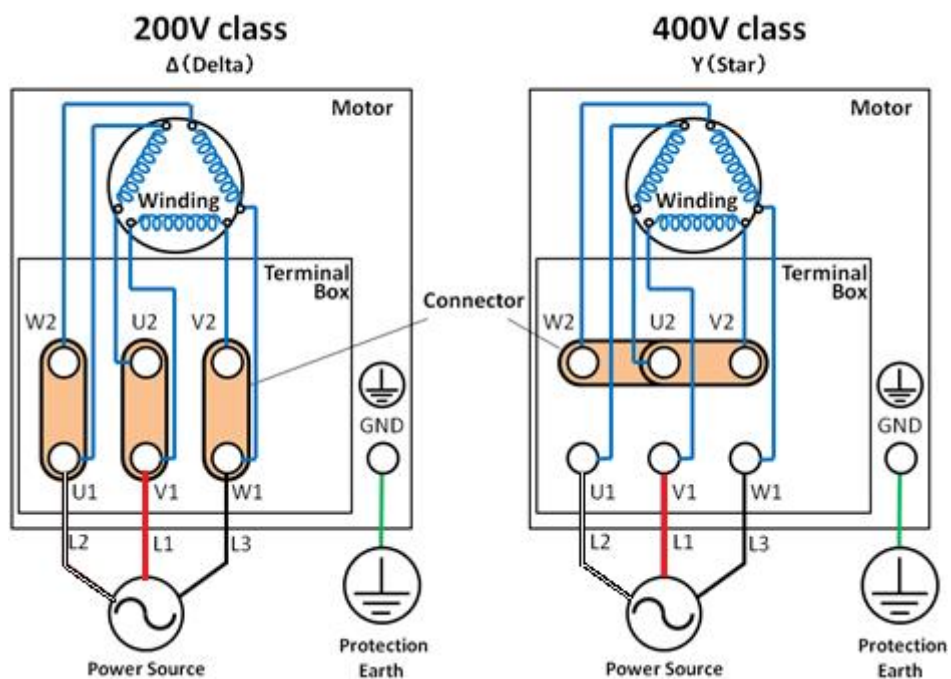


Fig. 12 Electrical wiring diagram



- 1) When a motor is different from the standard one, please do the setting of the suitable safety circuit in a rating current value of the motor you use.
- 2) Connect the electric wiring with a motor as the Direct-in start connection.
- 3) Confirm the rotation direction of a motor, and attach V-belt to Motor pulley.
- 4) Connect the electromagnetic valve for filling the oil to synchronize with the motor.
- 5) Should you use an automatic vacuum breaking valve, synchronize it with the motor as same as "4)".

Table 2 Rated current value about standard motor

Model	Motor (poles)	Rated Current (A) ※1						
		200V/50Hz	220V/60Hz	240V/50Hz	200V/60Hz	220V/60Hz	230V/60Hz	240V/60Hz
		380V/50Hz	400V/50Hz	415V/50Hz	380V/60Hz	400V/60Hz	440V/60Hz	480V/60Hz
PKS-016	2.2kW (4P)	8.6	8.5	9.3	8.2	7.6	7.6	7.5
		4.9	5.1	5.2	4.5	4.4	4.3	4.3
PKS-030	3.7kW (4P)	14.4	14.1	15.0	13.8	12.8	12.6	12.3
		8.1	8.4	8.7	7.4	7.3	7.1	7.2
PKS-070B	11kW (6P)	36.2	35.0	38.1	37.2	34.6	34.5	34.3
		20.2	21.1	22.0	20.0	20.0	19.9	19.8

* 1 Rated current are about standard motors. Should you use other motor, confirm the specific by the motor nameplate.

Table 3 Terminal size about standard motor for connection

Model	Terminal Screws※ 1	Earth terminal Screws※ 1	Applicable minimum diameter※ 2	Cable maximum line length※ 3	Over-current Breaker (A)※ 4	Minimum diameter of Earth cable
PKS-016	M4 (Terminal block)	M5	1.6mm	23m	30	1.6mm
PKS-030	M5 (Terminal block)	M6	2.0mm	23m	50	2.0mm
PKS-070B	M6 (Terminal block)	M6	14mm ²	37m	125	8mm ²

- ※1 Terminal screw size are about standard motors. Should you use a motor it is not standard, please confirm the motor specification.
- ※2 Applicable minimum diameter are for Metal tube wiring three storage(Direct-in start connection).
- ※3 Cable maximum line length are rough reference which suppose a voltage drop to an end of cable to less than 2% in minimum diameter.
- ※4 Over-current Breaker is for power switchboard, please select a Motor Circuit Breaker to protect the motor. Motor circuit breaker had better select in rated output of the motor.

**WARNING**

Install and operate this 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 this product.

**WARNING**

- 1) Turn OFF the Power Supply to do the electrical connection. Never try to work on it on keeping the electricity turned ON.
- 2) You have a risk of getting electrical shock when the machine caused a failure or electrical leakage. Make sure to have the steady grounding. You are also recommended to install a dedicated earth leakage breaker.

**CAUTION**

- 1) Install a safety circuit suitable for the capacity of the motor. If a safety circuit is not installed, or if a safety circuit that is unsuitable for the motor capacity is installed, the motor will be damaged leading to fire.
- 2) A correct wiring work must observe the law and the rule that relates safely. A wrong wiring work might start a fire.

**WARNING**

IE3 motor is used for this pump.

Striking current tends to be high because efficiency of IE3 motor is higher than conventional motor. Because of this consequence, there could be momentary operation by striking current of the motor in the case of current set rating of MCCB (Molded Case Circuit Breaker), ELCB (Earth Leakage Circuit Breaker) and THR (Thermal Relay).

It is required to readjust setting of MCCB, ELCB and THR.

3.7 Check and Replace V-belt

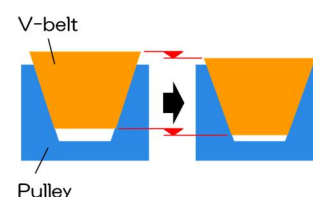


- 1) When performing the work of the inspection/replacement of the belt, perform the work after turning off the power switch without fail.
- 2) The measures such as lockout/tag out should be executed not so as to turn the power switch by mistakes during working.

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.



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 4. 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 4. Range of deflection load".
- 7) If the tension of belt is right, attach the belt cover.

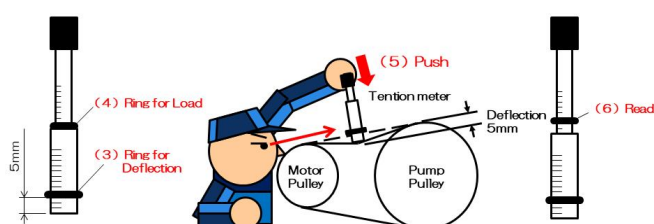


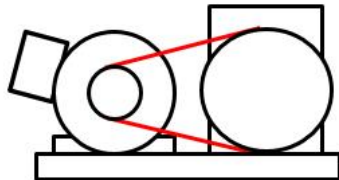
Table 4 Deflection volume and deflection load of belt

Model	Operating frequency	Reference value of deflection volume	For new belt tightening	For re-tightening
			Range of deflection load	Range of deflection load
PKS-016	50Hz	6mm	0.9~1.4kg	0.9~1.2kg
	60Hz	6mm	0.8~1.2kg	0.8~1.0kg
PKS-030	50Hz	8mm	1.2~1.8kg	1.2~1.6kg
	60Hz	8mm	1.1~1.7kg	1.1~1.4kg
PKS-070B	50Hz	10mm	1.9~2.9kg	1.9~2.5kg
	60Hz	10mm	1.9~2.9kg	1.9~2.5kg

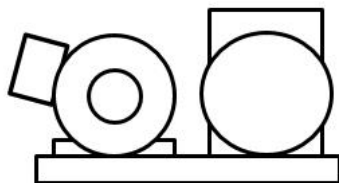
Replace and Re-tension the belt

<PKS-016>

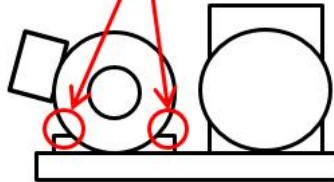
1. Shut down the pump and be sure to turn OFF the power supply.
2. Open the vent valve.
3. Remove the belt cover.



