

Oil Rotary Vacuum Pump

INSTRUCTION MANUAL

MODEL

VS Series

VS650B(-A, -W, -WL), VS750B(-A, -W)



Before using the pump, be sure to read this manual.
Afterwards, keep this manual at hand for immediate reference.

ULVAC, Inc.

www.ulvac.co.jp



Before Using the Unit

Oil Rotary Vacuum Pumps from ULVAC, Inc. (hereinafter referred to as "our company"): VS650B (-A, -W, -WL), VS750B (-A, -W) (hereinafter referred to as "this unit") Thank you for purchasing this product.

Upon receipt of the unit, please confirm the contents included are the same as you ordered and check the unit for any damage attributed to transportation etc. just in case.

This operation manual (hereinafter referred to as "manual") describes appropriate operation and maintenance methods in order to use the unit safely and effectively. Read this manual beforehand and use the unit correctly.

Install and operate this unit according to the local and national safety laws and regulations (such as fire laws and electric wiring code). Accordingly, you are required to take classes for general safety (electrical safety, cargo handling safety, etc.) that are valid in the country and the local area at the site. No one who hasn't take the classes can handle the unit.

The operator is required to have taken such trainings. In addition, the operator has expertise, skills, qualifications in electrics, mechanics, cargo handling, vacuum, etc.

This unit is designed to follow the current regulations as of the preparation of this manual. If the criteria of the regulations are changed in the future, the compliance is not guaranteed.

If the device with this unit built-in doesn't follow the same regulations, or if any changes are made to the unit itself, it may not be guaranteed to have its performance and safety. We don't guarantee (have no responsibility for) such performance and safety. Any unit modifications you have done are not covered by our warranty and we are not responsible for them.

Before installing/removing this unit, keep the unit from all the energy sources (such as electricity, compressed air, cooling water etc.)

All the parts of this unit are not intended for permanent use with the performance at the delivery. Even under the conditions of use expected in light of common sense, the performance inevitably deteriorates with time, which tends to cause trouble on the unit. We would like to ask you to grasp your conditions of use and cooperate to provide preventive maintenance to avoid any trouble.

If you cooperate with preventive maintenance measures, you can reduce the probability of troubles on this unit due to worn parts, and eventually the risk, such as downtime, fire, and effects on other processes due to unit troubles.

In addition, from the viewpoint of preventive maintenance, you are asked to prepare a maintenance and inspection plan and conduct parts replacement and overhaul accordingly.





If you have any unclear points, please contact the closest sales office, agency, or our Components Division

About Safety Notation











In this manual and warning signs on the unit, signal words and symbol marks are displayed in order for you to understand the matters to adhere. The meanings are shown below:

► Meaning of signal words:

The terms that signify the warning level for safety are referred to as "Signal Words."

	This indicates an imminently hazardous situation which, if the unit is misused, will result in operator's death or serious injury.
	This indicates a potentially hazardous situation which, if the unit is misused, could result in operator's death or serious injury.
	Signifies the possibility of suffering moderate degree of injury if the user failed in handling.
	Signifies important information about injury on human body.

► Meaning of symbol marks:

	Signifies potential danger for injury on human body.
	Signifies potential danger of electric shock.
	Signifies potential danger of high temperature.
	This indicates a potential hazard that causes a burst or explosion.
	This indicates a potential hazard that gets you caught in.
	Signifies the matters "prohibited" or must not to do.
	Signifies the matters "compulsory" or must to do.
	Signifies that a protective gloves must be worn.
	Signifies that a protective mask must be worn.
	Signifies that the operator must read the instruction manual.

Types and display position on warning labels

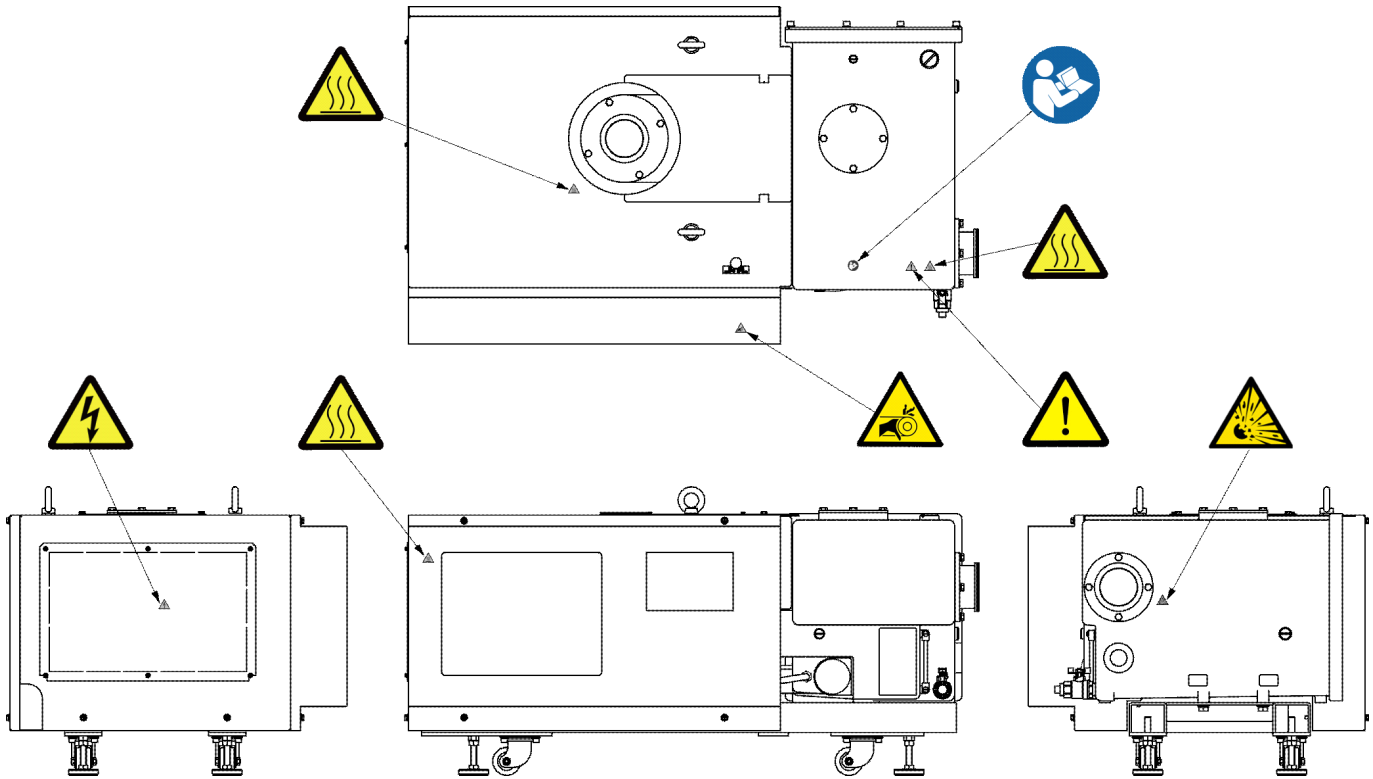
A warning label is attached onto a warning location on the unit. Never fail to check these labels before operating the unit.

► Types and explanation on warning labels

	<p>When this unit is stored without operation for a long period of time, problems with operation may occur due to the occurrence of rust or for other reasons. If the unit has not been used for a long period of time, contact your nearest ULVAC TECHNO or ULVAC service center for inspection.</p>
	<p>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.</p>
	<p>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.</p>
	<p>Do not operate the pump with any equipment installed on the outlet port side that prevents gas from passing in such a way as to block the outlet port. Pressure in this unit may increase, which causes damage to or oil leakage from the casing or level gauge, or overloads the electric motor.</p> <p>Explosive, flammable, and combustion supporting gases may be ignited in this unit, increasing its internal pressure. Do not discharge gases with these properties.</p>
	<p>This warning label indicates that there are moving parts around it. Take care not to get your hands or fingers caught in. Always close the panel and safety cover during pump operation. Be sure to turn OFF the power to the drive unit during maintenance. The moving parts may move even when the power is OFF. Take care not to get your hands or fingers caught in.</p>
	<p>Before use, read through the instruction manual and fully understand its contents.</p>

► Warning Label display position

■ For VS650B-A, VS750B-A (Air cooling type)



■ For VS650B-W, VS650B-WL, VS750B-W (Water cooling type)

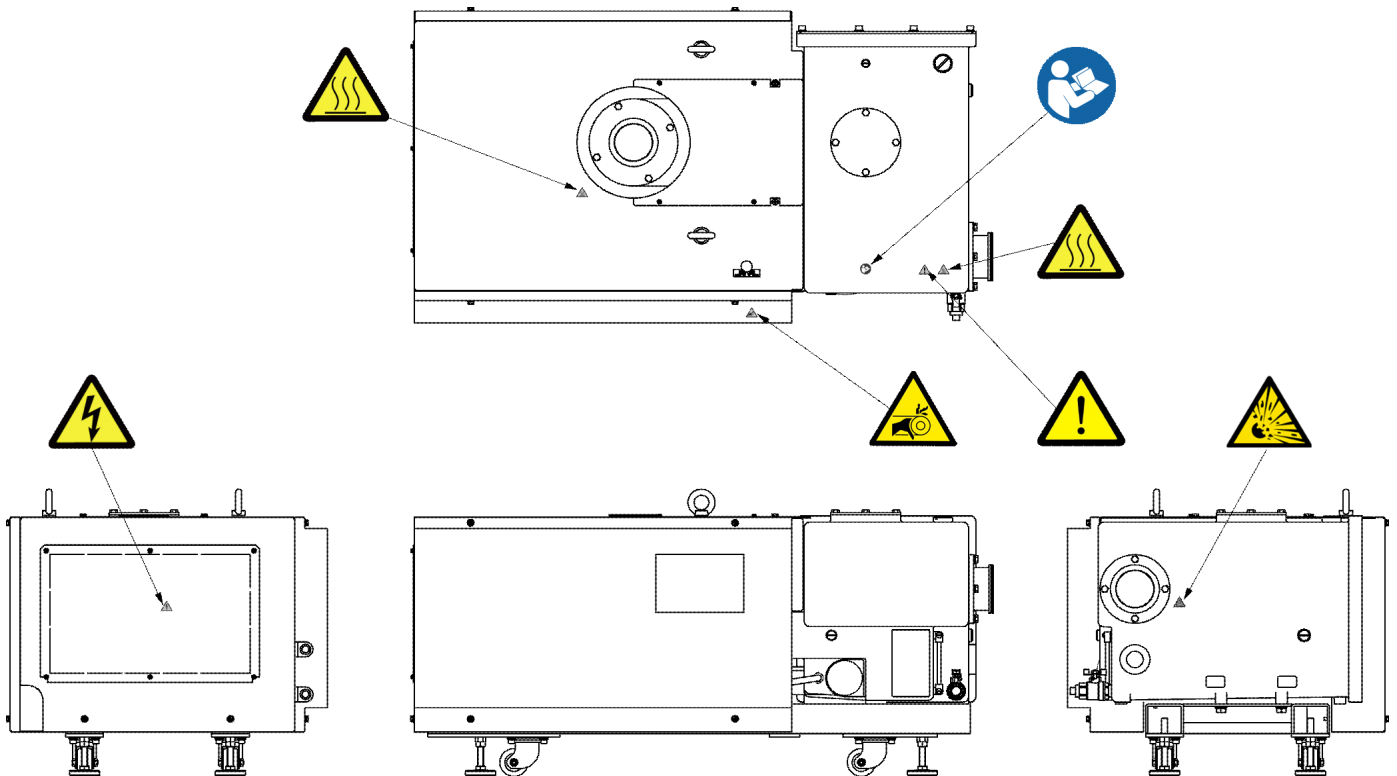


Figure 1: Warning label pasting position

Warranty Clause

This product is shipped after strict internal inspection. If you find any manufacturing defects, accidents during the transportation, or other defects attributed to our responsibility, please contact our Components Division at headquarters or the nearest sales office or agency. The repair/replacement is free of charge.

▶ Warranty Product

(a) Oil rotary vacuum pump: VS650B-A, VS650B-W, VS650B-WL
VS750B-A, VS750B-W

▶ Warranty Period

(a) Domestic: 1 year from the date of delivery.
(b) Direct export: 1 year from the date of B/L.

▶ Warranty Coverage

The warranty covers this unit only. If a failure or accident occurs in the exhaust of air or nitrogen due to defects in our design or manufacturing, we make repairs free of charge if it is within one year after the delivery.

(a) Domestic:

- For a product at the time of delivery with a damage because of trouble during transportation.
- For a product not satisfying the basic specification in spite of using the product within the service condition (temperature range, power supply, etc).

(b) Direct export:

- For a product at the time of delivery with a damage because of trouble during transportation.

However, for an international direct trade, it shall conform to the warranty coverage of international merchandise trade condition (INCOTERMS 2010 etc) defined at the time of each trade.

- For a product not satisfying the basic specification in spite of using the product within the service condition (temperature range, power supply, etc).

► Disclaimer

For any failures due to the following products or causes, it is out of warranty and repairs are borne by you even within the warranty period.

- Failures or malfunctions due to the exhaust of gas or substance other than air or nitrogen.
- Failures or malfunctions due to consumables.
- When using with a power supply with a power supply voltage and frequency that are different from those specified at the time of order placement.
- Failures and defects caused by natural disasters including fire, wind and flood, earthquake and thunderbolt, and unavoidable disasters including war.
- Failures and defects caused by careless handling or misuse.
- Products modified/disassembled/repared without our permission.
- Failures and defects under an abnormal environment (strong electromagnetic field, radiation environment, high temperature, high humidity, inflammable gas atmosphere, corrosive gas atmosphere, dust).
- Failures and defects due to noise.
- Product failure or indirect damage to your company in the event of a claim by a third party to us on violation of patents.
- When our engineers judge that the failures or defects are caused under the conditions of use inappropriate to this product.
- Out-of-warranty products
- **Consumable articles**

► How to Respond

(a) Domestic:

An alternative is delivered or the product is sent back to us or the nearest our ULVAC TECHNO, Ltd. for repair.

If it is necessary to respond on site, contact our Components Division, or the nearest sales office or agency for assistance.

(b) Direct export:

Return the product to our office or nearby service station. In response, we deliver a replacement or repair the product.

The return expense shall be borne by the customer.

► Others (Warranty Clause)

(a) If there are individual contracts and memorandum related to specifications in addition to this document, the contents in those documents prevail.

(b) Please let us know if you export this unit from Japan and take necessary procedures according to the provisions of export-related laws and regulations, such as foreign exchange laws and foreign trade laws.

(c) For any questions and consultation on this unit, check the model/serial number and then contact the nearest sales office or agency.

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(d) Note that the contents in this document is subject to change without prior notice.

About This Manual

In order for you to use this unit as long as possible, before working on the installment, operation, inspection or maintenance, read this manual carefully to fully understand the safety considerations, specifications, and operation of the unit.

Acknowledge in advance that, for improvement reason, the specification or price described herein may be subject to change without notice. When a change is made in this manual, the manual will be issued as a revised edition with the document number on the upper right of the cover page updated. If you need the latest version, contact your nearest sales office or agency.

Never fail to hand over this manual to the end user who actually uses the product.

Without our permission, any part in this manual cannot be duplicated for a third-party.

This manual is designed for a Japanese speaking user. When allowing a non-Japanese speaking user to work on the unit, provide a thorough safety education and handling instruction under the responsibility of the customer.

This instructions manual is copyrighted by ULVAC's Components Division.

Applicable Model

This manual applies to VS650B (-A, -W, -WL), VS750B (-A, -W).

The meaning of the symbols and numbers described in Model is as follows.

Table 1: Model List

Model	Rev.	Naming
VS650	B	W

Model

VS650 : 650m³/h (50Hz) *1
 750m³/h (60Hz)
 VS750 : 750m³/h (50Hz) *2

Rev.

B : Current Rev.

Naming

A : Air cooling
 W : Water cooling
 WL : Water cooling low noise *3

*1: 600 m³/h (50/60 Hz) for the low-noise L type.

*2: VS750B is for 50 Hz only. It cannot be operated at 60 Hz.

*3: The available cooling system of the low-noise L type is water cooling only.

*4: Explosion proof motor

- Only the motor is explosion proof. Thermostats and 24 VDC power supply connecting parts are not included.
- Multiple voltage cannot be selected. Specify the voltage.
- Only explosion proof motors are supported. Increased safety explosion-proof motors are not available.

*5: Use a motor of Mitsubishi for the explosion proof motor. Customers cannot specify the motor manufacturer.

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1. For safe use

Signifies, by each work, the method for avoiding danger and the actions prohibited to do for dangerousness reasons.

▶ 1.1 Handling the Unit

Overhaul or repair service of this unit is offered by your nearest ULVAC TECHNO or ULVAC service center.

 Danger 	<p>Connect the power line of this unit to the EMO system of the host device.</p> <p>The interlock system and control system of this unit are to be installed in the host device. Connect the power line of this unit to the EMO system of the host device.</p>
 Danger 	<p>Do not suck any gas other than inert gas.</p> <p>This unit is to exhaust inert gas (air, nitrogen, argon). If other gases (toxic gas, combustion gas, combustion-supporting gas, corrosive gas, explosive gas) are exhausted, they leak from the main unit of this unit or the parts of this unit are corroded and damaged. Furthermore, they cannot be used as they may ignite or explode due to residual gases or products not only during operation but also after the unit stops.</p>
 Danger 	<p>Do not suck toxic gases into this unit.</p> <p>If toxic gases are sucked into this unit, not only this unit but also the oil becomes toxic. Take care during maintenance.</p> <p>*The oil described here means a “vacuum pump oil“ (A vacuum pump oil is hereinafter referred to as “oil.”)</p>
 Danger 	<p>Install the unit in a ventilated indoor room</p> <p>Install the unit in a ventilated indoor room.</p> <p>If nitrogen or argon is leaked, you may be suffocated because of deficiency in oxygen.</p>
 Danger 	<p>Before installation or removal work, disconnect this unit from all energy sources.</p> <p>Before installation or removal work, disconnect this unit from all energy sources (such as electricity, compressed air, and cooling water).</p> <p>* If you are using compressed air, nitrogen gas, or other gases, remove it.</p>
<p>Notice</p> 	<p>Install appropriate first-stage traps.</p> <p>Install appropriate traps, such as filters, separators, condensers, to prevent this unit from sucking liquid and solid particles.</p>








- This unit is designed so as to conform to the rules and regulations at the time of preparing this manual. The conformity to the rules and regulations shall not be necessarily guaranteed if the standard of rules and regulations are changed in future.
- If a device embedded in this unit does not conform to the same rules and regulations or if the unit itself is modified, the performance and the safety of the unit may not be guaranteed. In such a case, we can neither guarantee the performance and the safety nor take the responsibility.
- For those who never took general safety education which is regarded to be effective publicly in the country intended to use, by any means, do not use the unit. An operator shall receive such trainings.
- Install and operate the unit according to the rules, regulations, and ordinances (Fire Service Laws and electric wire regulations) on safety of the country intended to use.
- If the details of dangerous substances to be used is not disclosed, or the substances difficult to undergo a detoxication processing are discharged, we may reject the maintenance and other related handlings.
- If you entrust us of an overhaul, maintenance, or repair etc, enter the necessary information in the "Pollution Certificate" attached to the end of this manual and submit it to a service center.
- If you export this unit to the outside Japan, you are required to pass through several examinations based on the foreign exchange and foreign trade laws, and the related government and ministerial ordinances and notifications etc. Contact a nearby sales office or agent.






[Sales offices list]

https://www.ulvac.co.jp/support_info/sales_office/







▶ 1.2 Acceptance/Transfer/Storage

1.2.1 Acceptance



 Warning  	<p>Use appropriate protective equipment and dismantling tools when dismantling.</p> <p>This unit is packed in a crate or cardboard. For packing in a crate, ask a specialist to dismantle it. As you may cut your hands with a nail or a piece of wood during work, instruct the dismantler to wear appropriate protective equipment, such as leather gloves, and to use appropriate dismantling tools, such as a crowbar.</p>
 Danger 	<p>Never get under this unit.</p> <p>The unit may drop or fall when hoisted if it is forcibly operated or the equipment is not properly maintained. Never get under this unit.</p>
 Warning 	<p>Use a crane or other cargo-handling equipment.</p> <p>Give instructions to hoist and transfer this unit using a crane or other cargo-handling equipment and eyebolts on the top of this unit when unpacking or hoisting it. Before using the eyebolts, make sure that there is no problem with them.</p>


<p> Warning</p> <p></p>	<p>An unqualified person shall neither perform a cargo-work nor operate a cargo-handling unit</p> <p>An unqualified person shall neither perform a cargo-work nor operate a cargo-handling unit. Ignorance to this may cause an accident or injury.</p>
<p> Warning</p> <p></p>	<p>Do not tilt this unit 10 degrees or more.</p> <p>Falling or other accidents may cause injury or damage.</p>
<p>Notice</p> <p></p>	<p>After unpacking, make sure that there are no missing or damaged items.</p> <p>After unpacking, make sure that there are no missing, damaged, or abnormal items. If there are any problems, do not perform installation work.</p> <p>* For accessories, refer to "Table 3: Standard Accessories List" on page 21.</p>

1.2.2 Transfer







<p> Warning</p> <p></p>	<p>Do not use casters as a mobile means or a supporting means for this unit.</p> <p>Do not use casters as a mobile means or a supporting means for this unit. Otherwise it may cause a malfunction. Use the casters for adjusting the position.</p>
<p> Warning</p> <p></p>	<p>Transfer this unit using cargo-handling equipment or a pallet truck.</p> <p>Transportation of this unit requires a load exceeding the safety standard. Therefore, carrying it by man power may cause injury, such as damage to your back. Hoist this unit using cargo-handling equipment (e.g. a mobile crane) or put and fix it on a pallet. Then transport it by a pallet truck.</p>
<p> Warning</p> <p></p>	<p>Do not tilt this unit 10 degrees or more.</p> <p>Falling or other accidents may cause injury or damage.</p>

1.2.3 Storage

<p> Caution</p> <p></p>	<p>Do not store this unit with water sucked in.</p> <p>Do not store this unit with water sucked in. The inside of this unit may rust, resulting in a malfunction.</p>
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<p>Notice</p>	<p>Protect environmental conditions.</p>
	<p>This unit is a unit with precise clearances. Make sure that the storage location meets the "environmental conditions for storage." * For the environmental conditions, refer to "3.1.2 Environmental Conditions during Storage" on page 18.</p>

▶ 1.3 Installation/Operation

<p>Warning</p>	<p>Do not remove the exterior panel.</p>
	<p>Never remove the exterior panel. During operation or for a while after operation stops, the unit remains at very high temperatures. If a human body touches the unit, it may get burned.</p>
<p>Warning</p>	<p>Do not remove the exterior panel.</p>
	<p>Never remove the exterior panel. There are electrical components, wires, and rotating parts, such as a motor, spindle, and shaft coupling inside the panel. You may get an electric shock or injured if you touch them</p>
<p>Warning</p>	<p>Do not remove the casters.</p>
	<p>Do not install this unit directly on the ground with the casters removed. Otherwise the air outlet at the bottom of the pump may be blocked, causing burns or fire due to abnormal overheating.</p>
<p>Notice</p>	<p>Operate this unit after its temperature reaches the operational ambient temperature.</p>
	<p>If this unit was stored outside the range of the operational ambient temperature, operate it after its temperature reaches the operational ambient temperature. Otherwise it may cause a malfunction.</p>
<p>Notice</p>	<p>Do not have the unit impacted, tilted, toppled sideways, stood upright, or made upside-down.</p>
	<p>Do not have the unit impacted, tilted, toppled sideways, stood upright, or made upside-down. The operation of the unit may be obstructed.</p>
<p>Notice</p>	<p>Install this unit in a horizontal position.</p>
	<p>After moving to the installation location, adjust the four adjusters within the range of 1 to 10 mm and install this unit horizontally on G.L. If you operate it with casters, vibration is transmitted to the floor. In addition, this unit may move itself and collide with surrounding equipment.</p>

<p>Notice</p>	<p>Protect environmental conditions.</p> <p>This unit is a unit with precise clearances. Make sure that the storage location meets the "environmental conditions during installation and operation."</p> <p>* For the environmental conditions, refer to "3.1.3 Environmental Conditions during Installation and Operation" on page 19.</p>
<p>Caution</p>	<p>Use the unit with a specified amount of oil.</p> <p>Be sure to use the unit with a specified amount of oil. If it exceeds the upper limit, oil may blow out from the outlet port when entering the atmosphere. In addition, if the oil level becomes lower than the lower limit during the operation, the bearings, shaft seals, etc. are damaged, which causes a leakage, abnormal noise, overloaded motor, or shutdown, causing a malfunction. When it is necessary to add oil, use the same oil as that being used.</p>

▶ 1.4 Removal/Transport

1.4.1 Removal

<p>Danger</p>	<p>Before installation or removal work, disconnect this unit from all energy sources.</p> <p>Before installation or removal work, disconnect this unit from all energy sources (such as electricity, compressed air, and cooling water).</p> <p>* If you are using compressed air, nitrogen gas, or other gases, remove it.</p>
<p>Warning</p>	<p>Wait for the temperature of the main unit to decrease.</p> <p>Immediately after operation is stopped, the main unit is at a high temperature. Wait for a while until the temperature of the main unit decreases and then remove and check the parts. Otherwise, you may get burned.</p>
<p>Warning</p>	<p>After the temperature of the main unit decreases, remove the piping for the inlet/outlet port.</p> <p>The unit remains at a high temperature for a while after operation stops. Make sure that the temperature of the main unit has decreased and then remove the piping for the inlet/outlet port</p>
<p>Caution</p>	<p>After the temperature of the main unit decreases, remove protective cover.</p> <p>The temperature of the inlet/outlet piping is 70°C or more. Make sure that the temperature of the main unit has decreased and then remove the protective cover.</p>

Notice

Fully seal the inlet/outlet port with a blind flange or cap, or by other means.

After removing the inlet/outlet piping, fully seal the inlet/outlet port of this unit with a blind flange or cap, or by other means.

1.4.2 Transportation

Warning

Do not use casters as a mobile means or a supporting means for this unit.

Do not use casters as a mobile means or a supporting means for this unit. Otherwise it may cause a malfunction. Use the casters for adjusting the position.

Warning

Transfer this unit using cargo-handling equipment or a pallet truck.

Transportation of this unit requires a load exceeding the safety standard. Therefore, carrying it by man power may cause injury, such as damage to your back. Hoist this unit using cargo-handling equipment (e.g. a mobile crane) or put and fix it on a pallet. Then transport it by a pallet truck.

Warning

Do not tilt this unit 10 degrees or more.

Falling or other accidents may cause injury or damage.

▶ 1.5 Disposal

When disposing of this unit, follow the laws and regulations set by the local government. Especially when exhausting harmful gas, commission a specialized disposal contractor to dispose of this unit. Note that the disposal costs shall be borne by you.

Warning

Commission a waste disposal contractor to dispose of.

Commission a waste disposal contractor authorized by the administrative body to dispose of.

Warning

When a harmful gas that is dangerous to the human body was used, commission a specialized disposal contractor to dispose of this unit.

When a harmful gas that is dangerous to the human body was used in this unit, be sure to commission a specialized disposal contractor to detoxify it.





Notice

Dispose of oil according to the safety data sheet.

Dispose of oil according to the "Precautions for Disposal" column in the safety data sheet. For the safety data sheet, obtain the latest version from your nearest sales office or agency.

▶ 1.6 Protection Device







Installation of an overload protection device is made mandatory by the Technical Standards for Electrical Installations. It is recommended to install a protective device (such as a ground-fault interrupter) other than the overload protection device. For selection of an overload protection device and a ground-fault interrupter, refer to "Table 9: Standard motor and wiring" on page 45.

 Warning 	<p>Provide a ground-fault interrupter.</p> <p>In the event of a short circuit, it protects the equipment and wiring and protects against overload. In addition, it protects against an electric shock and a ground fault that can lead to fire due to electric leakage. If no ground-fault interrupter is installed or if it is installed but does not match the motor capacity, it causes damage to equipment, fire, or an electric shock.</p>
 Warning 	<p>Be sure to install an overload protector.</p> <p>Be sure to install an overload protector suitable for the capacity. If no overload protector is installed or it does not match the capacity, it causes damage to the motor or fire.</p>





This unit has a three-phase current motor. For this motor, no protector is included. Connect the motor to the power supply through an overload protector.

▶ 1.7 Danger and safety measures specific to this unit















1.7.1 Intake and exhaust of dangerous gases/goods

 Danger 	<p>Do not suck any gas other than inert gas.</p> <p>This unit is to exhaust inert gas (air, nitrogen, argon). If other gases (toxic gas, combustion gas, combustion-supporting gas, corrosive gas, explosive gas) are exhausted, they leak from the main unit of this unit or the parts of this unit are corroded and damaged. Furthermore, they cannot be used as they may ignite or explode due to residual gases or products not only during operation but also after the unit stops.</p>
 Danger 	<p>Wear protective equipment.</p> <p>Before making an inspection etc., wear personal protective equipment suitable for toxic substances for use.</p>
 Warning 	<p>When exhausting dangerous gases or substances, ask a specialized company to detoxify it.</p> <p>When exhausting dangerous gases or substances and then overhaul or dispose of them, ask a specialized waste disposal company to detoxify it.</p>









1.7.2 Transfer of Heavy Object

 Danger 	<p>Never get under this unit.</p> <p>The unit may drop or fall when hoisted if it is forcibly operated or the equipment is not properly maintained. Never get under this unit.</p>
 Warning 	<p>An unqualified person shall neither perform a cargo-work nor operate a cargo-handling unit</p> <p>An unqualified person shall neither perform a cargo-work nor operate a cargo-handling unit. Ignorance to this may cause an accident or injury.</p>



1.7.3 Electric Shock

 Danger  	<p>Before installing electric wiring, turn off the primary power.</p> <p>Before installing electric wiring, turn off the primary power. Never leave the voltage applied during the work. There is the risk of electric shock.</p>
 Danger  	<p>Before inspection/relocation, turn off the primary power.</p> <p>Before inspection/relocation, be sure to turn off the primary power. There is the risk of electric shock.</p>
 Warning  	<p>Be sure to establish a ground for the ground terminal.</p> <p>The work of embedding a ground and connecting the ground wire requires the qualification of an electric work specialist. For incomplete grounding, there is the risk of electric shock.</p>
 Warning  	<p>Be sure to close the lid of the motor terminal box.</p> <p>After the completion of wiring to the motor, be sure to close the lid of the terminal box. Never open the lid during operation. There is the risk of electric shock.</p>
 Warning 	<p>Securely tighten the terminal.</p> <p>Securely tighten the terminal. Check the tightening condition once a month. In the event of insufficient tightening, the motor terminal block may be burnt.</p>







1.7.4 High Temperature

 Warning	<p>During operation or for a while after operation stops, do not touch the main unit, motor, or piping.</p>
	<p>During operation or for a while after operation stops, do not touch the main unit, motor, or piping as they are at a very high temperature. Otherwise, you may get burned.</p>
 Caution	<p>Install the protection cover to the piping.</p>
	<p>The temperature of the inlet/outlet piping is 70°C or more. After connecting the inlet/outlet port piping, install the protection cover.</p>
 Warning	<p>Wait for the temperature of the main unit to decrease.</p>
	<p>Immediately after operation is stopped, the main unit is at a high temperature. Wait for a while until the temperature of the main unit decreases and then remove and check the parts. Otherwise, you may get burned.</p>
 Warning	<p>Do not touch the main unit and motor section when using the gas ballast function.</p>
	<p>Do not touch the main unit and motor section when using the gas ballast function. It reaches a high temperature and you may get burned.</p>




1.7.5 Burst

 Warning	<p>Prevent the pressure on the outlet side of this unit from increasing to 0.03 MPaG or more.</p>
	<p>Measure the pressure on the outlet side of this unit. If it is 0.03 MPaG (0.3 kg/cm2G) or more, remove those that are preventing gas from passing through on the outlet side. If the pressure in this unit increases to 0.03 MPaG or more, this unit may burst. Maintain the oil mist separator on a regular basis to prevent it from being a resistance when gas is passing through.</p>

1.7.6 Leakage of high-temperature cooling water

 Warning 	<p>If this unit is operated without water supply, stop and keep it off.</p> <p>If this unit is operated without water supply, stop and keep it off. There is the risk that boiling high-temperature steam blows out from the inlet/outlet of cooling water.</p>
 Warning 	<p>Provide an interlock in the cooling water system.</p> <p>Install a flow meter in the cooling water system as an interlock so that this unit stops when the cooling water stops. If the unit is operated without cooling water supply, there is the risk that boiling high-temperature steam blows out from the inlet/outlet of cooling water.</p>
 Warning 	<p>Wait for the temperature of the main unit to decrease.</p> <p>Stop this unit and make sure that the temperature of the main unit is decreased. Then remove and check this unit.</p>

▶ 1.8 Safety Data Sheet

 Warning 	<p>Thoroughly read the safety data sheet.</p> <p>Obtain the safety data sheet (hereinafter referred to as the "SDS") and thoroughly read it in advance. If oil comes into contact with your skin or eyes, follow the SDS's first aid section.</p>
 Notice	<p>Use the specified oil.</p> <p>The use of any oil other than the specified ones affects the performance and life of this unit, which is not covered by the warranty.</p>

Do not use any chemical substance (oil) that is not specified on this unit.

Oil Rotary Vacuum Pump	Oil	ULVOIL R-72 (Standard oil)
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The SDS introduces the chemical substances that may be used or touched when operating this unit.

Carefully read it to understand the harmful characteristics. For the SDS, obtain the latest version from your nearest sales office or agency.

The SDS provides reference information for ensuring the safe handling of hazardous chemical substances.

If you handle oil, you should get the latest version of the SDS and understand that it is necessary to take appropriate measures depending on the actual conditions in each use case etc. in reference to this on your own responsibility before use. The SDS itself does not ensure safety.

2. Product Overview

The maximum evacuation rate of the oil rotary vacuum pump is 650 m³/h at 50 Hz or 750 m³/h at 60 Hz for "VS650B-A/VS650B-W," 600 m³/h at both 50 Hz and 60 Hz for "VS650B-WL," or 750 m³/h at 50 Hz for "VS750B-A/VS750B-W." Both are a single-stage vacuum pump of the low-vibration rotary vane type and the large-capacity oil tank is equipped with a built-in oil mist separator. Also in consideration of maintainability, there are features, such as a large opening for cleaning the oil tank and the oil mist separator that can be replaced as a cartridge. In addition, this is a vacuum pump that allows you to select between air cooling and water cooling depending on the installation environment. For details, refer to "Table 1: Model List" on page viii.

▶ 2.1 Features

- A large-displacement pump of the rotary vane type that can provide an evacuation of up to 3,100 m³/h when combined with the mechanical booster pump "PMB2400D"
- The low-vibration feature allows you to install the unit on an upper floor. Vibration in the low frequency range, such as those caused in an oscillating piston pump, can be reduced, which eliminates the need for the foundation work for installation.
- An oil mist separator is built in the oil tank. The cartridge type oil mist separator can be easily replaced.
- The large-capacity oil tank (oil amount: 23 to 27 L or 25 to 30 L) lengthens the cycle of oil change. The structure allows you to clean the inside of the oil tank easily, providing easy maintenance.
- You can select between air cooling and water cooling depending on the installation environment. An oil cooler is used to reduce the oil temperature.

▶ 2.2 Application Purpose



Do not use this unit for any application purpose other than those described in this document.

If used for any application purpose other than those described in this document, unexpected accidents or failures may occur.

- Vacuum packaging, adsorption transfer, electronic equipment, heat treatment, or other fields that use a vacuum
- Vacuum deposition equipment, sputtering equipment
- Vacuum heat treatment furnace
- Centralized evacuation system for factories
- Other places where cooling water cannot be used or where vibration is not preferred

▶ 2.3 Evacuation Principles

For VS650B and VS750B, three vanes are attached to a rotor installed inside the cylinder, and these vanes divide the inside of the cylinder into three spaces.

Gas in the divided spaces is compressed with the rotation of the rotor, changes periodically, and is discharged to the atmosphere through the exhaust valve. Oil plays a role of cooling and sealing to enhance the airtightness of the vanes and cylinder.