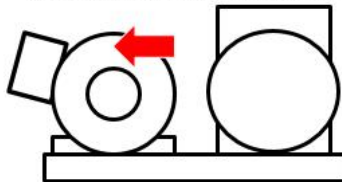
4. Remove the belt.



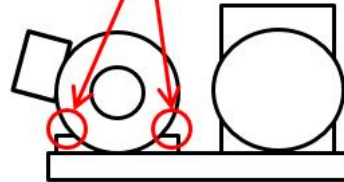
5. Loosen 4 bolts.



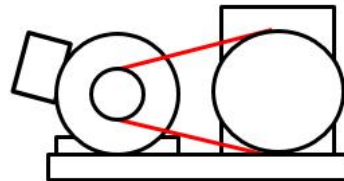
6. Slid the motor to the direction of the arrow.



7. Tighten 4 bolts.



8. Attach the belt.

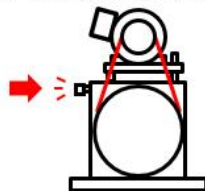


9. Measure the tension of the belt
OK→Go to 10
NG→Back to 4

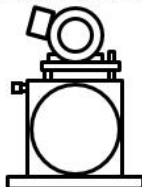
10. Attach the belt cover

<PKS-030, PKS-070B>

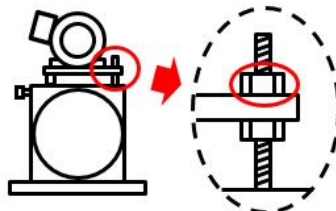
1. Shut down the pump and be sure to turn OFF the power supply.
2. Open the vent valve.
3. Remove the belt cover.



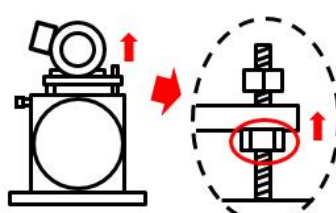
4. Remove the belt.



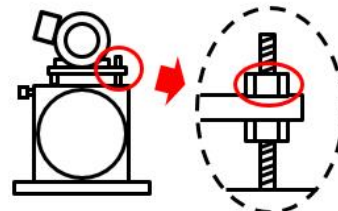
5. Loosen 2 nuts.



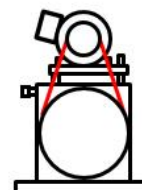
6. Close the nut in the direction that lifts the motor base.



7. Tighten 2 nuts.



8. Attach the belt.



9. Measure the tension of the belt
OK→Go to 10
NG→Back to 4

10. Attach the belt cover



CAUTION

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

4. Operation

4.1 Caution on Operation



- 1) The Pump oil might deteriorate in a shorter time depending on the application.
It is recommended to replace Pump oil the first within ten days after operation, and the oil replacement cycle is determined by the become dirty condition of the oil.
- 2) If the Pump is sucked a large quantity of water, you should replace the oil more frequently. If the Pump is kept operation without getting rid of sucked water, it would deteriorate lubrication of the oil and further help corrosion of the Pump inside and result in causing a failure. Do not store the Pump keeping sucked the water.
- 3) If the Pump sucked in chemical material such as acid, immediately replace the oil as it would cause the rust during the stop in one night to make the system does not applicable to operate.
We shall be not liable to the durability to chemical material.
When using this product in suction of chemical material, it is out of range of warranty.
- 4) You should also replace the oil, if the Pump sucked in the solvent which might deteriorate the oil. The Pump will be crashed in keeping operation with be sucked solvent. You shall have a risk if sucked in the solvent in operation even you replaced the oil.
When using this product in suction of solvents, it is out of range of warranty.
- 5) Caution shall be required for the operation under high pressure range.
 - a) Continuous operation one hour or more under high pressure 1000Pa or more would increase the oil volume that are discharged as the oil mist and cause rapid parts wear or cause a trouble such as burning.
 - b) You are recommended to control the oil level on regularly supplying the Pump oil.
 - c) The maintenance cycle might become shorter.



It is necessary to flow the cooling water during the operation. Be sure to check the water flow rate below.

(However only PKS-016 doesn't need to flow the cooling water.)

- Flow rate PKS-030 : 3 to 6 L/min
- PKS-070B : 5 to 9 L/min



This Pump is not pressure-proof.

- 1) 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.
- 2) This product is not made as the withstand pressure structure. Ensured pressure value of the Pump shall be 0.03MPa (0.3kgf/cm²) (Gauge pressure).
If any valve was put to a pipe after the Exhaust outlet, check and ensure that it is open.

Before starting the Pump, check the following again.

- (1) Piping and wire connection are completed.
- (2) Checking the oil level

Ensure that the oil level is between the two level lines on the oil level gauge.

4.2 Operation Start

Before starting the Pump, check the following again.

- (1) Piping and wire connection are completed.
- (2) Checking the oil level

Ensure that the oil level is between the two level lines on the oil level gauge. The oil level could be come down after operation. The oil level is lowered than limit level, you should fill the oil.

- (3) Checking the water flowing

Checking the cooling water is flowing.

- Flow rate PKS-030 : 3 to 6 L/min
- PKS-070B : 5 to 9 L/min

- (4) Checking the rotation

Close the main valve in pump inlet side, open the leak valve, and confirm the Pump which can rotate by hand lighter. There would be a problem, if the rotation is heavier.

(5) Checking the rotating direction

Close the main valve on the Inlet side, open the leak valve, and run the Pump for two to three seconds to check the rotating direction of the motor.

If the motor is rotating in the correct direction (Clockwise as viewed from the motor side), pressure will drop. If it is reversed, interchange two of the three wires shown in Fig, 11.

(6) After checking (1), (2), (3), (4) and (5) above, close the leak valve and run the Pump. Here, ensure that the vacuum gauge between the main valve and the Pump indicates a pressure close to the ultimate pressure.



CAUTION

Be sure to flow the cooling water with the volume indicated on the Table. 1 or more. If the Pump run without flowing the cooling water, the Pump will be broken down, or the high temperature steam is jetted due to evaporating the inside remaining water.



CAUTION

1) The Pump was designed rising up temperature when the Gas ballast valve opens so that effect of gas ballast is improved.

Pump Room temperature + about 60°C (gas ballast open)

Motor Room temperature + about 55°C (gas ballast open)

You have a risk of getting burnt. Do not touch the Motor and Pump unit as they become high temperature during operation. Apply an appropriate protection to avoid touching the surface as necessary.