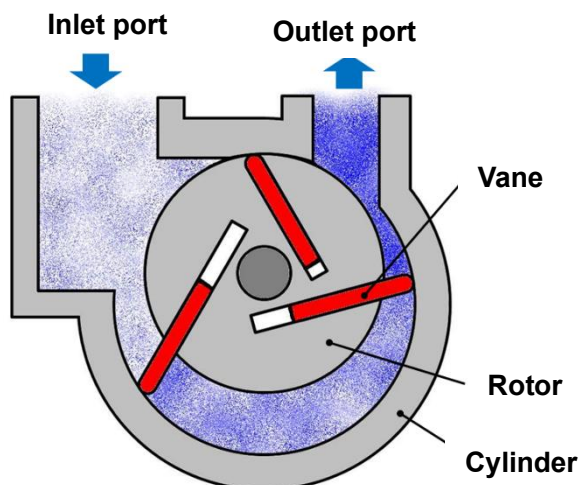


Figure 2: Cross section of the inside of the cylinder

▶ 2.4 Pump Performance

2.4.1 Ultimate Pressure

"Ultimate pressure" described in the catalog and the body text means "the limit pressure that can be obtained by the pump without introducing gas from the inlet port of the pump (no-load operation)." We use the specified vacuum pump oil and, after completely cutting off the equipment, connect a Pirani gauge only to the inlet port of the pump for measurement. For an actual vacuum unit, the location where the vacuum gauge is installed is far from the pump and, due to the effect of water vapor and various gases generated from water droplets, rust, and other deposits that adhere to the inner wall of the unit, piping, or other parts, the ultimate pressure becomes higher than the catalog value. This is because the volatile gas dissolved in the pump oil or foreign substances or gases sucked into the pump from the vacuum chamber contaminate the vacuum gauge head or decompose (deteriorate) the components of the pump oil, increasing the oil vapor pressure.

2.4.2 Pumping speed

The pumping speed of an oil rotary vacuum pump depends on the type and pressure of the gas to be drawn in. A high pressure region provides the maximum pumping speed and, as the pressure decreases, the pumping speed gradually decreases. The effective pumping speed of this unit indicates the maximum value when dry air is drawn in.

The correspondence between the suction pressure and the pumping speed is shown in "Figure 3: Pumping speed" on page 13.

2.4.3 Required Power

The power for driving a vacuum pump is the sum of the work (mechanical work) against the rotational friction of mechanical elements and the work (compression work) that compresses the air, providing the maximum suction pressure between 2×10^4 and 4×10^4 Pa.

At a pressure of 10 Pa or less, the compression work is a little and most of the power is spent on the unit. In the general usage of the pump, the pressure range with the maximum load is the suction pressure range of 2×10^4 and 4×10^4 Pa. When operating with the gas ballast valve open, a large amount of power is required at all times as the compression work is large even at a low suction pressure.

In addition, when the temperature of the pump installation location is low (such as in a cold area and an outdoor area in winter), the temperature of the pump oil is low in temperature and high in viscosity, requiring a large amount of power especially at startup. However, the pump temperature gradually increases as the operating time passes, which decreases the oil viscosity, reducing the power value for a stable condition.

▶ 2.5 Performance Curve

2.5.1 Pumping Speed

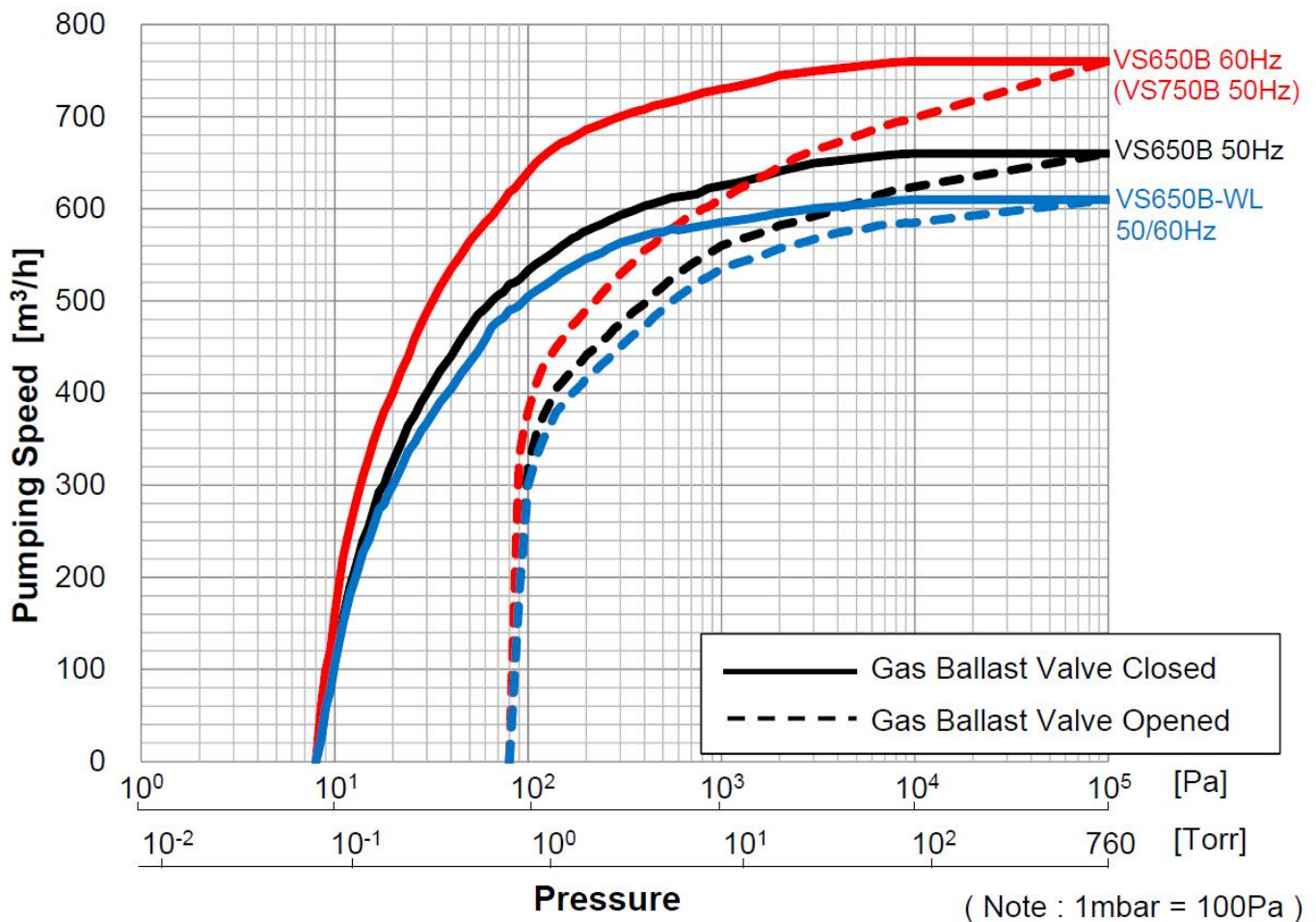


Figure 3: Pumping speed

▶ 2.6 Name and Function of Parts

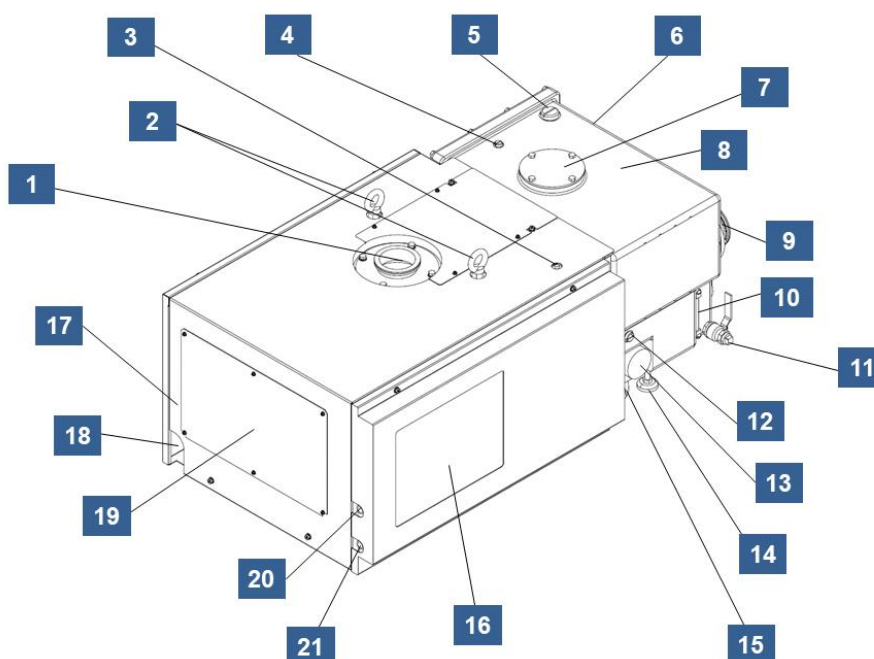


Figure 4: Name of parts (VS650B/VS750B)

Table 2: Name of Parts (VS650B/VS750B)

Name		Function	Reference
1	Inlet port	Connect the container and piping for evacuation. (DN100 ISO-K)	3.6.1
2	Eyebolt	Used when hoisting this unit using a crane.	3.3.1
3	Manual gas ballast valve (inside)	Used when supplying gas ballast gas.	4.4
4	Pressure gauge mounting port	Used when installing a pressure gauge. (G1/4)	6.2.6
5	Oil cap	Used when supplying oil. (G1)	3.5
6	External filter port	This is the port to return oil from the external filter. (G1/2)	—
7	Outlet port (Vertical)	Connect the pipe that discharges the exhaust gas. (DN100 ISO-K)	3.6.2
8	Oil mist separator (Inside)	Oil is separated from the gas exhausted by the pump.	6.2.6
9	Outlet port (horizontal)	Connect the pipe that discharges the exhaust gas. (DN100 ISO-K)	3.6.2
10	Oil level gauge	Check the amount of oil.	3.5
11	Oil drain port	The valve used to discharge oil. (Rc1)	6.2.1
12	Purge gas port	Connect the pipe that supplies a purge gas. (G3/8)	3.6.5
13	Oil filter	Remove impurities contained in oil that circulates in the pump.	6.2.11

Name		Function	Reference
14	Adjuster foot	Adjust the height of this unit.	3.3
15	Caster	These are swivel wheels.	3.3
16	Air outlet (for air cooling type only)	Draw in air to cool oil.	8.2
17	24 VDC power connection part (inside)	The thermostat wire is connected to the terminal block.	3.7.2 3.7.3
18	Wire exit port	The place to draw out the motor wiring.	3.7.1
19	Motor connection part (inside)	Used when installing electrical wiring to the motor.	3.7.1
20	Cooling water outlet (For water cooling type only)	Connect the pipe that discharges cooling water. (Rc1/2 female screw)	3.6.3
21	Cooling water inlet (For water cooling type only)	Connect the pipe that supplies cooling water. (Rc1/2 female screw)	3.6.3

▶ 2.7 System Configuration

Perform the direct-connect starting of the pump. See Table 5 for required power capacity.

■ For VS650B-A, VS750B-A (Air cooling type)

The power supply is the only required utility. Cooling water is unnecessary.

■ For VS650B-W, VS650B-WL, VS750B-W (Air cooling type)

The cooling water and power supply are required as utilities.

The cooling water enters through the cooling water inlet of the panel, circulates through the heat exchanger, and discharges through the cooling water outlet. It is recommended to provide a flowmeter in the cooling water system and provide an interlock that stops the pump when the amount of water becomes lower than the specified value. It is also recommended to place water leakage sensors at the lower part of the pump and on the floor near the pump so that the power is shut off if a leak sensor is activated. When using water with a large amount of impurities, such as scale and iron, filter them with a filter installed in the prior stage before use.

The area surrounded by the broken line in the figure below falls within the customer's responsibility. Customers are responsible for preparing and managing these pipes, wires, and pieces of equipment.

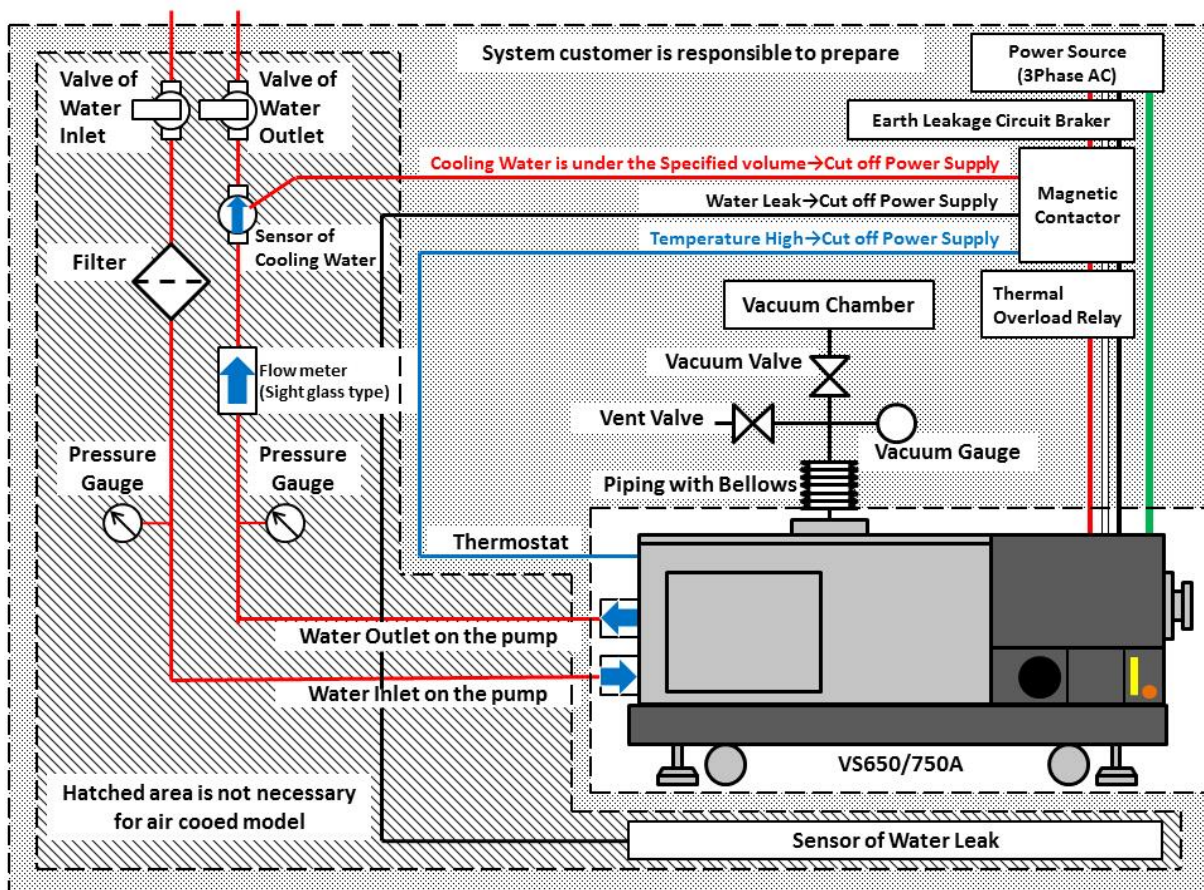


Figure 5: System connection diagram

Notice

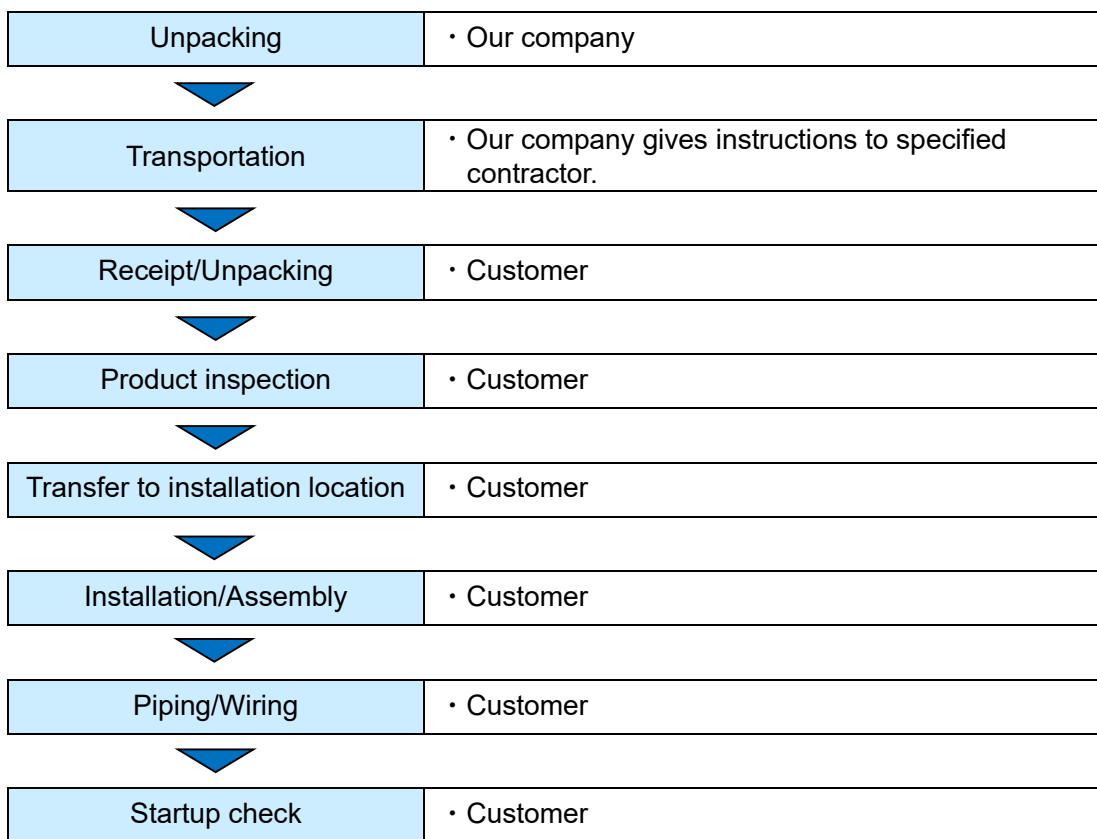
The warranty covers this unit only (refer to "Warranty Scope"). Note that any failures and damage due to piping, wiring, or equipment within the customer's responsibility mentioned above are not covered by the warranty.

3. Installation

▶ 3.1 Before Installation

3.1.1 Responsibility for Work from Shipping to Startup



This unit is based on the premise that our company is responsible for packing to shipping (transportation) and the customer for receipt to startup. However, depending on the contract conditions of this unit, the customer may conduct all or part of transportation, unpacking, and installation.



Notice

The process from shipping to startup may not be limited to the above. Check the content described in the specifications of this unit. If you have any questions, contact your nearest sales office or agency.

3.1.2 Environmental Conditions during Storage

 Caution	<p>Do not store this unit with water sucked in.</p> <p>Do not store this unit with water sucked in. The inside of this unit may rust, resulting in a malfunction.</p>
	

If this unit is stored in a warehouse or front chamber before installation, or not used for a long period of time, store it following the conditions below.

Ambient temperature	-30 to 60°C (No freezing allowed)
Ambient humidity	90 %RH or less (No condensation allowed)
Altitude	1,000 m or less of altitude above sea level
Vibration resistance	Vibration acceleration of 0.5 G (114 dB) or less
Others	No corrosive and explosive gases allowed.
	(No dust allowed)
	To be in a ventilated room.
	Do not double-stack this unit, turn it over, push it over sideways, or stand it upright.
	Do not make an impact on this unit.
	Do not expose it to direct sunlight.
	Keep it away from heat sources.
	Drain the cooling water piping before storage. At low temperatures (0°C or less), water may freeze and damage the parts.
Do not tilt 10 degrees or more.	

3.1.3 Environmental Conditions during Installation and Operation












This unit is a unit with precise clearances. Satisfy the following during installation and operation.

Ambient temperature	10 to 40°C (for ULVOIL R-72)
Ambient humidity	80 %RH or less (No condensation allowed)
Altitude	1,000 m or less of altitude above sea level
Others	No corrosive and explosive gases allowed.
	(No dust allowed)
	To be in a ventilated room.
	Do not double-stack this unit, turn it over, push it over sideways, or stand it upright.
	Do not make an impact on this unit.
	Do not expose it to direct sunlight.
	Keep it away from heat sources.
	Adjust the four adjusters within the range of 1 to 10 mm and install this unit in a horizontal position.
	After the adjustment, fix it with hexagon nuts.
	Securely fix this unit in case of an earthquake.
Do not tilt 10 degrees or more.	

▶ 3.2 Unpacking

This unit is protected by stretch film, cushioning materials, or by other means, packed in a wooden frame or cardboard, and shipped. For packing in a crate, ask a specialist to dismantle it. Give the following precautions and instructions to the dismantling contractor.

3.2.1 Precautions for Unpacking

<p> Warning</p> <p> </p>	<p>Use appropriate protective equipment and dismantling tools when dismantling.</p> <p>This unit is packed in a crate or cardboard. For packing in a crate, ask a specialist to dismantle it. As you may cut your hands with a nail or a piece of wood during work, instruct the dismantler to wear appropriate protective equipment, such as leather gloves, and to use appropriate dismantling tools, such as a crowbar.</p>
<p> Danger</p> <p></p>	<p>Never get under this unit.</p> <p>The unit may drop or fall when hoisted if it is forcibly operated or the equipment is not properly maintained. Never get under this unit.</p>
<p> Warning</p> <p></p>	<p>Use a crane or other cargo-handling equipment.</p> <p>Give instructions to hoist and transfer this unit using a crane or other cargo-handling equipment and eyebolts on the top of this unit when unpacking or hoisting it. Before using the eyebolts, make sure that there is no problem with them.</p>
<p> Warning</p> <p></p>	<p>An unqualified person shall neither perform a cargo-work nor operate a cargo-handling unit</p> <p>An unqualified person shall neither perform a cargo-work nor operate a cargo-handling unit. Ignorance to this may cause an accident or injury.</p>
<p> Warning</p> <p></p>	<p>Do not tilt this unit 10 degrees or more.</p> <p>Falling or other accidents may cause injury or damage.</p>

3.2.2 Check after Unpacking

After unpacking, check that the content is the same as what you ordered and that it is not damaged due to transportation.

If you let us know after using the product, it may be borne by your company.

Although the product has been shipped with extreme care, check the following points after unpacking just in case.

■ Check item










- Does the actual content match with your order?
- Are accessories (instructions manual, optional parts) included?
- Are there any parts damaged during transportation?
- Are there any screws and nuts loosened during transportation? Are any parts disconnected?

In the event of any failure, contact your nearest sales office or agency within one week from the date of delivery.







Table 3: Standard Accessories List

Item name	Specifications	Qty.	Remarks
Oil one time portion	ULVOIL R-72	1 set	For the consumed amount, refer to the specification table.
Instructions manual	Japanese/English	1 copy	—

▶ 3.3 Transportation

 <p>Warning</p> 	<p>Do not use casters as a mobile means or a supporting means for this unit.</p> <p>Do not use casters as a mobile means or a supporting means for this unit. Otherwise it may cause a malfunction. Use the casters for adjusting the position.</p>
 <p>Warning</p> 	<p>Transfer this unit using cargo-handling equipment or a pallet truck.</p> <p>Transportation of this unit requires a load exceeding the safety standard. Therefore, carrying it by man power may cause injury, such as damage to your back. Hoist this unit using cargo-handling equipment (e.g. a mobile crane) or put and fix it on a pallet. Then transport it by a pallet truck.</p>
 <p>Warning</p> 	<p>Do not tilt this unit 10 degrees or more.</p> <p>Falling or other accidents may cause injury or damage.</p>
 <p>Warning</p> 	<p>Wear safety shoes during transportation.</p> <p>Always wear safety shoes when transporting this unit</p>
 <p>Notice</p>	<p>Do not have the unit impacted, tilted, toppled sideways, stood upright, or made upside-down.</p> <p>Do not have the unit impacted, tilted, toppled sideways, stood upright, or made upside-down. The operation of the unit may be obstructed.</p>

3.3.1 How to Hoist using Crane

 <p>Danger</p> 	<p>Never get under this unit.</p> <p>The unit may drop or fall when hoisted if it is forcibly operated or the equipment is not properly maintained. Never get under this unit.</p>
 <p>Warning</p> 	<p>An unqualified person shall neither perform a cargo-work nor operate a cargo-handling unit</p> <p>An unqualified person shall neither perform a cargo-work nor operate a cargo-handling unit. Ignorance to this may cause an accident or injury.</p>
 <p>Warning</p> 	<p>Use a crane or other cargo-handling equipment.</p> <p>Give instructions to hoist and transfer this unit using a crane or other cargo-handling equipment and eyebolts on the top of this unit when unpacking or hoisting it. Before using the eyebolts, make sure that there is no problem with them.</p>

1. If this unit is packed with metal brackets, remove the metal brackets.
2. Prepare appropriate hoisting attachments and check the eyebolts for any abnormalities, such as looseness or damage.
3. Hook the hoisting attachments on the eyebolts of this unit and hook them on the hook of the crane.

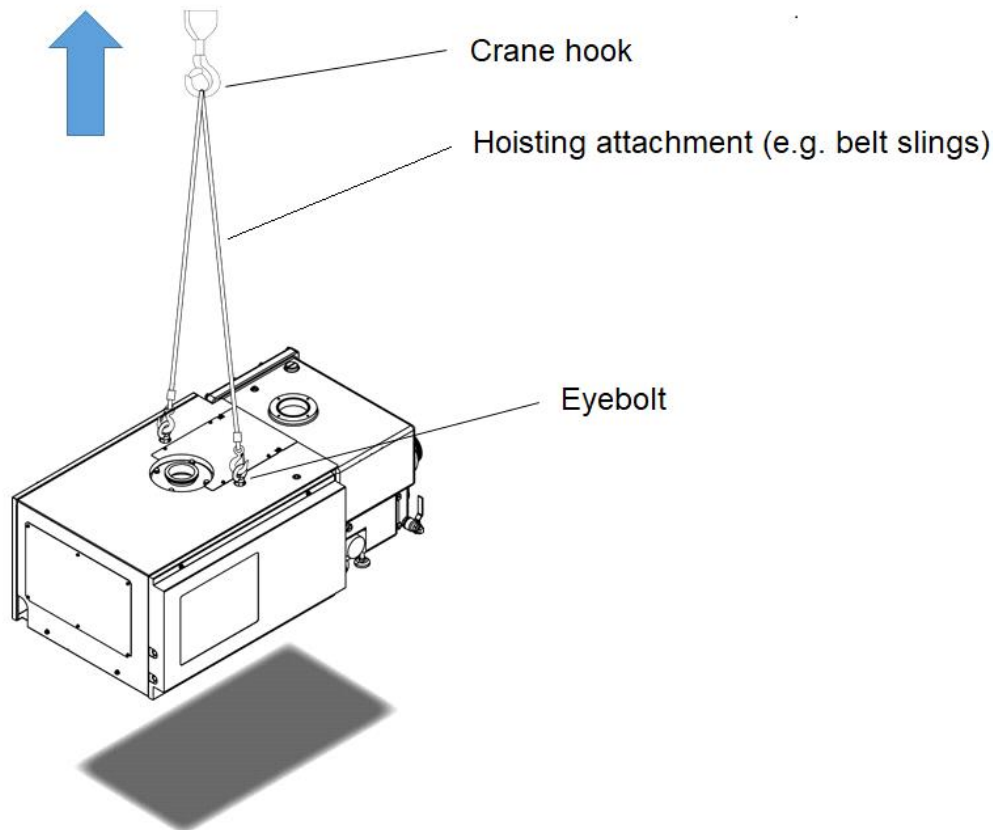


Figure 6: Hoisting using Crane

4. Slowly operate the crane to hoist this unit until just before this unit leaves the ground.
5. Operate the crane again to hoist this unit until this unit leaves the ground.
6. When the hoisting starts, check whether or not the belt slings and hoisting equipment are in good condition. In addition, make sure that the load is not tilted.
7. When lowering this unit, slowly lower it using a crane to prevent it from being impacted and damaged.

3.3.2 How to Transport using Pallet Truck

Warning



Do not transport this unit with the adjusters raised.

When transporting using a pallet truck, lower the adjusters (4 places). Transportation of this unit with no adjusters on the pallet may cause this unit to tip over, resulting in injury or damage.

1. When putting this unit on a pallet, lower the adjusters (4 places).

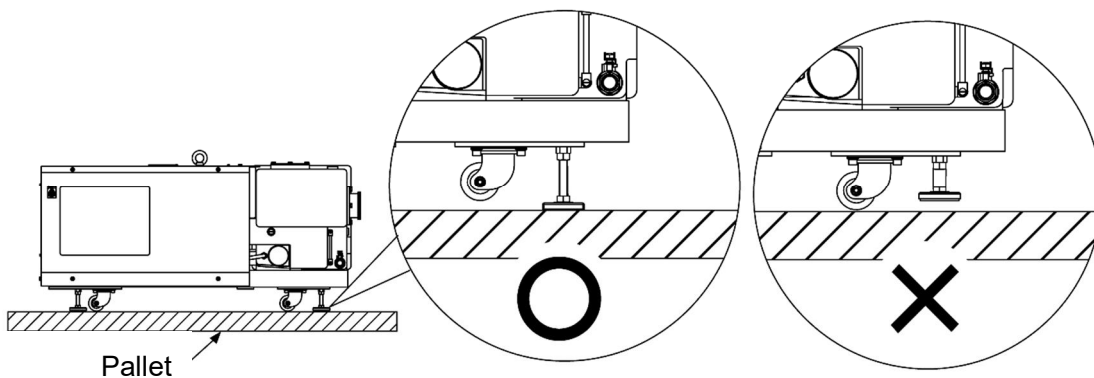
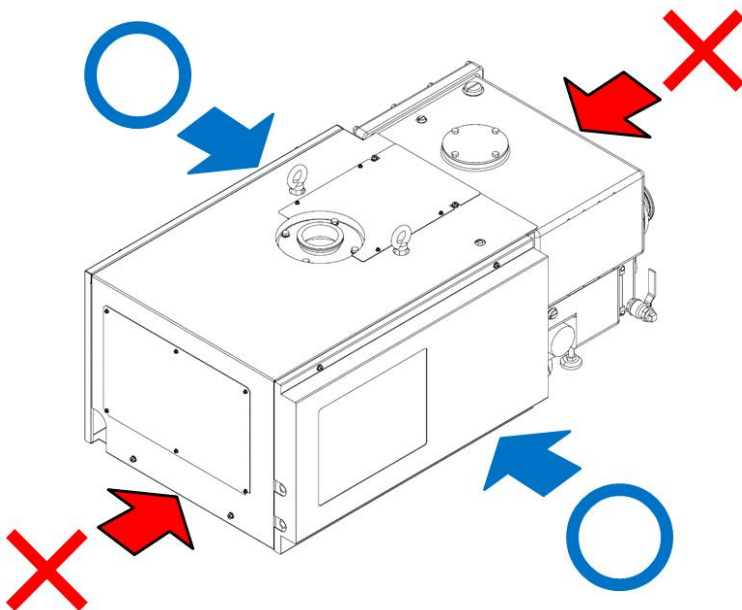


Figure 7: Adjusters in Transportation

2. Insert the fork of the pallet truck into the pallet and slowly lift it.
3. Transport the unit while checking that there are no obstacles in the direction of travel.

When transporting the unit with a pallet truck or forklift without using a pallet, be sure to insert the fork from the front or back. If it is inserted from the side, it may tip over.








* An optional product with vibration-proof rubbers can be inserted from the side.


Figure 8: Fork insertion direction

▶ 3.4 Installation

Arrange this unit in consideration of work, such as installation, removal, inspection, and cleaning, and release of exhaust gas to the outside. Install this unit in a horizontal position and fix it using vibration-proof rubbers to prevent looseness.

<p>Danger</p> 	<p>Before installation or removal work, disconnect this unit from all energy sources.</p> <p>Before installation or removal work, disconnect this unit from all energy sources (such as electricity, compressed air, and cooling water).</p> <p>* If you are using compressed air, nitrogen gas, or other gases, remove it.</p>
<p>Warning</p> 	<p>Comply with Rules and Laws and Regulations.</p> <p>Install and operate this unit in compliance with the safety codes and laws (e.g. fire protection laws and electric codes) in the country and region where you use this unit.</p>
<p>Warning</p> 	<p>Do not remove the casters.</p> <p>Do not install this unit directly on the ground with the casters removed. Otherwise the air outlet at the bottom of the pump may be blocked, causing burns or fire due to abnormal overheating.</p>
<p>Warning</p> 	<p>Never place flammables within 1 m around the motor and vacuum pump.</p> <p>Never place flammables within 1 m around the motor and vacuum pump.</p> <p>There is a risk of fire.</p>
<p>Warning</p> 	<p>Do not place walls or obstacles within 0.5 m from the air outlet of the motor.</p> <p>Do not place walls or obstacles within 0.5 m from the air outlet of the motor (at the end of the motor).</p> <p>There is a risk of burn injury and fire due to abnormal overheating. * For air cooling type</p>

3.4.1 Leveling

<p>Notice</p> 	<p>Install this unit in a horizontal position.</p> <p>After moving to the installation location, adjust the four adjusters within the range of 1 to 10 mm and install this unit horizontally on G.L. If you operate it with casters, vibration is transmitted to the floor. In addition, this unit may move itself and collide with surrounding equipment.</p>
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After transporting this unit to the installation site, adjust the adjusters so that it is installed as horizontally as possible (the adjustable range: +10 mm or less). If necessary, adjust the adjusters while checking the level. After adjusting the adjusters, fix it with hexagon nuts.

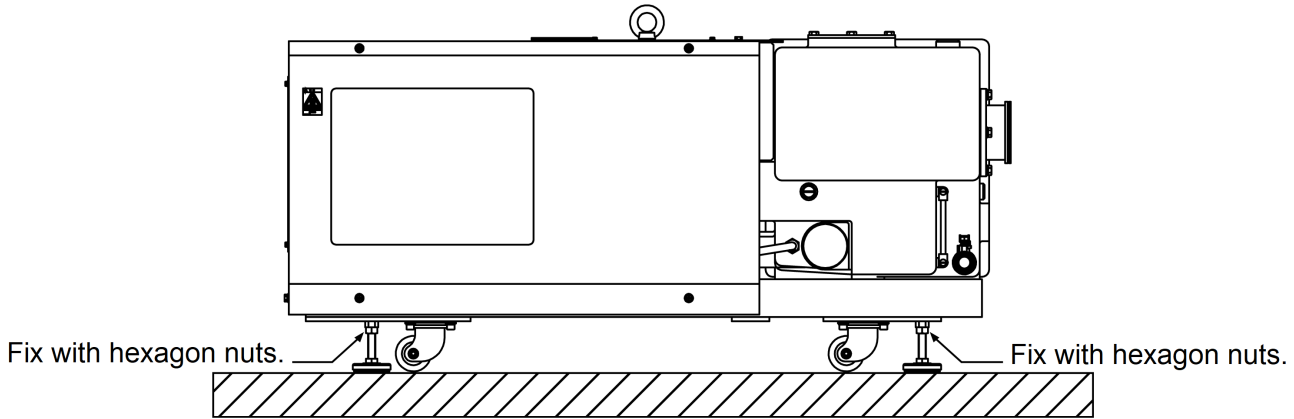




Figure 9: Adjusters in Installation






3.4.2 Earthquake-Proof Measures

<p>Notice</p> 	<p>Do earthquake-proof fixing. Securely fix this unit in case of an earthquake. If it is fixed insufficiently, it may tip over or move, causing damage to peripheral devices.</p>
<p>Notice</p> 	<p>Piping and wiring need to be structured to absorb shaking. The vacuum piping, cooling water piping, purge gas piping, and electric wiring need to be structured to absorb shaking to prevent the piping from being broken or disconnected by the specified shaking.</p>

▶ 3.5 Oil Filling

3.5.1 Oil Filling

Use the oil specified by our company. The standard oil "ULVOIL R-72" is available. Add oil so that the oil level is at the level line "MAX." of the oil level gauge. The pump can operate when the oil level is between the level lines of the oil level gauge during operation. * The oil level is defined as "the oil level during pump operation." Refer to "Figure 10: Oil cap and oil level gauge position" on page 28, and "Figure 11: Specified oil level" on page 29.

 <p>Warning</p> 	<p>Thoroughly read the SDS.</p> <p>Obtain the SDS and thoroughly read it in advance.</p> <p>If oil comes into contact with your skin or eyes, follow the SDS's first aid section.</p>
 <p>Danger</p> 	<p>Wear protective equipment.</p> <p>Before making an inspection etc., wear personal protective equipment suitable for toxic substances for use.</p>
<p>Notice</p> 	<p>Use the specified oil.</p> <p>The use of any oil other than the specified ones affects the performance and life of this unit, which is not covered by the warranty.</p>

Use the oil specified by our company.