2) The pump temperature is “Room temperature + about 30°C” as a normal (when the pump operate in the ultimate pressure, and Gas ballast valve is close).



3) Refrain from touching any part other than valve when operating the Gas ballast.

4) Ensure to close the Gas ballast to start the operation. The oil might jet out during operation around high pressure range.

5) Oil mist would appear through the Exhaust side if operated around high pressure range. Attach the oil mist trap (option) and perform the duct piping, and pass the oil through the removal devices.



CAUTION

- 1) As the viscosity of pump oil is higher in the low temperature, the Pump is difficult to operate with standard power. The pump runs with opening the leak valve and inlet completely for several minute, the pump temperature get rising, and the current get low by normal value. If the current of Pump doesn't low immediately or the current fluctuates irregularly, you must stop the Pump.
- 2) You have to stop the Pump, if you heard the abnormal sound or vibration of the pump.



CAUTION

Please countermeasure the following, when the rotation isn't smooth at a start.

- 1) Check the oil level and fill the Pump with the oil.
- 2) The pump stops even at atmospheric pressure inside for more than 3 days, the oil was sucked into cylinder of the Pump. The over load protection device would work so that the pump need to start higher power than normal due to sucked oil. In this case, please do inching (switch ON to OFF for a short time) several times.

4.3 Operation Stop

- (1) Close the main valve on the Inlet side, and stop the Pump.
- (2) Open the Suction leak valve to make atmospheric pressure inside the Pump.



CAUTION

The Vacuum pump gets high temperature during operation. Refrain from touching the Motor and Pump unit Pump cools down after having stopped operation.



CAUTION

- 1) Ensure to close the Main valve and open the Leak valve to stop the Pump. if failed in following this procedure, the Pump cylinder gets filled with the oil in several minutes, which might make difficult to restart operation or give damage to the Pump unit. Further the oil might accidentally flow back to the Vacuum chamber.
- 2) If failed in closing the Main valve, the vacuum might leak from the Exhaust side through the Pump unit.

- (3) 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.

4.4 Gas Ballast Function

Breathed condensed gas shall be liquefied through the compress process of the Pump, mixed with the Pump oil and then cycled mixed together inside the Pump unit. This status brings you the same situation that you used the high steam pressure oil that raises the ultimate pressure. It also shortens the life cycle of the Shaft seal since the oil lubrication shall deteriorate.

If introduced the air or dry nitrogen through the gas ballast valve just before the Pump compression process, the condensed gas is not liquefied but exhausted with the air through the Exhaust valve.

- (1) To use the gas ballast, breathe in the air through the gas ballast valve before sucking in the condensed gas and operate the Pump around twenty minutes; this is because the “gas ballast effect” becomes larger as the Pump temperature is higher up to about 70°C. Wait until the Pump temperature raises enough to open the main valve so as to operate the Pump. The “gas ballast effect” under low temperature shall be lower than the specified process performance.
- (2) Note further that keeping the gas ballast valve open when not breathing in the condensed gas shall cause the Pump oil splashing and power loss and further rise the ultimate pressure. If the Pump doesn’t breathe the condensed gas, you have to use the pump with closing the gas ballast valve.
- (3) You have to note also that the condensed gas might remain in the Pump oil after you have exhausted a lot of condensed gas or exhausted the condensed gas (air or gas that contains less water or other steam that contaminates the oil) without opening the gas ballast valve since the process capacity of the condensed gas by the gas ballast valve is limited. In such a case, close the Main valve, breathe in the air through the gas ballast valve and idle operate the Pump. Then the oil temperature shall rise up and be cleaned by means of the Gas ballast effect. Keep on idle operating the Pump without opening the gas ballast valve as far as the specified ultimate pressure is attained. You need to replace the Pump oil if it was not cleaned after operated long time.
- (4) The water would be collected in the bottom of Oil-tank when the large quantity of water is sucked into the pump which can’t process the condensed gas more than the limit of capacity.

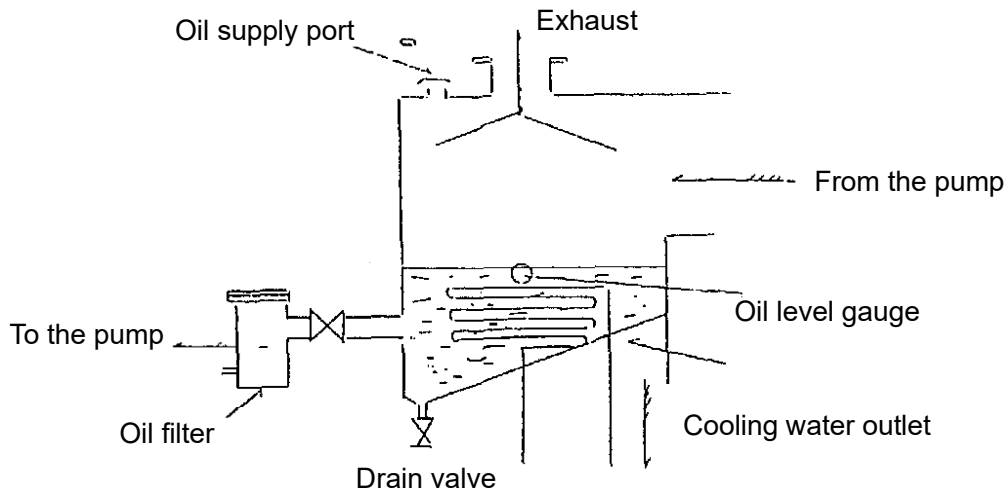


Fig. 13 Oil tank structural drawing



- 1) The Vacuum pump gets high temperature during operation. As the gas ballast valve also gets high temperature, be sure to wear protective gear such as a pair of gloves.
- 2) Ensure to close the gas ballast valve to start operating the Pump. The oil might jet out of the gas ballast valve during the operation around high pressure range.



If you kept opening the gas ballast valve when not exhausting the condensed gas, it might cause the oil splash, power loss or ultimate pressure rise. Keep the gas ballast valve closed when not exhausting the condensed gas.



The guaranteed pressure resistance of this pump is 0.03 MPa (0.3 kg / cm²) (gauge pressure). Operate the supply pressure of the gas ballast gas to be introduced within the following range.
 Supply pressure: Atmospheric pressure to 0.03 MPa (0.3 kg / cm² (gauge pressure)) or less.

4.5 Vacuum Pump Oil For cold district

Starting the Pump operation might become difficult in winter season, outdoor, or in the cold district.

This is the overload phenomenon caused by increased viscosity of the Pump oil. To make sure, you should confirm that the capacity of the motor overload protective device conforms to the motor rated value, the Pump is not broken and the cable does not have abnormality. Then, warm up the Pump oil or replace the oil with the Vacuum pump oil ULVOIL R-42 having lower viscosity.

Recommended type of oil:

- (1) ULVOIL R-72 (standard oil)
- (2) ULVOIL R-42 (For cold district in winter. In the case of ambient temperature 4~10°C)



The ULVOIL R-72 could be difficult to use for the Pump in 10°C or less. The rotation is heavier in the cold temperature because of low viscosity of the oil in the Pump. If the pump use The ULVOIL R-42, the pump can run in about 4 °C. The ULVOIL R-42 is lower viscosity than ULVOIL R-72. However, it is over 10°C, you must use back to ULVOIL R-72. There is a risk of using the ULVOIL R-42 in over 10°C, the pump is occurred leaking the seal parts or oil because of low viscosity.

4.6 Oil mist trap (TM-2/TM-3/TM-4 (optional part))

The oil mist trap can be mounted The TM series (as optional parts) to trap the oil mist discharged from the Pump (refer to “Table 5”). The TM series can be removed the oil mist more than 90%, they can be made the Clean environment, and they also can be reduced the sound of exhaust. However, if the pump is run in higher inlet pressure (over 6.7kPa) or keep sucking the high temperature gas, the TM series be occurred clogging with oil sludge in a filter element due to high pump temperature. The clogging with oil sludge is occurred in the conditions such as large amount of oil mist passing the TM series, it can be occurred even the oil doesn't be deteriorated.

Table 5 Recommended the oil mist trap for Pump models

Oil mist trap	Pump	Bolts	O-ring
TM-2	PKS-016	M8×L20, 4pc.	JISB2401 V70, 1 pc.
TM-3	PKS-030	M10×L25, 4pc.	JISB2401 V100, 1 pc.
TM-4	PKS-070B	M10×L25, 8pc.	JISB2401 V120, 1pc.

5. Pump Performance

5.1 Ultimate Pressure

“Ultimate pressure” described in the catalogue and this document means “the limit value pressure obtained by the Pump in a state not introducing any gas through the suction inlet (no load operation).”

ULVAC measures the value by the Pirani gauge connected to the Pump suction inlet using the specified vacuum pump oil after having completely blocked out the Pump unit from the system.

Be cautious as the Pirani gauge as well as the thermocouple vacuum gauge would indicate a value 5 to 10 times much than the value that the McLeod gauge shall indicate. This is caused by the fact that the McLeod gauge shall get rid of the condensed gas constituent (mainly water) included in the measured gas.

Actual vacuum equipment on the site shall likely to raise the ultimate value higher than the catalogue value as the vacuum gauge was put far away from the Pump or maybe affected by the water drop, rust or other substances attached to the system inside wall or pipe, or water vapor and miscellaneous gas generated from attached substances. It is because the oil vapor pressure is raised up since the volatile gas melt in the Pump oil, foreign substance and gas sucked in the Pump from the vacuum chamber might contaminate the gauge head and/or decompose (deteriorate) the Pump oil constituent.

5.2 Pumping Speed

Exhaust speed of the Oil rotary pump shall vary depending on the type and pressure of the sucked gas. It shall indicate the maximum exhaust speed in the high pressure range and lower speed little by little lower becomes the pressure.

Effective exhaust speed of this machine is the maximum value when it sucked in the dried air.

Fig.13 to Fig.15 show the relation of the suction pressure and exhaust speed.

5.3 Power Requirements

Motive energy to drive the Vacuum pump is a total value of the work of the mechanical element on the rotary friction (mechanical work) and the work of compressing the air (compression work) that becomes maximum when the suction pressure is between $3 \times 10^4 \sim 4 \times 10^4$ Pa. If the pressure went down under 10Pa, the compression work becomes smaller, then most of the motive energy shall be spent on the mechanical work. General use of the Pump shall indicate the largest load pressure range while the suction pressure was between $3 \times 10^4 \sim 4 \times 10^4$ Pa.

Operation opening the gas ballast valve would require larger motive energy at all the time as its compression work is large even the suction pressure was small. Further, when the temperature of the Pump site was low (in cold district or outdoor installation) starting the Pump would require larger motive energy since the Pump oil temperature was low and its viscosity is higher. However the motive energy value shall decrease and come stable as

the oil viscosity comes lower while the Pump temperature shall rise as it goes through operation.

IMPORTANT PKS-016 will exceed the rated current of motor the pressure range of 13.3kPa to 53.2kPa. The continuous operation of the pump in this pressure range is caused of some troubles such as Motor burning so that you have not to operate continuous in this pressure range or have not to exceed rated current with arranging inlet pressure by the main valve.

IMPORTANT PKS-030 will exceed the rated current of motor the pressure range of 13.3kPa to 53.2kPa. The continuous operation of the pump in this pressure range is caused of some troubles such as Motor burning so that you have not to operate continuous in this pressure range or have not to exceed rated current with arranging inlet pressure by the main valve.

Fig.13 to Fig.15 show the relation of the suction pressure and Power requirements.