Oil Rotary Vacuum Pump	Oil	ULVOIL R-72 (Standard oil)
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MEMO

- If the pump does not work due to a low ambient temperature, warm up oil or jog the pump several times (short-time ON/OFF operation, inching operation) to start it. If the unit rotates for a few seconds and then stops, continue operation can be performed in some cases by opening the leak valve and starting while performing a slow leak. When the pump is warmed up, close the leak valve and return to the normal operation.
- The jog operation of the pump may cause failures due to the loaded motor. If the the pump needs to be frequently jogged, warm up oil before starting.

Caution



Use the unit with a specified amount of oil.

Be sure to use the unit with a specified amount of oil. If it exceeds the upper limit, oil may blow out from the outlet port when entering the atmosphere. In addition, if the oil level becomes lower than the lower limit during the operation, the bearings, shaft seals, etc. are damaged, which causes a leakage, abnormal noise, overloaded motor, or shutdown, causing a malfunction. When it is necessary to add oil, use the same oil as that being used.

*For the amount of oil, refer to “8.1 Performance Specifications91” on page 91.

Notice



Do not start with the oil level at the lower limit.

Do not start with the oil level at the lower limit. Starting below the lower limit may cause failures.

MEMO

- It takes approx. 1 minute for oil to spread out. After the oil level becomes stable, operate the unit for a few seconds once. Operating the unit lowers the oil level. This is because oil circulates in the main unit, oil cooler, and other section during operation. Check during operation whether or not the oil level is between the level lines of the oil gauge.
- The oil level may drop when oil is added and the unit is operated during an overhaul or after being stopped for a long period of time with oil removed. In that case, add oil while checking the oil level gauge so that the oil level reaches the specified amount.

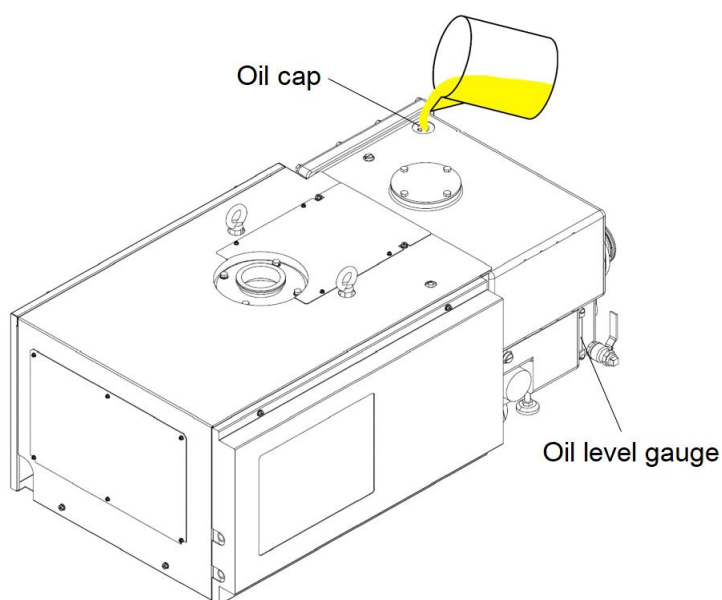


Figure 10: Oil cap and oil level gauge position

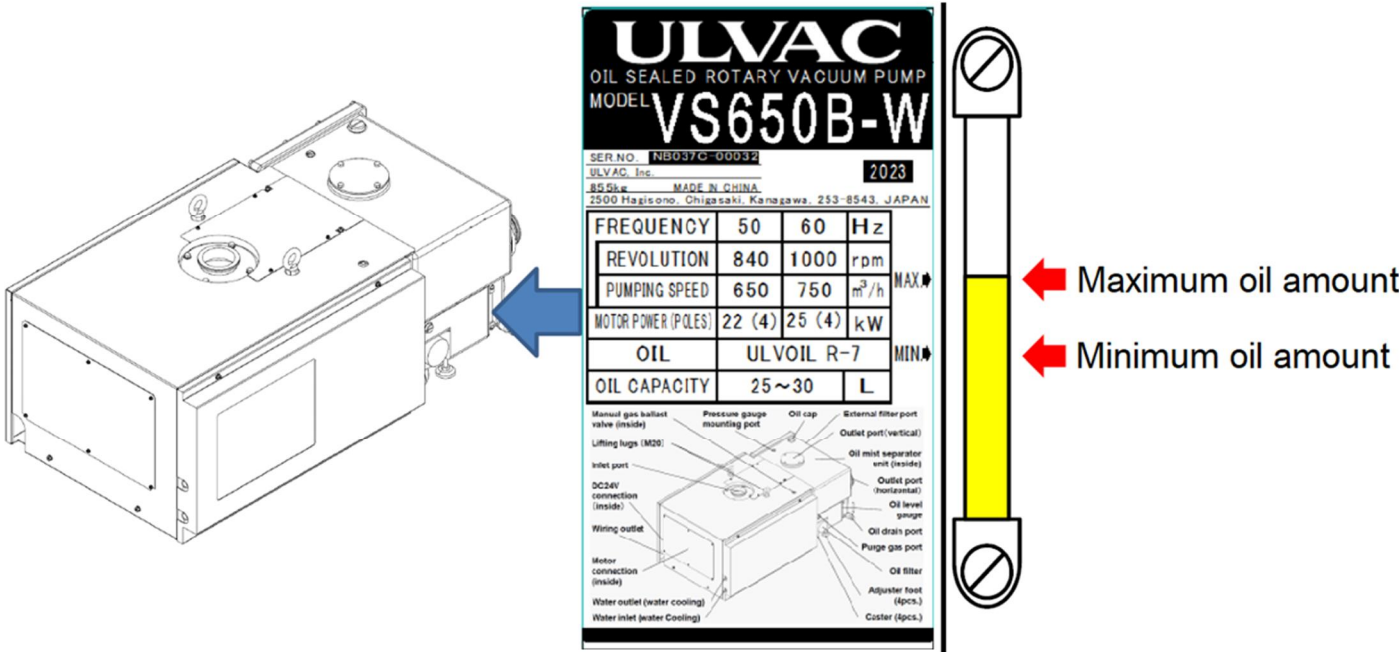


Figure 11: Specified oil level

▶ 3.6 Piping

 	<p>Shut off dangerous energy.</p> <p>Before piping and wiring work, refer to "For Safe Use" and make sure that all energy sources (such as electricity, pneumatic pressure, and cooling water) are shut off before starting work.</p> <ul style="list-style-type: none">* If you are using compressed air, nitrogen gas, or other gases, remove it.* Refer to "1. For safe use" on page 1.* Refer to "1. For safe use" on page 1.
 	<p>Piping and wiring need to be structured to absorb shaking.</p> <p>The vacuum piping, cooling water piping, purge gas piping, and electric wiring need to be structured to absorb shaking to prevent the piping from being broken or disconnected by the specified shaking.</p>
 	<p>Take care not to damage the gasket and the sheet surface of the gasket.</p> <p>Take care not to damage the gasket and the sheet surface (inlet/outlet port) of the gasket. After assembling the pipes, perform a leak test for the entire system.</p>
 	<p>Do not allow foreign matter to enter the inlet/outlet port of this unit.</p> <p>When connecting the pipes, take care not to drop foreign matter (e.g. bolts) into the inlet/outlet port of this unit. If foreign matter drops, it is necessary to disassemble this unit and remove it. Contact your nearest ULVAC TECHNO or ULVAC service center.</p>
 	<p>Do not apply loads directly to the inlet/outlet port of this unit.</p> <p>Do not apply loads, such as the connection piping, directly to the inlet/outlet port of this unit.</p>
 	<p>Use metal piping with sufficient compressive strength and corrosion resistance.</p> <p>If the vacuum pump is used to exhaust flammable/combustion supporting gases or corrosive gases, use metal piping with sufficient compressive strength and corrosion resistance.</p>
 	<p>Use piping with sufficient compressive strength.</p> <p>If the piping consists of thin metal pipes, such as accordion type and bellows, the piping may resonate due to exhaust pulsation, causing the noise to exceed the work environment reference value. Use piping with sufficient compressive strength.</p>
 	<p>Take care not to allow foreign matter to mix.</p> <p>If the pump sucks solids, such as dust and fine powder, or water, not only the ultimate pressure gets worse but also it may cause a failure. The inside of the pump is designed to rotate with a slight clearance and, if foreign matter enters the pump, it may become unable to rotate.</p>

! Caution



Install the protection cover to the piping.

The temperature of the inlet/outlet piping is 70°C or more. After connecting the inlet/outlet port piping, install the protection cover.

■ **Applicable Specifications**

- Refer to "8.2 External Dimensions" on page 92.

■ **Applicable Piping**

- Piping according to the safety rules and laws and regulations in the country of destination.
- Materials that does not rust inside.
- Heatproof temperature of 100°C or more.

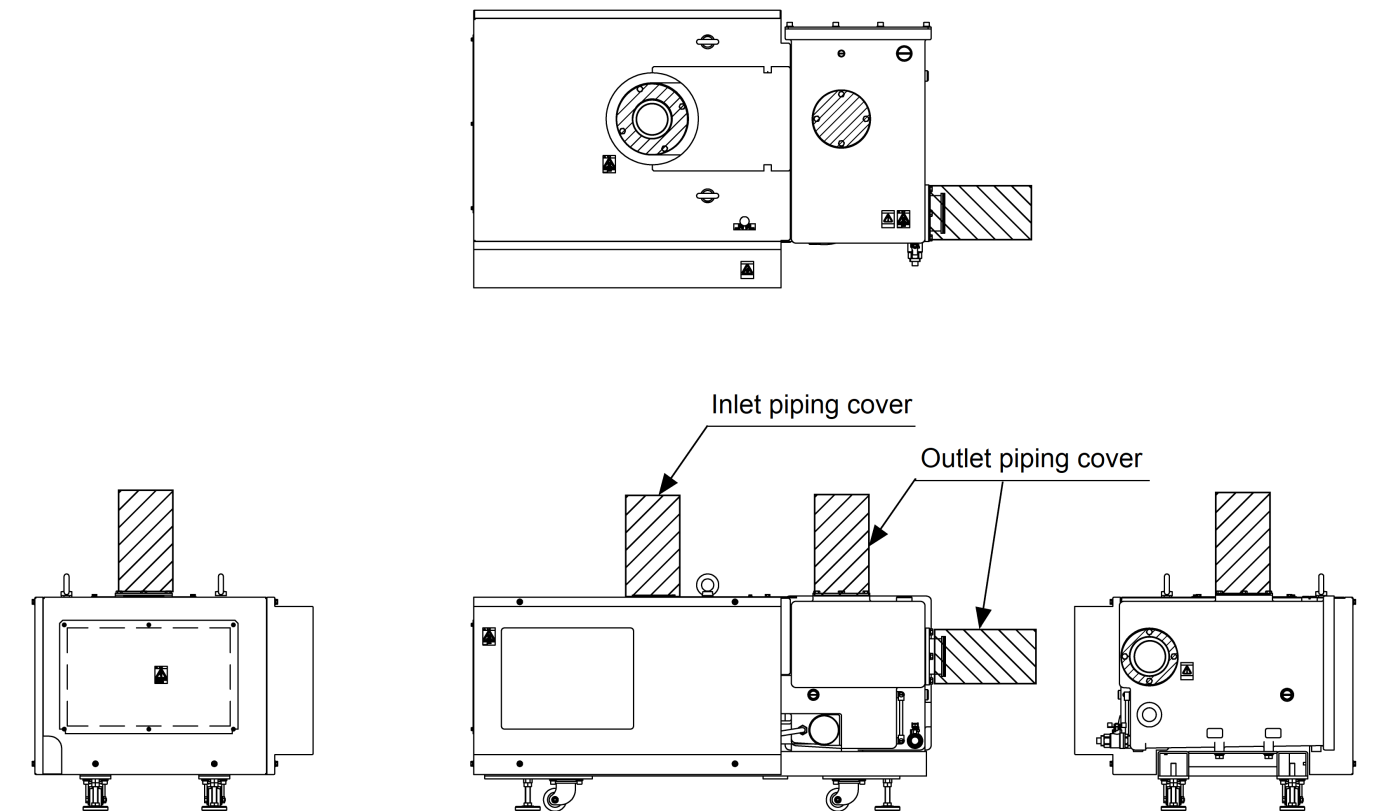






Figure 12: Sample installation of protection cover

3.6.1 Inlet Port Piping








 Warning 	<p>Use the included inlet port only.</p> <p>The inside of the inlet port acts as the sealing surface of the check valve in structure. Use the included inlet port only.</p>
 Notice	<p>When connecting the pipe, remove the protective cap.</p> <p>A protective cap is attached to the inlet port at the factory. When connecting the pipe, remove the protective cap.</p> <p>* When you have ordered the optional JIS flange, a storage flange is attached to the inlet port. When connecting the pipe, remove the storage flange.</p>
 Notice	<p>Use piping with bellows for the inlet piping (recommended).</p> <p>Connect between the inlet port of the pump and the piping with pipes larger than the size of the inlet port. It is recommended to install piping with bellows to prevent vibrations of the pump from being transmitted to the vacuum chamber.</p>

- Install a vacuum valve, vacuum gauge, and leak valve between the vacuum chamber and the pump. Refer to "Figure 5: System connection diagram" on page 16.
- Sufficiently clean the inside of the vacuum chamber, pipes, vacuum valves, and other components before connecting them to the pump. If they are contaminated and connected as they are, the ultimate pressure increases or it takes longer to reduce pressure down to the specified pressure. Do not touch vacuum sections with your bare hands, but with gloves.
- When sandblasting the vacuum container, completely remove sand.
- Completely remove weld scale and rust in the pipes. When welding on the inlet port side on site, take measures in such a way as to remove the pump or put paperboards in the inlet port of the pump to prevent foreign substances to enter the pump.
- When using this unit in combination with a mechanical booster pump, install a leak valve on the vacuum chamber side of the mechanical booster pump.
- Install the leak valve as close to the vacuum chamber as possible to prevent backflow of oil into the vacuum chamber when the pump is stopped.
- Connect a pipe to the inlet port of the pump using the flange shown in "Table 4: Inlet port diameter."

Table 4: Inlet port diameter

Model	Inlet port diameter
VS650B-A/-W/-WL	DN100 ISO-K
VS750B-A/-W	* VG100 when you ordered an optional JIS flange.

3.6.2 Outlet Port Piping








 Warning 	<p>Do not block the outlet port.</p> <p>Do not operate the pump with any equipment installed on the outlet port side that prevents gas from passing in such a way as to block the outlet port. Pressure in this unit may increase, which causes a rupture of or oil leakage from the casing or level gauge, or overloads the electric motor. This unit is not pressure-proof in structure. The guaranteed pressure-proof value of this unit is 0.03 MPaG (0.3 kg/cm²G).</p>
 Warning 	<p>Do not block the outlet port.</p> <p>A protective cap is attached to the outlet port at the factory. When connecting the pipe, remove the protective cap. Operating this unit without removing the protective cap may cause the protective cap to fly with great force.</p> <p>* When you have ordered the optional JIS flange, a storage flange is attached to the outlet port. When connecting the pipe, be sure to remove the storage flange. Operating this unit without removing the storage flange may increase pressure in this unit, causing damage to or oil leakage from the casing or level gauge, or overloading of the motor.</p>
 Danger 	<p>Be sure to use conductive material for the outlet port piping and ground it.</p> <p>Be sure to use conductive material (which conducts electricity) and ground it when installing the piping of the outlet port. If non-conductive material is used, static electricity is generated when the outlet gas passes through, which may cause explosion or fire.</p>
 Notice	<p>The configuration is such that the condensed gas does not return directly to this unit.</p> <p>For the configuration, bend sideways the piping on the outlet side using an L-shaped pipe or by other means so that the condensed gas does not return directly to this unit. It is recommended to provide a mechanism to drain accumulated liquid.</p>





- This unit comes equipped with a built-in oil mist separator as standard and it not necessary to install an oil mist trap externally.
- Note that if a pipe is connected to the outlet port with the inside diameter of the pipe small or with any foreign substances on the inside surface of the pipe, it increases pressure in the pump. Consequently, the pump case or oil level gauge may burst, oil may leak, or the motor may be overloaded.
- For connection such as between the outlet port of the pump and a duct pipe, refer to "Table 5: Outlet port diameter."

Table 5: Outlet port diameter

Model	Outlet port diameter
VS650B-A/-W/-WL	DN100 ISO-K
VS750B-A/-W	* VG100 when you ordered an optional JIS flange.

3.6.3 Cooling Water Piping (for Water Cooling Type)

<p>Notice</p> 	<p>Use the piping with an appropriate resistant water pressure and heatproof temperature.</p> <p>For the cooling water system, use joints and pipes with a resistant water pressure of 0.5 MPaG or more and a heatproof temperature of 90°C or more.</p> <p>* When operating at the maximum load and the cooling water inlet temperature is 30°C, the cooling water outlet temperature becomes 90°C.</p>
<p>Notice</p> 	<p>Install a valve, which matches the piping connector, at the cooling water inlet/outlet.</p> <p>Cooling water may leak during the work. Install a valve, which matches the piping connector used by the equipment, at the cooling water inlet/outlet.</p>
<p>Notice</p> 	<p>Use appropriate joints.</p> <p>Connect appropriate joints to the cooling water piping. Do not confuse between the cooling water inlet and the cooling water outlet.</p>
<p>Warning</p> 	<p>Be sure to supply the specified amount of cooling water.</p> <p>If the amount of cooling water is reduced, it may cause failures such as rapid wear or seizing up of the components of this unit. Take care especially in high pressure regions as this is highly likely to occur there. It is recommended to install a flowmeter in the cooling water system and provide an interlock that stops this unit when the amount of water becomes equal to or lower than the specified value.</p>
<p>Notice</p> 	<p>Install a flowmeter (e.g. flow sight) at the cooling water source.</p> <p>Install a flow meter (e.g. flow sight), which allows you to visually recognize the flow, at the cooling water supply source, such as a device, to check whether or not cooling water flows.</p>
<p>Notice</p> 	<p>Secure the required flow rate.</p> <p>If operation is continued with the cooling water flow rate below the specified amount, this unit may break down. Secure at least the specified flow rate. In addition, if the supply source and drain port are far apart from each other or if there is a height difference in the piping (lifting drainage to a position higher than this unit), a sufficient flow rate may not be secured. In that case, secure the flow rate by changing the piping layout, making the piping thicker, or increasing the supply pressure within the specified range.</p>
<p>Notice</p> 	<p>When using multiple units, connect the cooling water pipes in parallel.</p> <p>When using multiple units, connect the cooling water pipes in parallel. A series connection is insufficient in cooling capacity, which may cause a failure.</p>

<p>Notice</p>		<p>Use water with fewer impurities for cooling water.</p> <p>It is recommended to use water with fewer impurities (e.g. industrial water; refer to the table below) for cooling water of this unit.</p> <p>In the cooling water system of this unit, water scale, such as calcium carbonate, settles on depending on the water quality, which may reduce the cooling water flow rate.</p> <p>In addition, chlorine ions corrode the inner walls, which may cause leakage of cooling water. Furthermore, when pure water is used, metal is separated therefrom, which may cause leakage of cooling water.</p> <p>Note that in advance that in such a case, the repair cost may be borne by you.</p> <p>[Reference] The standard quality of water supply in the Japanese industrial water works</p> <table border="1" data-bbox="384 705 1484 891"> <thead> <tr> <th>Turbidity</th> <th>pH</th> <th>Alkalinity</th> <th>Hardness</th> <th>Total residue on evaporation</th> <th>Chloride ion</th> <th>Iron</th> <th>Manganese</th> </tr> </thead> <tbody> <tr> <td>20mg / L or less</td> <td>6.5~8.0</td> <td>75mg/L or less</td> <td>120mg/L or less</td> <td>250mg/L or less</td> <td>80mg/L or less</td> <td>0.3mg/L or less</td> <td>0.2mg/L or less</td> </tr> </tbody> </table> <p>Established by: Japan Industrial Water Association (Industrial water quality standard committee)</p>	Turbidity	pH	Alkalinity	Hardness	Total residue on evaporation	Chloride ion	Iron	Manganese	20mg / L or less	6.5~8.0	75mg/L or less	120mg/L or less	250mg/L or less	80mg/L or less	0.3mg/L or less	0.2mg/L or less
Turbidity	pH	Alkalinity	Hardness	Total residue on evaporation	Chloride ion	Iron	Manganese											
20mg / L or less	6.5~8.0	75mg/L or less	120mg/L or less	250mg/L or less	80mg/L or less	0.3mg/L or less	0.2mg/L or less											
<p>Notice</p>		<p>Water with a lot of impurities is filtered using a filter or by other means.</p> <p>When using water with a large amount of impurities, such as scale and iron, filter them with a filter installed in the prior stage before use.</p>																
<p>Notice</p>		<p>Do not install electrical equipment or wiring on the floor below or near this unit.</p> <p>This is designed so that no water leak occurs under the specified conditions and checked through a water leak test. However, in the event of abnormal conditions outside the specifications (e.g. an abnormal increase in water pressure), a water leak may occur. In that case, water will continue to leak unless the supply from the equipment is stopped. Do not install electrical equipment or wiring on the floor below or near this unit.</p> <p>It is also recommended to place water leak sensors on the floor below and near this unit so that the power is shut off if a leak sensor is activated.</p>																
<p>Notice</p>		<p>When stopping the operation in winter, drain water inside.</p> <p>When operation is stopped in winter, water in the cooling water piping may freeze, causing damage to them. While operation is stopped, drain water inside by blowing compressed air from the cooling water outlet or by other means.</p>																

■ Specifications of connection

- Connection port: Rc1/2

■ Applicable piping

- Joints and pipes with a resistant water pressure of 0.5 MPa or more
- Heatproof temperature: 90°C or more

Table 6: Specifications of cooling water

Cooling water	Supply pressure (MPa)	0.5 or less
	Differential pressure between inlet and outlet (MPa)	0.1 or more
	Flow rate (L/min)	3.0 or more
	Feedwater temperature (°C)	5 to 30 (non-condensing)

MEMO

- During operation, cooling water cools down oil circulating in the pump using a heat exchanger. When the pump stops, oil stops circulating at the same time and the main unit of the pump and the oil tank are naturally-cooled. This cooling takes time.

3.6.4 Gas Ballast Gas

This unit comes equipped with the gas ballast function as standard. If the target gas contains a condensable gas and moisture, use the gas ballast gas to prevent liquid from accumulating inside the main unit. When air or nitrogen is introduced from the gas ballast valve immediately before the compression process of the pump, the condensable gas is discharged together through the exhaust valve without being liquefied.

For the standard model, the gas ballast valve is closed at the factory shipment. If necessary, open the gas ballast valve (M8 hexagon socket head bolt) located inside in reference to "Figure 13: Manual gas ballast valve position"

*** If you have ordered an optional solenoid valve type gas ballast valve, the gas ballast valve is opened at the factory shipment.**

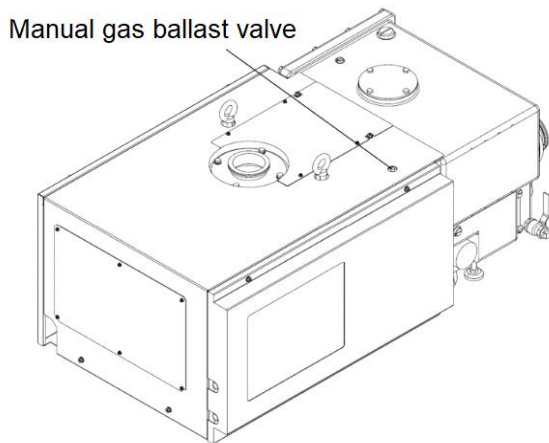


Figure 13: Manual gas ballast valve position

* For the gas ballast function, refer to "4.4 Gas Ballast Function" on page 59.

3.6.5 Purge Gas

This unit has a purge gas port.

By introducing purge gas, most of the air built up in the oil tank can be expelled. Remove the seal plug and introduce CDA (dew point: -60°C) or nitrogen as a purge gas.

Notice



When introducing compressed air, set the supply pressure to 0.03 MPaG or less.

When introducing compressed air (CDA with a dew point of -60°C or nitrogen), set the supply pressure to 0.03 MPaG or less.

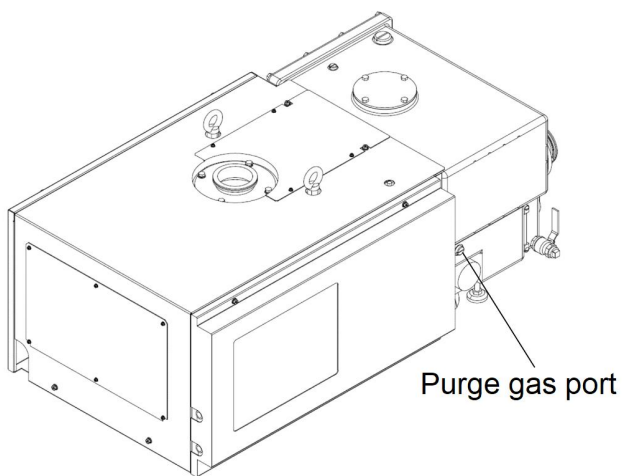



























Figure 14: Purge gas port position

▶ 3.7 Electric Wiring

 Warning 	<p>Use cables certified by the national safety standards.</p> <p>Use cables certified by the national safety standards in the country of destination (e.g. products certified by UL, TUV).</p>
 Warning 	<p>Comply with Rules and Laws and Regulations.</p> <p>Install and operate this unit in compliance with the safety codes and laws (e.g. fire protection laws and electric codes) in the country and region where you use this unit.</p>
 Danger  	<p>Electric wiring must be carried out by qualified personnel.</p> <p>Electric wiring must be carried out by qualified personnel.</p>
 Danger  	<p>Before installing electric wiring, turn off the primary power.</p> <p>Before installing electric wiring, turn off the primary power. Never leave the voltage applied during the work. There is the risk of electric shock.</p>
 Danger 	<p>Before installation or removal work, disconnect this unit from all energy sources.</p> <p>Before installation or removal work, disconnect this unit from all energy sources (such as electricity, compressed air, and cooling water). * If you are using compressed air, nitrogen gas, or other gases, remove it.</p>
 Warning 	<p>Fix or cover the cables.</p> <p>Fix the cables so that they do not come into direct contact with this unit, or prepare covers (cable racks).</p>
 Warning  	<p>Do not use other than at the rated voltage.</p> <p>Do not use other than at the rated voltage. Otherwise the ground-fault interrupter or motor breaker does not work properly, causing burnout or fire.</p>
 Warning 	<p>Check whether or not the wire connections are suitable for the working voltage.</p> <p>Before use of this unit, check that the wire connections are suitable for the working voltage.</p>

<p>Warning</p> 	<p>Provide a ground-fault interrupter.</p> <p>In the event of a short circuit, it protects the equipment and wiring and protects against overload. In addition, it protects against an electric shock and a ground fault that can lead to fire due to electric leakage. If no ground-fault interrupter is installed or if it is installed but does not match the motor capacity, it causes damage to equipment, fire, or an electric shock.</p>
<p>Warning</p> 	<p>Be sure to install an overload protector.</p> <p>Be sure to install an overload protector suitable for the capacity. If no overload protector is installed or it does not match the capacity, it causes damage to the motor or fire.</p>
<p>Warning</p> 	<p>In the wiring work, provide safety circuits.</p> <p>In the wiring work, be sure to provide safety circuits, such as molded-case circuit-breakers, electromagnetic contactors, and thermal overcurrent contactors.</p>
<p>Warning</p> 	<p>Use appropriate electromagnetic switches.</p> <p>The rated current value of the motor depends on the motor manufacturer. Use electromagnetic switches that work at the rated current of the motor for use.</p>
<p>Warning</p> 	<p>Make the thermal settings appropriately.</p> <p>Set the thermal setting to the rated current value of the motor that is suitable for the voltage and frequency of the power supply in use.</p>
<p>Notice</p> 	<p>When using an automatic vacuum breaking valve, connect it so that it works with the motor.</p> <p>When using an automatic vacuum breaking valve (a time-lag electromagnetic leak valve that opens 3 to 5 seconds to introduce air into the pump after the motor for driving the pump stops), connect it so that it works with the motor.</p>

- Confirm the specifications of the power supply of this unit. This unit does not have a mechanism to shut off the power. Be sure to install an MCCB (molded-case circuit-breaker) on the primary side. Prepare a power supply with the capacity to the power specifications of this unit in reference to "Table 9: Standard motor and wiring" on page 45.
- Perform the direct-connect starting of the pump.
- When selecting wires, refer to the current at the maximum load for the model for use and check that the current is within the allowable range of the wire specifications. Also check that the wire size can pass through the wire outlet.









Example: STO (Size: AWG4 / No. of cores: 4) - Outer diameter of core: approx. ϕ 10 / Allowable current value: approx. 110 A (ambient temperature: 30°C)
 2PNCT (Size: 22 mm² / No. of cores: 4) - Outer diameter of core: approx. ϕ 9 / Allowable current: approx. 95A (ambient temperature: 30°C)

Table 7: Power capacity and recommended overload protector - Rating List

Model No.		VS650B-A, VS650B-W, VS650B-WL	VS750B-A, VS750B-W
Starting system		Direct-connect starting	Direct-connect starting
200-V class voltage	Power capacity	50Hz	130kVA
		60Hz	200kVA
	Motor overload protector	90A	90A
400-V class voltage	Power capacity	50Hz	130kVA
		60Hz	200kVA
	Motor overload protector	45A	45A

3.7.1 Wire Connection of Main Power Supply

This unit uses 200-V and 400-V class shared motors. The unit can be operated without changing the 200-V and 400-V class motors by changing the wiring connections inside the motor terminal box. Install electrical wiring in reference to "Figure 15: Connection wiring diagram in terminal box" on page 41 and "Table 9: Standard motor and wiring" on page 45. When changing to Δ connection, refer to "Table 8: Terminal block connection confirmation and wiring layout change method" on page 43.

 	<p>Be sure to establish a ground for the ground terminal.</p> <p>The work of embedding a ground and connecting the ground wire requires the qualification of an electric work specialist. For incomplete grounding, there is the risk of electric shock.</p>
 	<p>Be sure to close the lid of the motor terminal box.</p> <p>After the completion of wiring to the motor, be sure to close the lid of the terminal box. Never open the lid during operation. There is the risk of electric shock.</p>
 	<p>Check whether or not all screws inside the motor terminal box are tightened.</p> <p>Check that all screws inside the motor terminal box are tightened. If the tightness is insufficient, it may cause fire.</p>
 	<p>Install wiring for direct-connect starting.</p> <p>Install wiring for direct-connect starting. A star delta connection makes it difficult to start in some cases.</p>

- Install grounding wires so that the wire lengths become as short as possible.
- The ground terminal on the motor side is the screw indicated by the ground mark \oplus in the terminal box.
The power cord size connected to the ground must be at least the same as that of the power cord for the power supply to the motor. Set the ground resistance depending on the working voltage of the power supply:
200 V to 240 V: 100 Ω or less, 380 V to 460 V: 10 Ω or less.
- Decide the electric wire size in consideration of a voltage drop of the electric wire. Under normal conditions, use electric wires with a voltage drop within 2% of the motor rated voltage
[Calculating formula of voltage drop: $\sqrt{3} \times \text{Wire Resistance } (\Omega/\text{km}) \times \text{Wiring Distance (m)} \times \text{Rated Current of Motor (A)} \times 10^{-3}$]
- Take measures such as lockout and tag out to prevent the power switch from being accidentally turned on during work.

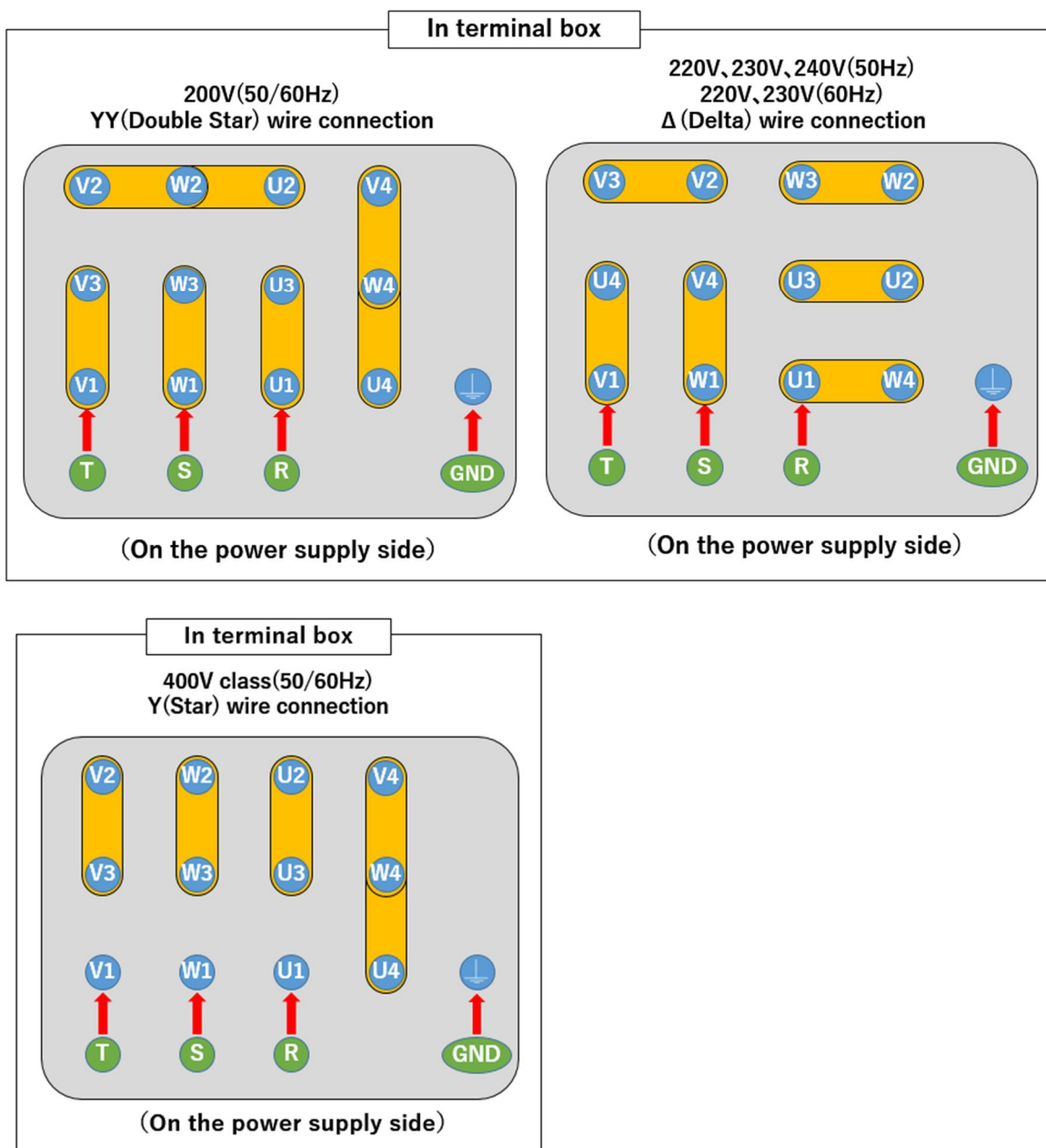
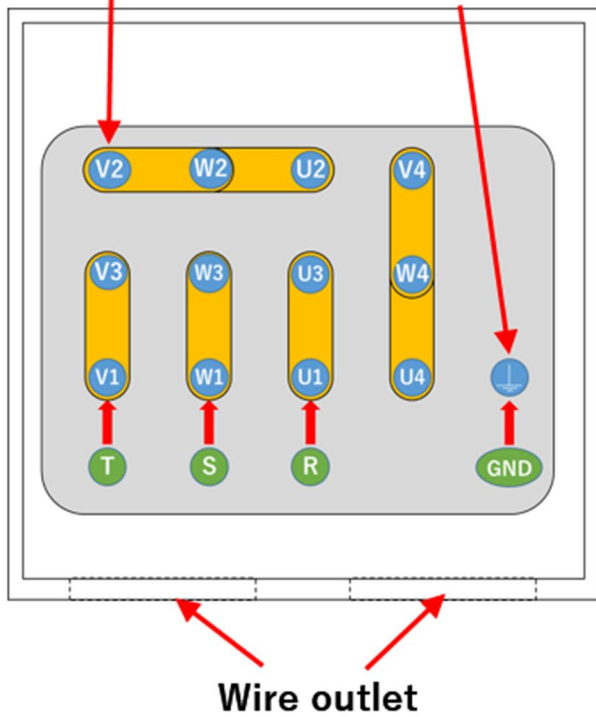