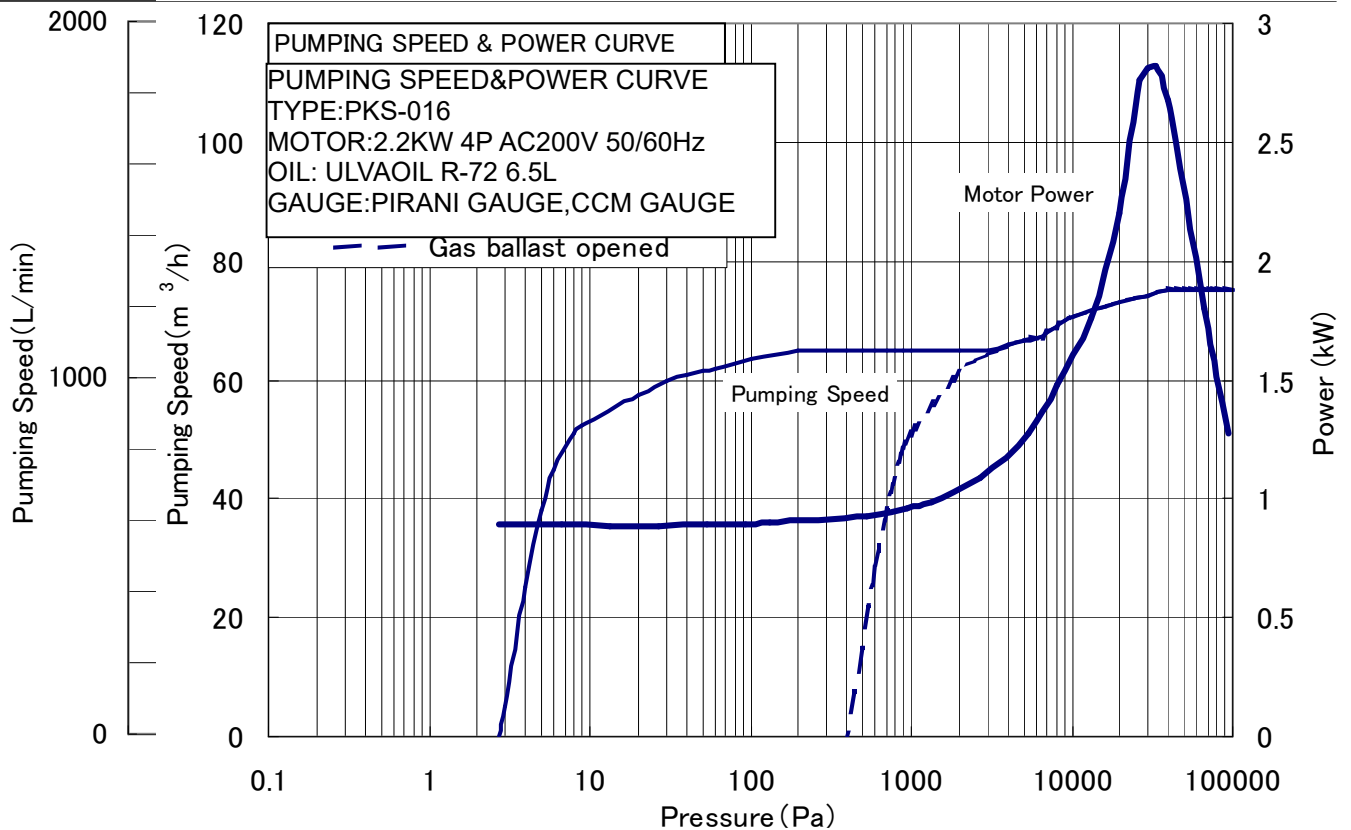


Fig. 14 Pumping speed and Power Requirement curves about PKS-016

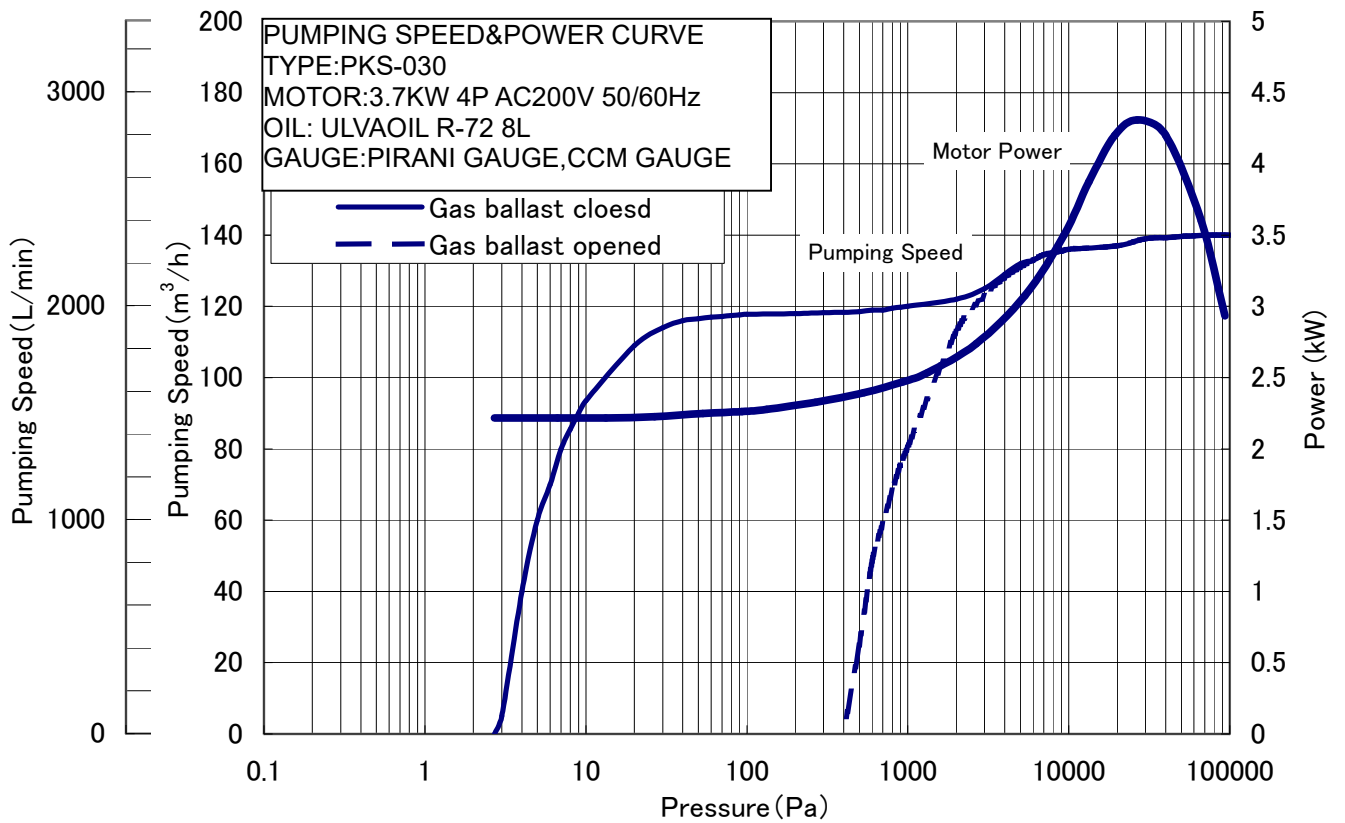


Fig. 15 Pumping speed and Power Requirement curves about PKS-030

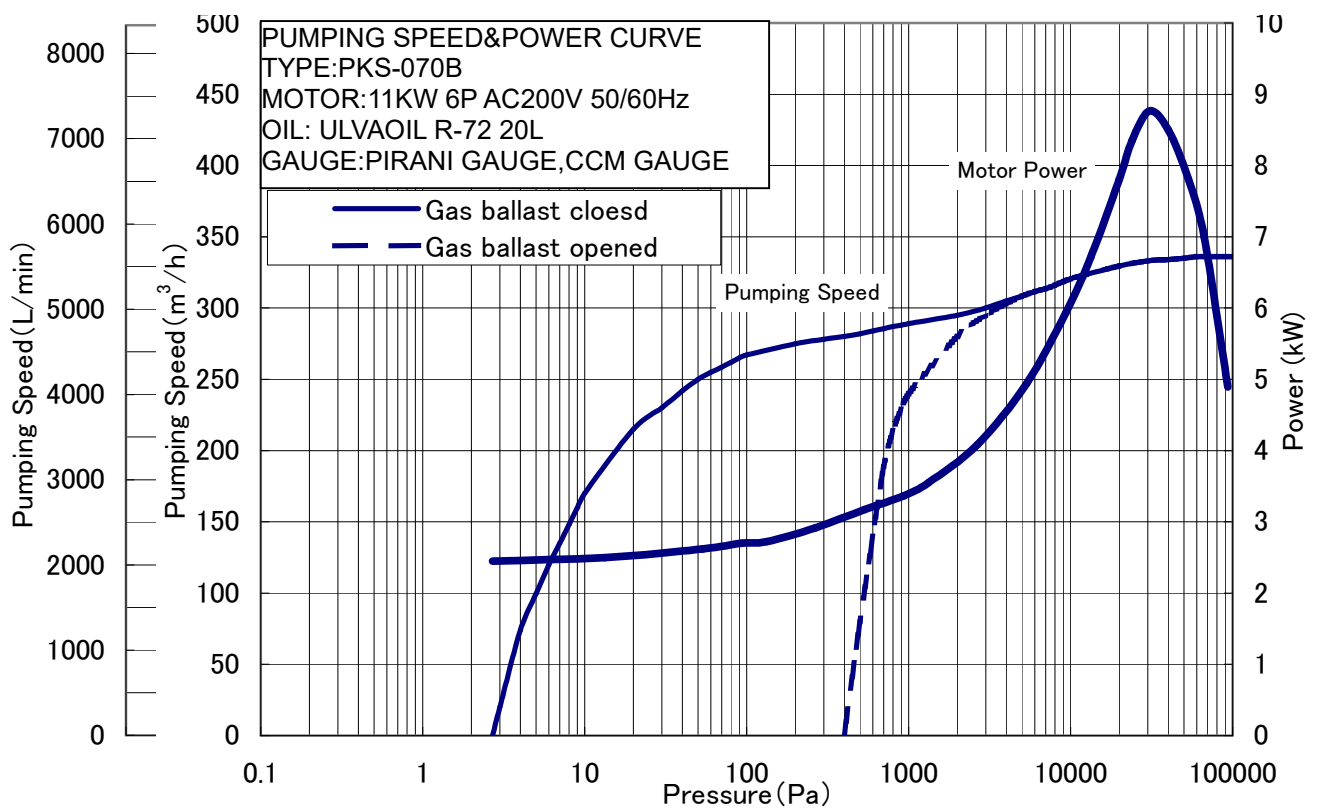


Fig. 16 Pumping speed and Power Requirement curves about PKS-070B

6. Maintenance and Check

6.1 Maintenance

You should check following points at least once per three days while you continue operation.