Figure 15: Connection wiring diagram in terminal box

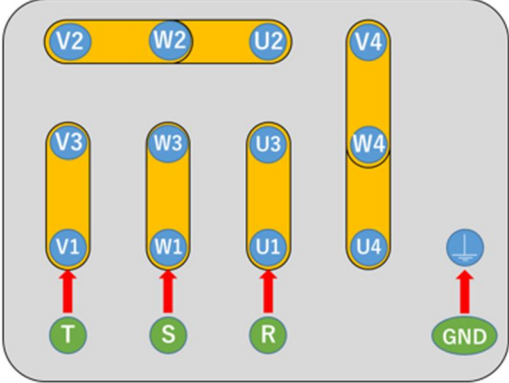
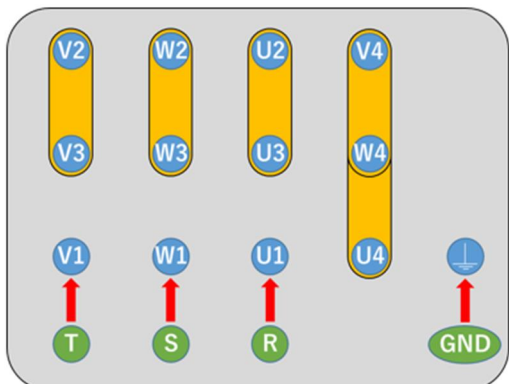
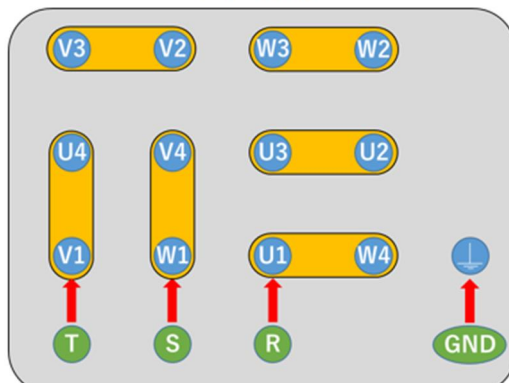
Screw for terminal box(12places)
Screw for ground terminal



Screw for ground terminal	M6
Screw for terminal box	M6
Wire outlet	M36

Figure 16: Major dimensions of terminal box

Table 8: Terminal block connection confirmation and wiring layout change method

Sequence	Procedure	Picture
No.1	<p>Open the cover of the terminal box and check which connection is used for the connection of the terminal block, YY connection, Y connection, or Δ connection.</p> <p>Check the power supply voltage to be used. When operating at 200V (50/60Hz): Confirm YY connection. When operating at 400V class (50/60Hz): Confirm that it is a Y connection.</p> <p>When changing from YY connection to Y connection or from Y connection to YY connection, change the layout of the short-circuit plate as shown in the figure on the right.</p> <p>Tightening torque for M6 nuts: 3-6.5Nm.</p> <p>* When changing from Δ connection to YY connection or Y connection, it is necessary to change the wiring layout. Refer to the next section, "How to change wiring layout," and change the wiring layout.</p> <p>When operating at 220V, 230V, 240V (50Hz) or 220V, 230V (60Hz): Make sure that it is delta connection.</p> <p>When changing from Y connection to Δ connection or YY connection to Δ connection, it is necessary to change the wiring layout. Refer to the next section, "How to change wiring layout," and change the wiring layout.</p>	<div style="text-align: center;"> <p>200V YY(Double Star)</p>  </div> <div style="text-align: center; margin-top: 20px;"> <p>400V class Y(Star)</p>  </div> <div style="text-align: center; margin-top: 20px;"> <p>220V 230V 240V(50Hz) 220V 230V(60Hz) Δ (Delta)</p>  </div>

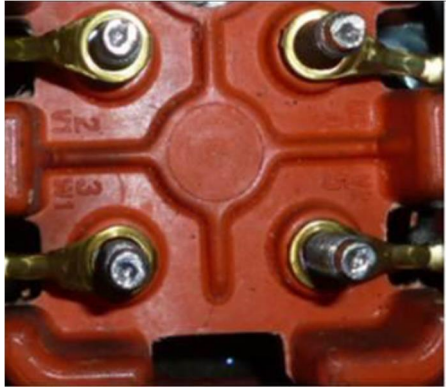
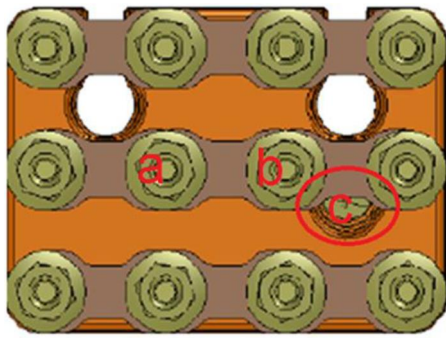
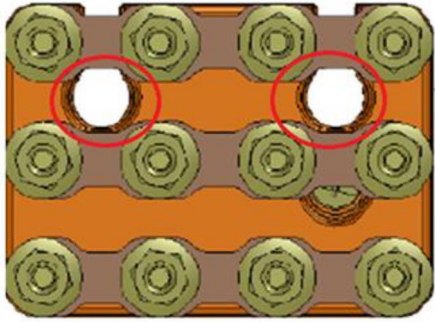
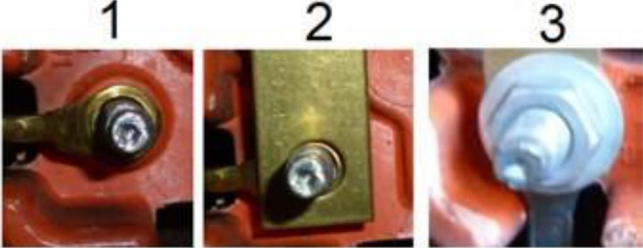
How to change the layout of wiring		
Sequence	Procedure	Picture
No.2	To facilitate rearrangement, remove all nuts and all shorting plates from the terminal block while holding the terminals in place.	
No.3	The terminals (a and b) in the center of the terminal block must be replaced. In this case, the terminal block must be removed from the terminal box. If so, loosen the bolt (c) in the center of the terminal block.	
No.4	Use the center hole in the terminal block to attach the terminal to the center pin of the terminal block.	
No.5	Refer to No.1 and assemble the terminals and short-circuiting plates so that they are arranged according to the specifications of the power supply voltage to be used, and then fix them with nuts. Tightening torque for M6 nuts: 3-6.5Nm. The order of assembly is the terminal, the shorting plate, and the nut.	 <p>1 2 3</p> <p>Terminal Bridge Nut</p>

Table 9: Standard motor and wiring

Pump model	Motor capacity kW	Wire connection in terminal box	Power- supply voltage V	Power- supply frequency Hz	Rated current A	molded-case circuit breaker	Recommended wire size for Japan mm ²	Recommended wire size for USA AWG	Recommended wire size for Europe mm ²	Terminal mark	Terminal screw	Tightening torque N · m	Crimp-style terminal model No. J.S.T. MFG. Co., Ltd.								
VS650B-A VS650B-W VS650B-WL	22	YY-connection (Double Star)	200	50	83.0	175	22	3	25	U1 V1 W1	M6 nut with width across bolt of 10 mm	4.0~5.0	R22-6								
			200	60										83.0							
	22	Δ-connection (Delta)	220	50	76.6																
			230	50	76.1																
	25	Δ-connection (Delta)	240	50	75.9																
			220	60	81.5																
	25	Y-connection (Star)	230	60	78.9																
			380	50	44.4																
	22	Y-connection (Star)	400	50	43.8					125	14	6	16	U1 V1 W1	M6 nut with width across bolt of 10 mm	4.0~5.0	R14-6				
			415	50	43.9																
	25	Y-connection (Star)	380	60	45.0																
			400	60	45.0																
25	Y-connection (Star)	440	60	42.7																	
		460	60	42.4																	
VS750B-A VS750B-W	22	YY-connection (Double Star)	200	50	83.0	175	22	3	25					U1 V1 W1	M6 nut with width across bolt of 10 mm	4.0~5.0	R22-6				
			220	50														76.6			
	22	Δ-connection (Delta)	230	50	76.1																
			240	50	75.9																
	22	Y-connection (Star)	380	50	44.4									125	14	6	16	U1 V1 W1	M6 nut with width across bolt of 10 mm	4.0~5.0	R14-6
			400	50	43.8																
	22	Y-connection (Star)	415	50	43.9																
			415	50	43.9																

※VS750B-A, and VS750B-W: Only for 50Hz. It cannot be used at 60Hz.

3.7.2 Connection to Thermostat

A thermostat is provided as standard on this unit to protect the pump when the pump overheats abnormally and exceeds the set temperature (115°C). However, if necessary, install wiring to the 24-VDC power supply connection so that the power supply is shut off when the thermostat is activated.

This thermostat is a bimetal type which opens the contact with an increase in temperature to cut off continuity. Once activated, it does not recover automatically. Make sure that the pump temperature is low enough and that the power to the pump is turned off, and then remove the panel and press down the protrusion at the center of the thermostat.

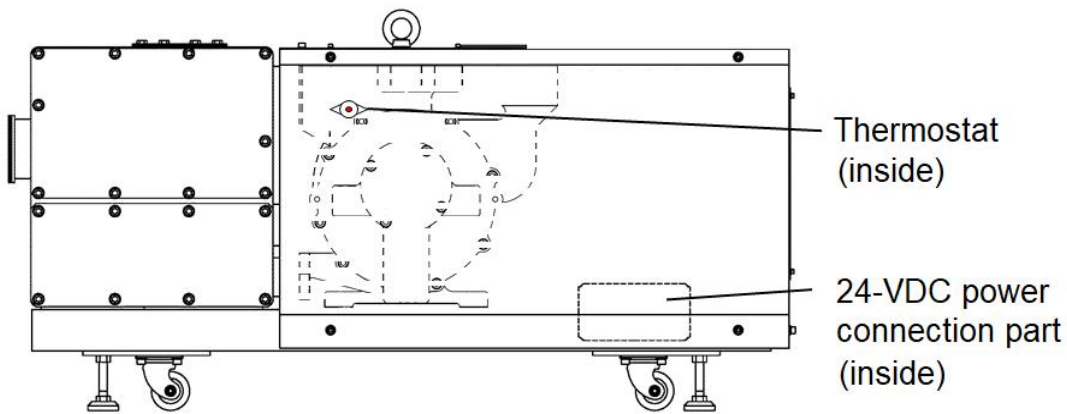


Figure 17: Layout of 24-VDC power connection part

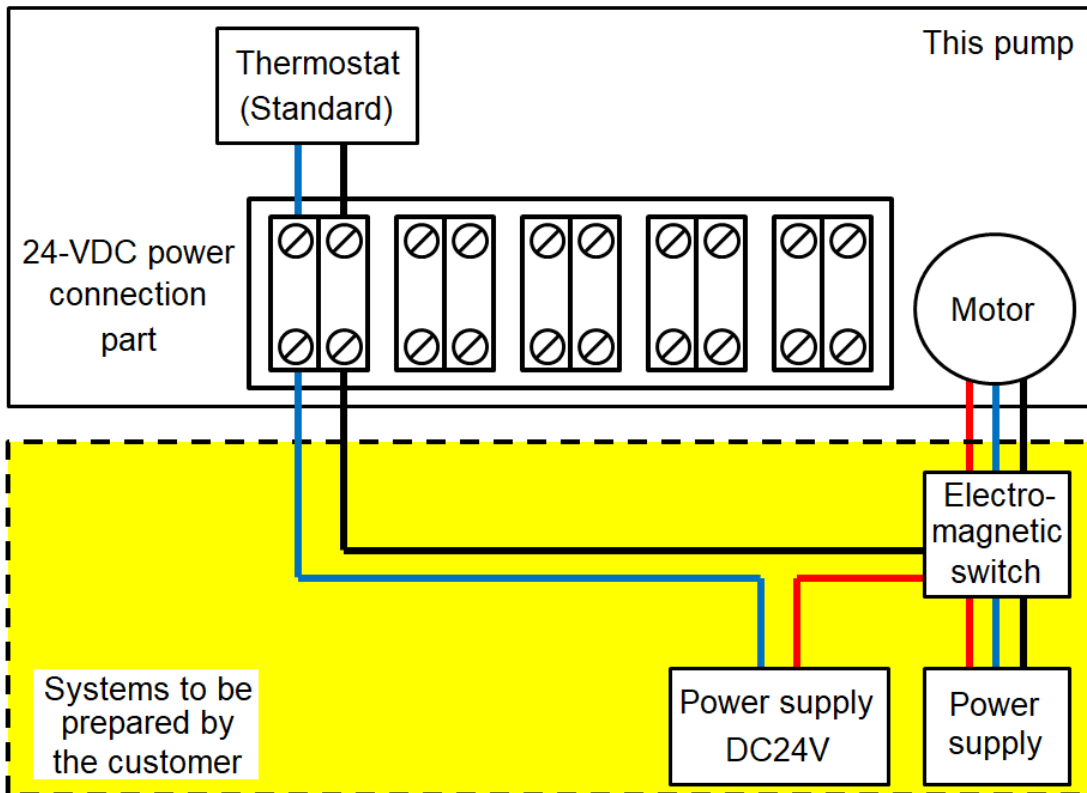


Figure 18: Connection wiring diagram of 24-VDC power connection part

3.7.3 Connection to Electromagnetic-Valve Type Gas Ballast Valve

When you have ordered an optional solenoid valve type gas ballast valve, it can be opened/closed remotely by wiring a single-phase 24 VDC to the 24-VDC power connection part of "Figure 20: Connection wiring diagram of 24-VDC power wire connection (Electromagnetic-valve type gas ballast valve)" as shown in the figure below.

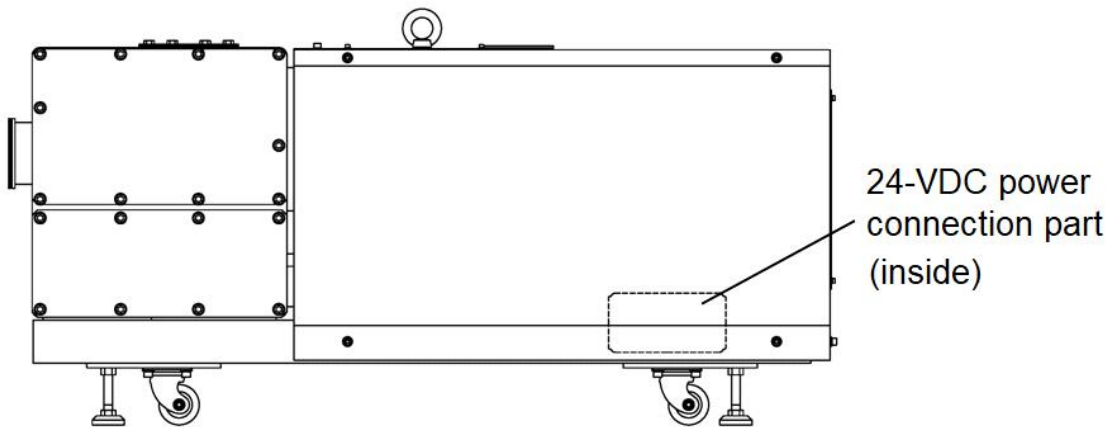


Figure 19: Layout of 24-VDC power connection part

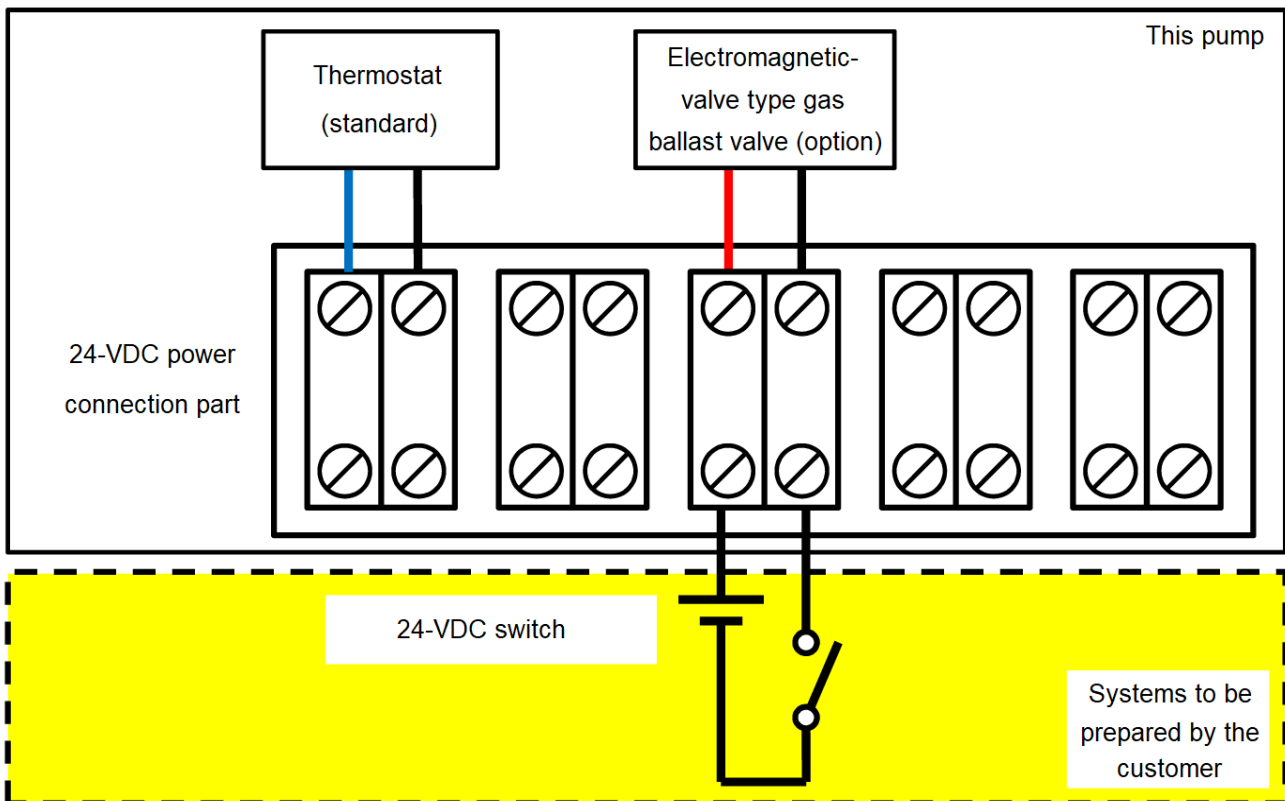


Figure 20: Connection wiring diagram of 24-VDC power wire connection (Electromagnetic-valve type gas ballast valve)

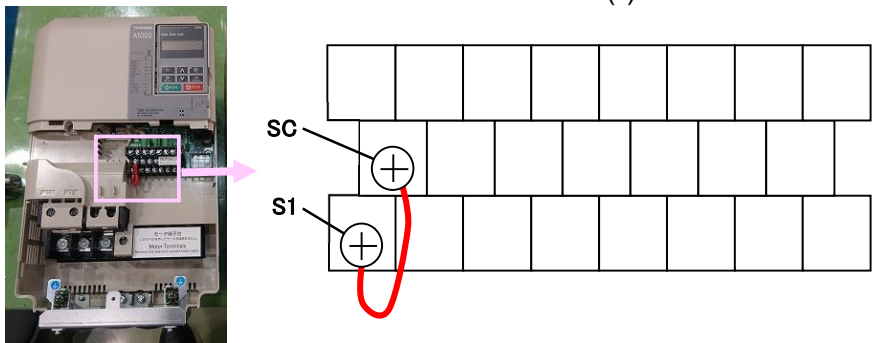
3.7.4 Starting with Inverter

If the power capacity required for the direct-connect starting at 200 VAC/60 Hz cannot be prepared, start with an inverter (sold separately).