Check the machine much more frequently during high overload operation (continuous operation at 1000Pa or more, repeated operation between atmospheric pressure and vacuum).

- (1) Whether the Pump oil volume is between two level lines or not.
- (2) Whether the Pump oil is discolored or not.
- (3) Whether there is no foreign noise.
- (4) Whether there is no water leak from the Pump.
- (5) Whether there is no oil leak from the Pump.
- (6) Whether there is anything strange in the motor current value.

6.1.1 Operation in the winter (for vacuum pump oil : ULVOIL R-42)

Standard oil is ULVOIL R-72, If the pump is difficult to start operation please replace ULVOIL R-72 of Standard oil to ULVOIL R-42 for using the winter after the following check.

- (1) Whether the belt is not loose or not
- (2) Whether the fuse capacity for motor is not shortage
- (3) Whether rotating of the belt is not tight by hand or not

ULVOIL R-42 can use April to November in Japanese domestic because of the cold temperature although the oil should be back to ULVOIL R-72 in about December to March. If you use R-42 except for in winter, it would be occurred some troubles.

6.2 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.

6.2.1 Pump Oil Level Check

The Pump oil level should be between the two level lines on the oil level gauge. (Refer to Fig.4 to 6)

6.2.1.1 Lubricating

Remove oil the filling plug, and fill the Pump with oil until oil level should be between the two level lines on the oil level gauge.

Fill the Pump with oil regularly so that the pump lifetime is to become longer. It has a risk of being lowered performance and broken down, when the Pump is run under the following conditions.

- 1) Oil level is lower than limit level
- 2) Oil color is getting cloudy black

6.2.2 Vacuum Pump Oil Check

The vacuum pump oil will be gradually deteriorated the cause of got contamination by sucking gas or high temperature of the Pump. Replace the pump oil periodically by contamination or viscosity.

If substances of low boiling point (water, organic solvent, etc.) are mixed with pump oil or sludge collects on the bottom of the Pump case, the ultimate pressure cannot be recovered by one oil change, but the oil must be changed several times.

If the Pump is operated using pump oil containing much moisture content, the ultimate pressure is rise, leading to poor function of the mechanical friction parts of the Pump. In the worst case, the Pump will seize up and cannot be rotated.

Check and replace the oil periodically, and determine the oil replacement cycle by application.

(1) Periodic replacement the vacuum pump oil

Should you replace the vacuum oil with new one periodically, the pump life would be longer and maintained the performance. Check the contamination of the oil from keeping watch over the oil level gauge window and oil filter.

Fill the Pump with oil until oil level should be between the two level lines on the oil level gauge. Table 6 indicates the Replacement timing of vacuum pump oil.

(2) Oiler

The bearings in the pump are also lubricated by the vacuum pump oil. You should check the oil level of the Oiler in Bearing-case upper part. The pump needs to be filled the oil when the oil is not enough. You should fill the oiler with oil until 80% of all. If you should not fill the oil up to 100%, it is possible to be overflowed the oil out of the oiler due to the thermal expansion.

Note: The oiler in the vacuum pump oil is also supplied with the bearings of the pump.

However, the reduction rate of oil in oiler may be difference by the machine; the pump performance would not be deteriorated. Although there are two oilers in the Pump, the reduction rate of oil in the oiler may be different from the deterioration of the oil seals.



When the reduction rate of the oil in the oiler becomes 0.1 cc or more per hour, the oil seals are deteriorated, replace the oil seals.



The oil could not be flowed into a Bearing-case after overhaul or oil level was lowered completely. Please remove a plug in the bearing case upper part and fill the oiler with the oil. The oil is overflowed out of the plug hole after replacing the air with oil in the Bearing-case. Please tighten the plug, and fill the oiler with the oil until 80% of all.

Table 6 Replacement timing of vacuum pump oil

Application	Replacement timing
Vacuum system for study / laboratory, small vacuum system	Within 6 months ~ 1 year
Vacuum system for production / vacuum evaporation	Within 3 ~ 6 months
Vacuum valve exhaust system / large vacuum evaporation system	Within 3 months
Metallurgy vacuum system such as thermal treatment, melting and the like	Within 1 month
High vacuum dry / vacuum impregnation vacuum formation and vacuum packing system	Within 1 month
Low vacuum dry / pug mill / food packing system	Within 1 week

Proceed as follows.

- (1) 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. (Refer to Fig.4 to 6) Fresh 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.



DANGER

Use of the toxic, combustible or combustion susceptible gas and substance other than inactive gas is not allowed by the vacuum pump.



If the Pump was used to exhaust the toxic gas, the Pump oil as well as the Pump unit shall become toxic. Pay a full attention.



CAUTION

1) Read “1. 2 Chemical Material Safety Data Sheet” previously before starting lubrication.

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



2) Wear protective gears such as rubber gloves, protective goggles and so on.

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



CAUTION

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.

6.2.3 Oil Leak Check

The Pump system needs repair if occurred any oil leak from the Shaft sealing or Pump unit. Type of the seals and O-rings are listed at the end of this document. Please contact the Service Center close to you for purchase and repair.

6.2.4 Checking Gas Ballast Function

When used the Gas ballast function, the valve or in the introduction passage inside the Pump may be stuck in the dust. Replacement parts and repair support at the local service center. Please contact us.

6.2.5 Checking Metal Mesh at the Suction Inlet

The Suction inlet might be clogged by the dust contained in the gas breathed in from the Vacuum chamber and thus the Pump performance might be impaired.

If there is the metal mesh is dirty, please wash that.

Further it is anticipated that any welding scale drops off in the pipe particularly at the beginning of the system start. Be fully cautious.

6.2.6 Checking Noise and Abnormal Vibration

Checking around the Pump

- 1) Check whether bolts and nuts and the like fixing the Pump are loose or not.
- 2) Check whether pipes connected to the inlet/outlet are loose or not.
- 3) Check and ensure that there is no leakage from the piping and valves.

Checking the Pump

Please refer to the “6.2.6 Trouble shooting.”

Should the condition was not recovered after having checked points indicated there, please contact the closest Service Center.

6.2.7 Checking belt

Checking the V-belt the following when the pump is replaced the new oil.

- (1) Whether the belt tension is appropriate or not.
- (2) Whether the belt and pulley has a abnormal wear or crack or not.
- (3) Whether the water and oil adhere to the belt or not.

If you can't solve a problem even if you check the mentioned above, please contact the Service Center close to you.



- 1) When performing the work of the inspection/replacement of the belt, perform the work after turning off the power switch without fail.
- 2) The measures such as lockout/tag out should be executed not so as to turn the power switch by mistakes during working.

6.2.8 Checking oil mist trap

To use the Oil mist trap, be cautious not to have clog of the filter element in the trap. Too much clog would prevent the exhaust gas from passing through the filter element, raise the pressure inside the Pump unit and might result in breaking it.

Limit value of the pressure inside the Pump is 0.03MPaG (0.3kg/cm²G) (Gauge pressure).

We recommend you to install a Pressure monitor. Refer to the Instruction Manual of the oil mist trap as for the install position of the pressure monitor. For the pressure monitor mounting position, refer to the instruction manual for the oil mist trap.

6.2.9 Checking drain valve

If you leave the drain valve with half opened for several months, it might get deformed that you might not be able to shut the Pump all the way. When storing the Pump, please make sure the valve is completely shut. If you are using the plug instead of valve, the same situation will be applied.

6.3 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.

6.4 Overhaul

If there found remarkable Pump contamination or performance deterioration due to the operation condition, you are recommended to conduct regular overhaul regardless of the check items described above.

Overhaul shall be required to keep the performance as well as the safety and further to continue this production on forecast.

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.



CAUTION

- 1) 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.
- 2) 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.

6.5 Trouble shooting

Table 7 How to distinguish breakdown and countermeasure for the Pump

Confirm the check items before contact our service center about marking "O".		Check items for countermeasure	Check the leak lubrication line and piping. Check the seal at the contact surface of exhaust valves.	Replace the oil seals.	Check the contact surface of Exhaust-valve, Valve-guide, and Slide-vane	Disassemble the Pump. If the pump can't rotate by hands.	Check the configuration of a thermal relay, and the pump oil which is our recommended.	Check the exhaust valve and outer ring of bearing.	Measure the current.	Replace the oil seal	Check the oil mist trap which is not clogged up.	Check and repair, or replace the parts.	Check and repair, or replace the parts.	Check the exhaust valve. And check the flowing of oil.	Check and repair.	Disassemble and repair.	
Check items for countermeasure	Oil lubrication line is correct or not?	<input type="radio"/>													<input type="radio"/>	Confirm the oil circulation valve does not have a problem by eyes or not.	
	Whether the oil is filled over the upper line or not?	<input type="radio"/>										<input type="radio"/>				Drain the oil until the oil is between two lines.	
	Whether the pump oil is replaced soon or not?	<input type="radio"/>													<input type="radio"/>	Keep running the pump and wait and see until outgas evacuate.	
	Whether there is a leak at piping or not?	<input type="radio"/>										<input type="radio"/>			<input type="radio"/>	Seal at the leak	
	Whether the pump is keeping running in high pressure or not?	<input type="radio"/>			<input type="radio"/>				<input type="radio"/>		<input type="radio"/>	<input type="radio"/>			<input type="radio"/>	Replace the proper oil or replace oil more frequently.	
	Whether the pump is sucked foreign contamination or not?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				Install the filter at the pump inlet side (between inlet and chamber).	
	Whether the pump is sucked the solvent or not?	<input type="radio"/>	<input type="radio"/>						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					Install the proper trap at the pump inlet side (between inlet and chamber).	
	Whether the pump is sucked the dusts or not?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>				<input type="radio"/>	Install the trap at the pump inlet side (between inlet and chamber).	
	Whether the pump is sucked the water or not?	<input type="radio"/>							<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					Install the trap at the pump inlet side (between inlet and chamber).	
	Whether oil is deteriorated or not?	<input type="radio"/>	<input type="radio"/>				<input type="radio"/>		<input type="radio"/>	<input type="radio"/>					<input type="radio"/>	<input type="radio"/>	Replace the oil with the new one.
	Whether oil level is lower than limit level or not?	<input type="radio"/>			<input type="radio"/>										<input type="radio"/>		Fill the oil.
	Whether oil is in between two lines or not?	<input type="radio"/>															Fill or drain the oil to adjust the oil level
	Whether Screw bolts are loose on circuit board and motor base or not?				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>							<input type="radio"/>	Fasten the screw bolts and bolts.
	Whether the pulley key is not fix or not?				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>							<input type="radio"/>	Fix the pulley key to be loose.
	Whether the belt is loose or not?	<input type="radio"/>			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>							<input type="radio"/>	Move the motor to the proper position, and adjust the belt tension.
	Whether the gas ballast valve opens or not?	<input type="radio"/>													<input type="radio"/>		Gas ballast valve closes by hands.
	Whether the cooling water doesn't flow or not?	<input type="radio"/>	<input type="radio"/>						<input type="radio"/>								Confirm the cooling water is flowed by eyes.
	Whether the cooling water is flowed or not?	<input type="radio"/>															Confirm the cooling water is flowed by eyes.
	Whether pulley and rotation speed is correct or not?	<input type="radio"/>													<input type="radio"/>		Motor pulley replaces the correct one so that the rotation is correct.
	Whether the rotation direction is correct or not?	<input type="radio"/>			<input type="radio"/>												Rotate to be correct
Whether the pump pulley rotates or not?	<input type="radio"/>				<input type="radio"/>										<input type="radio"/>	Supply the power	
Whether the motor pulley rotates or not?	<input type="radio"/>				<input type="radio"/>										<input type="radio"/>	Supply the power.	
Trouble	Ultimate pressure is worse.																
	Pump oil leak out.																
	Abnormal sound is occurred.																
	Pump doesn't start.																
	Pump doesn't work in winter.																
	Abnormal vibration is occurred.																
	The circuit breaker is thrown.																
	Oil in oiler is reduced earlier.																
	Oil level gauge is pushed out.																
	Oil is jetted out from outlet																
	Bearing grease is dripped.																
	Pump temperature is very high.																
	Ultimate pressure is getting worse.																
	Rotation isn't steady. Pump can't rotate finally.																
	Check items for countermeasure																

Table 8 Trouble shooting

Trouble	Causes	Processing Method
The Pump does not run.	Motor connection is wrong.	Check the connection
	Motor pulley and pump pulley doesn't rotate.	Check the electric power line.
	Safety circuit such as a MS(Magnetic Switch) is not correctly set.	Make the Safety circuit conform to the Motor specification.
	Belt is loose.	Fasten the belt.
	Pulley key does not fix.	Fix the key.
	Collect the oil into the cylinder.	Conduct the inching at a start up.
	Oil viscosity got higher.	Change oil.
	Foreign substance entered in the Pump caused burning the rotor or the like.	Conduct the overhaul (Replacement of the cylinder, rotor, cover and so on.)
	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.)
The pressure does not decline, and the Pumping speed is slow.	Gas and ballast leak valve don't close.	Close Gas ballast valve and leak valve.
	Rotation direction is wrong.	Do the connection again to correct the rotation direction.
	Rotation speed is wrong. (Power supply frequency and motor pulley do not correspond.	Replace the motor pulley with proper one to correspond frequency and motor speed.
	Metal mesh at the inlet is clogged.	Remove the pipe above the inlet and wash the mesh.
	Oil is dirty. a. Water is being suctioned. b. Dust is being suctioned. c. Solvent vapor is being suctioned. d. Foreign substance enters in.	Replace with new oil. Conduct the 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.
	The oil is not circulating. a. Oil pit of the Cover or the like is clogged. b. Oil filter is clogged up. c. Electromagnetic valve is broken.	Disassemble, check, overhaul. a. Clean the oil pit. Replace the new oil. b. Clean the oil filter. c. Confirm the connection. Check and replace the electromagnetic valve.
	New oil pump was just entered.	Perform no-load operation for a while.
	The oil isn't supplied by the specified volume.	Supply the oil by the specified volume.
	Pneumatic valve is not normal.	Check and replace the exhaust valve and spring of exhaust valve.
	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.
	Pressure measurement method is wrong.	Measure correctly the pressure.
Pump exhaust capacity is smaller compared to the Vacuum chamber capacity.	Select another Pump type.	

Trouble	Causes	Processing Method
The pressure does not decline, and the Pumping speed is slow.	Water doesn't flow.	Confirm the water flowing.
	Vacuum gauge is not appropriate.	Use the Vacuum gauge that matches the measurement pressure range and correctly calibrated one to measure the pressure.
	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.
	Not using the ULVAC genuine oil.	Conduct the overhaul of the Pump and replace the oil with the ULVAC oil.
Unusual sounds and vibrations are occurred.	Bolts on the foundation or motor base are loosening.	Install as levelly as possible.
	The oil is not supplied by the specified volume.	Control the oil level. Supply the oil by the specified volume. Conduct the overhaul.
	Crackled sound is heard at the ultimate pressure.	When the sound is disappeared conducting Slow leak, it is not unusual.
	Belt is loosening.	Adjust the belt tension.
	Pulley key is not fixed.	Pulley key fastens again.
Abnormal heating	Keeping continuous operation under high inlet pressure.	Don't keep continuous operation under high inlet pressure.
	The oil is not supplied by the specified volume. (Pump temperature may be getting higher when the oil level is lower.)	Control the oil level. Supply the oil by the specified volume.
	Suction gas is hot.	Install a cooling device such as the gas cooler on the suction side.
	The oil is not circulating. a. Oil pit of the cover or the like is clogged. b. Oil filter is clogged. c. Electromagnetic valve is broken.	Conduct the overhaul. a. Clean the oil pit. b. Check and repair the oil distributor valve. c. Confirm the connection. Replace the electromagnetic valve.
	Gas ballast valve is opening.	The temperature is higher when Gas ballast valve is opened.
	Oil is dirty.	Replace with new oil. Conduct the overhaul.
	Cooling water is not flowing.	Confirm the cooling system.
Large amount of oil jet out from outlet.	Pump oil is filled over the specified volume.	Drain the oil until it gets the specified volume.
	Keeping continuous operation under high inlet pressure	Install the oil mist trap on the exhaust side.
Oil leaks to the outside of the Pump.	Deterioration of the O-ring and/or oil seal of the Case and Cover.	Conduct the overhaul.
Reduction oil in Oiler get earlier than usual.	Deterioration of the oil seals	Fill the Oiler to oil, and keep running. When the reduction rate of the oil in the oiler becomes 0.1 cc or more per hour, the oil seals are deteriorated, replace the oil seals.
Motor current value is abnormal.	Foreign substance entered inside the Pump impaired the Motor rotation.	Conduct the overhaul. Removal of foreign substance inside the Pump.
	Abnormal sliding of the rotor and/or vane.	Conduct the overhaul

Problem	Causes	Processing Method
Oil level gauge is pushed out.	Oil mist trap is clogged	Replace the element of oil mist trap.
	Pipes are clogged in the exhaust side.	Install the pipes wider than outlet diameter.
Initially, performance was being satisfied, but the vacuum degree became decreased.	Oil is dirty.	Replace with new oil.
Rotation is not steady, and the pump gradually does not rotate.	Motor and pump pulley are not rotating.	Confirm the connection of power.
	Belt is loosening.	Adjust the best tension.
	Pulley key is not fixed.	Fasten the pulley key.
	Oil is dirty.	Replace the new oil.

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.



- 1) **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.**
- 2) **Dispose the vacuum pump oil following the description of the [Caution on disposal] in the Chemical Material Safety Data Sheet. Contact our Sales division as for the SDS.**

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

- PKS-016
- PKS-030
- PKS-070B

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) Domestic business in Japan:

- Product, which has damage, caused by a failure on delivery.
- Products not satisfying the standard specifications although this product is used under the service conditions described in this document such as temperature range and power etc.

- (2) Direct export transaction:

- Product, which has damage, caused by a failure on delivery.
The warrantee scope shall confirm to INCOTERMS2010.
- Products not satisfying the standard specifications although this product is used under the service conditions described in this document such as temperature range and power etc.

8.4 Response procedure

- (1) Domestic business in Japan:

ULVAC send a replacement or Buyer return the defective items to ULVAC, Inc. or to the local ULVAC representatives for repair. If field service is required, Buyer shall ask ULVAC, Inc. or the local ULVAC representatives.

- (2) Direct export transaction:

ULVAC send a replacement or Buyer return the defective items to ULVAC, Inc. or to the local ULVAC representatives for repair. Return charge shall be paid by Buyer.

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) Failure occurred by noise.**
- (7) Secondary damage by defect of this Product defect.**
- (8) Secondary damage to Buyer by the reason that third party sued ULVAC for patent infringement.**
- (9) ULVAC engineer decided the reason of failure was improper use which does not conform to the use condition of this Product.**
- (10) 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 are subject to change without notice in future.**

9. Main Replacement Parts

Table 9 Main replacement parts list

1) For PKS-016

Description	Specification	Q'ty	Material	
			standard	Spec. K
Bearing	No.6307	2	SUJ	
Oil seal	VC-40625	2	NBR	FKM
	SC-406212	2	NBR	FKM
	TC-355511	1	NBR	FKM
O-ring	JIS B 2401 G105	2	NBR	FKM
	JIS B 2401 G75	2	NBR	FKM
	JIS B 2401 V70	2	NBR	FKM
V-belt	A-55(50Hz)	3	-	
	A-55(60Hz)	3	-	

2) For PKS-030

Description	Specification	Q'ty	Material	
			standard	Spec. K
Bearing	No.6410	2	SUJ	
Oil seal	VC-65885	2	NBR	FKM
	SC-658812 (custom-made)	2	NBR	FKM
	TC-478012	2	NBR	FKM
O-ring	JIS B 2401 P50	2	NBR	FKM
	JIS B 2401 G130	2	NBR	FKM
	JIS B 2401 VI00	2	NBR	FKM
V-belt	A-74(50Hz)	5	-	
	A-73(60Hz)	5	-	

3) For PKS-070B

Description	Specification	Q'ty	Material	
			standard	Spec. K
Bearing	No.21313	2	SUJ	
Oil seal	VC-70955	1	NBR	FKM
	SC-709513 (custom-made)	1	NBR	FKM
	VC-65885	1	NBR	FKM
	SC-658812 (custom-made)	1	NBR	FKM
	TC-628512	2	NBR	FKM
O-ring	AS568-253 (former AN6230-31)	2	NBR	FKM
	JIS B 2401 V120	2	NBR	FKM
V-belt	B-96(50Hz)	6	-	
	B-94(60Hz)	6	-	



This mark is applied to the electronic information product sold in the People's Republic of China. The figure at the center of the mark is the validity date of environmental protection. This product does not influence the environment, the human body and the property during the period reckoning the manufacturing date as long as the caution for safe use regarding the products are observed.

*The environmental protection validity date is not the product warranty period.

Table. Making format for names and contents of hazardous substances or elements

Name of parts	Hazardous substances or elements					
	Pb	Hg	Cd	Cr ⁶⁺	PBB	PBDE
Body	○	○	○	○	○	○

○: indicating that content of the hazardous substance or element in all homogeneous materials of the part does not exceed the requirements for concentration limits specified by SJ/T11363-2006.
 ×: indicating that content of the hazardous substance or element in, at least one kind of, homogeneous materials of the part exceeds the requirements for concentration limits specified by SJ/T11363-2006. Producer may further explain the technical excuse to the items marked with "X" perspecific conditions here.