- Please use the "YY connection" for the motor connection.
- The recommended inverter is CIMR-AA2A0081 (Three-phase 200V, light-load rating ND, maximum applicable motor: 22 kW) of A1000 Series manufactured by YASKAWA Electric Corporation. Use of other inverters shall be the customer's responsibility.
- Before using an inverter (installation, wiring, operation, maintenance, and inspection), be sure to read the instructions manual for the inverter. In addition, be sure to familiarize yourself with the safety information and precautions regarding the inverter before use.
- Change the parameters to the following values. For parameters not listed in the table, do not change them from the factory-default settings of the inverter. For instructions on how to set the parameters, see the instructions manual for the inverter.

No.	Name	Set value		
b1-01	Frequency Command Select 1	0	-	: Operator
b1-03	Stop Method Select	1	-	: Free run stop
b1-04	Reverse Disable Select	1	-	: Motor Reverse Disable
b1-17	Operation Permission at Power-On	1	-	: Permission *
C6-01	ND/HD Select	1	-	: Light-load rating (ND)
d1-01	Frequency Command 1	60.00	Hz	
E1-13	Base Voltage	200.0	VAC	
E2-01	Motor's Rated Current	90.7	A	
E2-02	Motor's Rated Slip	1.04	Hz	
E2-03	Motor's No-Load Current	26.7	A	
E2-05	Motor's line-to-line resistance	0.09	Ω	
E2-06	Motor's Leakage Inductance	23.2	%	
E2-07	Motor's Core Saturation Factor 1	0.49	-	
E2-08	Motor's Core Saturation Factor 2	0.75	-	
E2-11	Motor Rated Power	25	kW	
H5-11	Transmission ENTER Function Select	1	-	
L5-01	No. of Retries	10	-	
L7-01	Forward Electric Mode Torque Limit	88	%	
L7-02	Reverse Electric Mode Torque Limit	88	%	
L7-03	Forward Regeneration Mode Torque Limit	88	%	
L7-04	Reverse Regeneration Mode Torque Limit	88	%	



- Remove the terminal cover of the inverter and short-circuit (*) terminals SC and S1 in the control circuit.

























* If the above settings are made, the pump starts on power-on. If the pump needs to be started from the inverter, set parameter No. b1-17 to "0: Disabled" without short-circuiting the control circuit. In this case, the pump starts by pressing the "RUN key" on the inverter.




4. Operation










▶ 4.1 Cautions on operation

 Danger 	<p>Do not suck any gas other than inert gas.</p> <p>This unit is to exhaust inert gas (air, nitrogen, argon). If other gases (toxic gas, combustion gas, combustion-supporting gas, corrosive gas, explosive gas) are exhausted, they leak from the main unit of this unit or the parts of this unit are corroded and damaged. Furthermore, they cannot be used as they may ignite or explode due to residual gases or products not only during operation but also after the unit stops.</p>
 Danger 	<p>Do not suck toxic gases into this unit.</p> <p>If toxic gases are sucked into this unit, not only this unit but also the oil becomes toxic. Take care during maintenance.</p>
 Danger 	<p>When exhausting flammable/combustion-supporting gas with a vacuum pump, introduce diluted gas.</p> <p>In the event that flammable/combustion-supporting gas is exhausted with a vacuum pump, introduce diluted gas.</p> <p>Introduce diluent gas from the inlet port so that the concentration of the gas to be exhausted is lower than the explosion limit.</p>
 Warning 	<p>Do not use in a place where a dangerous atmosphere may occur.</p> <p>Do not use in a place where a dangerous atmosphere may occur due to explosive gas. Otherwise it may cause injury or fire.</p>
 Warning 	<p>Never place flammables within 1 m around the motor and vacuum pump.</p> <p>Never place flammables within 1 m around the motor and vacuum pump.</p> <p>There is a risk of fire.</p>
 Warning 	<p>Do not place walls or obstacles within 0.5 m from the air outlet of the motor.</p> <p>Do not place walls or obstacles within 0.5 m from the air outlet of the motor (at the end of the motor).</p> <p>There is a risk of burn injury and fire due to abnormal overheating. * For air cooling type</p>

 Warning 	<p>If it does not work or there is an abnormality, immediately turn off the power switch.</p> <p>If it does not work or there is an abnormality, immediately turn off the power switch to prevent accidents. Contact your nearest ULVAC TECHNO or ULVAC service center for inspection/repair.</p>
 Warning 	<p>Do not block the outlet port.</p> <p>Do not operate the pump with any equipment installed on the outlet port side that prevents gas from passing in such a way as to block the outlet port. Pressure in this unit may increase, which causes a rupture of or oil leakage from the casing or level gauge, or overloads the electric motor. This unit is not pressure-proof in structure. The guaranteed pressure-proof value of this unit is 0.03 MPaG (0.3 kg/cm²G).</p>
 Warning 	<p>Check that the valve is open.</p> <p>If the valve is installed on a pipe after the outlet port, make sure that the valve is open. It may burst.</p>
 Caution 	<p>Use the unit with a specified amount of oil.</p> <p>Be sure to use the unit with a specified amount of oil. If it exceeds the upper limit, oil may blow out from the outlet port when entering the atmosphere. In addition, if the oil level becomes lower than the lower limit during the operation, the bearings, shaft seals, etc. are damaged, which causes a leakage, abnormal noise, overloaded motor, or shutdown, causing a malfunction. When it is necessary to add oil, use the same oil as that being used.</p> <p>* For the amount of oil, refer to "8.1 Performance Specifications" on page 91.</p>
 Notice 	<p>Operate this unit after its temperature reaches the operational ambient temperature.</p> <p>If this unit was stored outside the range of the operational ambient temperature, operate it after its temperature reaches the operational ambient temperature. Otherwise it may cause a malfunction.</p>
 Warning  	<p>Close the gas ballast valve before starting operation.</p> <p>Be sure to close the gas ballast valve before starting operation. In high pressure regions, oil may blow out from the gas ballast valve.</p>
 Warning  	<p>During operation or for a while after operation stops, do not touch the main unit, motor, or piping.</p> <p>During operation or for a while after operation stops, do not touch the main unit, motor, or piping as they are at a very high temperature. Otherwise, you may get burned.</p>

<p>Warning</p> 	<p>Do not put your fingers or objects in the opening of the motor.</p> <p>Do not put your fingers or objects in the opening of the motor. There is a risk of electric shock, injury, fire, or other problems.</p>																
<p>Warning</p> 	<p>Do not touch rotating parts, such as the motor, spindle, and shaft joints, during operation.</p> <p>Do not touch rotating parts, such as the motor, spindle, and shaft joints, during operation of this unit. You may get injured.</p>																
<p>Warning</p> 	<p>Do not remove the exterior panel.</p> <p>Never remove the exterior panel. There are electrical components, wires, and rotating parts, such as a motor, spindle, and shaft coupling inside the panel. You may get an electric shock or injured if you touch them</p>																
<p>Warning</p>  	<p>Do not touch any place other than the valve during gas ballast operation.</p> <p>During operation of this unit, the main unit is at a high temperature. Do not touch any place other than the valve during gas ballast operation.</p>																
<p>Notice</p> 	<p>Use water with fewer impurities for cooling water.</p> <p>It is recommended to use water with fewer impurities (e.g. industrial water; refer to the table below) for cooling water of this unit.</p> <p>In the cooling water system of this unit, water scale, such as calcium carbonate, settles on depending on the water quality, which may reduce the cooling water flow rate.</p> <p>In addition, chlorine ions corrode the inner walls, which may cause leakage of cooling water. Furthermore, when pure water is used, metal is separated therefrom, which may cause leakage of cooling water.</p> <p>Note that in advance that in such a case, the repair cost may be borne by you.</p> <p>[Reference] The standard quality of water supply in the Japanese industrial water works</p> <table border="1" data-bbox="384 1568 1485 1751"> <thead> <tr> <th>Turbidity</th> <th>pH</th> <th>Alkalinity</th> <th>Hardness</th> <th>Total residue on evaporation</th> <th>Chloride ion</th> <th>Iron</th> <th>Manganese</th> </tr> </thead> <tbody> <tr> <td>20mg / L or less</td> <td>6.5~8.0</td> <td>75mg/L or less</td> <td>120mg/L or less</td> <td>250mg/L or less</td> <td>80mg/L or less</td> <td>0.3mg/L or less</td> <td>0.2mg/L or less</td> </tr> </tbody> </table> <p>Established by: Japan Industrial Water Association (Industrial water quality standard committee)</p>	Turbidity	pH	Alkalinity	Hardness	Total residue on evaporation	Chloride ion	Iron	Manganese	20mg / L or less	6.5~8.0	75mg/L or less	120mg/L or less	250mg/L or less	80mg/L or less	0.3mg/L or less	0.2mg/L or less
Turbidity	pH	Alkalinity	Hardness	Total residue on evaporation	Chloride ion	Iron	Manganese										
20mg / L or less	6.5~8.0	75mg/L or less	120mg/L or less	250mg/L or less	80mg/L or less	0.3mg/L or less	0.2mg/L or less										

 	<p>Be sure to supply the specified amount of cooling water.</p> <p>If the amount of cooling water is reduced, it may cause failures such as rapid wear or seizing up of the components of this unit. Take care especially in high pressure regions as this is highly likely to occur there. It is recommended to install a flowmeter in the cooling water system and provide an interlock that stops this unit when the amount of water becomes equal to or lower than the specified value.</p>
	<p>Install a flowmeter (e.g. flow sight) at the cooling water source.</p> <p>Install a flow meter (e.g. flow sight), which allows you to visually recognize the flow, at the cooling water supply source, such as a device, to check whether or not cooling water flows.</p>
	<p>Perform warm-up operation before processing and degassing operation when the unit is stopped.</p> <p>When processing, be sure to perform warm-up operation before processing and degassing operation when the unit is stopped (operation in the atmosphere relief mode). In the event of processing under the condition where the increase in temperature of this unit in early stages is insufficient or in the presence of residual gas when the unit stops, condensable gas condenses inside this unit, which may shorten the life of this unit.</p>
	<p>Take care not to allow foreign matter to mix.</p> <p>If the pump sucks solids, such as dust and fine powder, or water, not only the ultimate pressure gets worse but also it may cause a failure. The inside of the pump is designed to rotate with a slight clearance and, if foreign matter enters the pump, it may become unable to rotate.</p>
 	<p>Do not draw in chemicals such as acid.</p> <p>If chemicals such as acid are drawn in, it may become unable to operate. If chemicals such as acid are drawn in, it may rust and become inoperable during the period of overnight stop. Therefore, change oil immediately after drawing in. This unit is not covered by the warranty if used for drawing in chemicals.</p>
 	<p>Do not draw in chemicals such as solvents.</p> <p>If chemicals such as solvents are drawn in, it may become unable to operate. If a solvent or another chemical that deteriorates the oil lubricity is drawn in, change the oil as it may cause galling or other problems. This unit is not covered by the warranty if used for drawing in solvents or the like.</p>
 	<p>Control the oil level for continuous operation at high suction pressures.</p> <p>Continuous operation for 1 hour or more at a high pressure of 1,000 Pa or more increases the amount of oil discharged as oil smoke, which results in a shortage of oil, causing failures such as rapid wear or seizing up of the components. Add oil frequently to control the oil level. Note that the maintenance cycle may be shorter.</p>

 Caution	<p>For continuous operation at high suction pressures, change oil frequently.</p>
 	<p>Continuous operation at high suction pressures causes an extremely high oil temperature. Consequently, the oil rapidly deteriorates, resulting in poor ultimate pressure and displacement, rapid wear of the parts, or failures such as seizing up. Change oil frequently. It is also effective to install an oil cooler to cool the oil inside the pump.</p>
 Caution	<p>When exhausting a large amount of water etc., change oil frequently.</p>
	<p>When exhausting a gas containing a large amount of moisture etc., change oil frequently. When operating with a large amount of water mixed in oil, the ultimate pressure first increases and then the oil lubricity deteriorates. This may lead to failures such as oil leaks through oil seals, internal corrosion, breakage of displacement plate, and seizure inside the pump.</p>
 Caution	<p>Do not clog the oil filter.</p>
	<p>If the amount of oil circulation is reduced due to a clogged oil filter, it may cause failures such as rapid wear or seizing up of the parts. This is highly likely to occur especially in high pressure regions. Take care. * For replacement of the oil filter, refer to "6.2.11 Replacement of Oil Filter" on page 81.</p>
 Notice	<p>Install an oil mist separator on the outlet port side.</p>
	<p>Operating in high pressure regions generates oil smoke (oil mist) from the outlet side. Install the duct piping through the separator. * This unit comes equipped with an oil mist separator as standard.</p>

▶ 4.2 Preparation for Operation

Warning



Do not block the outlet port.

Do not operate the pump with any equipment installed on the outlet port side that prevents gas from passing in such a way as to block the outlet port. Pressure in this unit may increase, which causes a rupture of or oil leakage from the casing or level gauge, or overloads the electric motor. This unit is not pressure-proof in structure. The guaranteed pressure-proof value of this unit is 0.03 MPaG (0.3 kg/cm²G).

4.2.1 Pre-Operation Check

Before operating this unit, check the following again.

1. Check that the piping and electric wiring connection work have been completed.
2. Check that the outlet port is not blocked by a protective cap or storage flange.
3. Check whether the specified amount of oil is contained. (Refer to "Figure 11: Specified oil level" on page 29.)
4. Open the cooling water valve and check that there is no cooling water leakage. (For water cooling type)
5. Check whether the gas ballast valve is closed.

At high pressures, oil may blow out from the gas ballast valve.

Make the following checks with the vacuum valve closed and the leak valve open.

The vacuum gauge is prevented from being damaged or jumped out in the reverse rotation.

6. Check whether or not the pulley rotates smoothly by rotating it by hand.
If it is extremely heavy, care must be taken. If it gets lighter while turning it by hand, there is no problem with starting the pump. If you still feel heavy, refer to "7. Troubleshooting" on page 84.

■ How to confirm the direction of the motor rotation

Make the checks with the vacuum valve closed and the leak valve open.

The vacuum gauge is prevented from being damaged or jumped out in the reverse rotation.

- 1) Operate this unit for approx. 1 to 2 seconds and stop it.
- 2) During the above operation, check the direction of motor rotation viewed from the motor connection part.

The direction of rotation is that indicated by the arrow shown in the photo.



Figure 21: Direction of motor rotation

If the motor rotates in the correct direction, close the leak valve. The pressure decreases.

If the motor rotates in the opposite direction, the phases on the power supply side are exchanged. Therefore, exchange two of the three wires shown in "Figure 15: Connection wiring diagram in terminal box" on page 41.

▶ 4.3 Startup and stop operation method

4.3.1 Startup

Notice



Warm up for approx. 30 minutes (recommended) after startup.

In order to make full use of the exhaust performance of this unit, it is recommended to warm up for approx. 30 minutes after startup.

To start this unit, follow the procedure below.

1. Close the vacuum valve and leak valve.
2. Turn on the power to the motor.

Check whether the pressure gauge between the vacuum valve and the pump indicates a pressure drop to around the ultimate pressure.

If the pressure does not drop, refer to "7. Troubleshooting" on page 84.

3. Open the vacuum valve.

- In cold climates, the oil viscosity increases, which may make it difficult to start with the specified power. In such a case, fully open the leak valve and operate for several minutes with the inlet port exposed to atmospheric pressure. Then the oil temperature increases and the current returns to the specified value. If the current value does not drop with time, stop immediately. Also take care if the current value fluctuates irregularly.
- If irregular abnormal noises and vibrations occur, stop the operation immediately.

* When using the gas ballast gas, refer to "4.4 Gas Ballast Function" on page 59.

MEMO

- To prevent the motor from being loaded, do not start the pump twice or more an hour for a cold start or once or more an hour for a hot start.

4.3.2 Stop

The inlet port of this unit has a function to seal the inlet port when this unit stops. This keeps the inside of the vacuum vessel in a vacuum even after the unit stops.



During operation or for a while after operation stops, do not touch the main unit, motor, or piping.

During operation or for a while after operation stops, do not touch the main unit, motor, or piping as they are at a very high temperature. Otherwise, you may get burned.

To stop this unit, follow the procedure below.

1. Close the vacuum valve.
 2. Open the leak valve.
 3. Stop the pump and return the pressure inside the pump to atmospheric pressure.
- When stopping the operation, be sure to close the vacuum valve to keep the unit side in a vacuum, open the leak valve, and then stop the pump. Failure to follow this operation may cause the pump cylinder filled up with oil in a few minutes, making it difficult to restart or causing damage to the pump. In addition, oil flows back to the vacuum chamber side in some cases.
 - If the vacuum valve is not closed, a vacuum leakage may occur from the exhaust side through the inside of the pump.

MEMO

- When using the vacuum valve in combination with a pneumatic valve or electromagnetic (electric) valve or using the leak valve in combination with an automatic vacuum breaking valve, it is helpful with no worries even when the operation stops in an emergency.
- During operation, cooling water cools down oil circulating in the pump using a heat exchanger. When the pump stops, oil stops circulating at the same time and the main unit of the pump and the oil tank are naturally-cooled. This cooling takes time.

4.3.3 Drain of this unit

Perform drain work when there is a risk of freezing or when this unit is not used for a long period of time.

Notice



Drain water in this unit.

Drain water in this unit. Accumulated water may cause a failure, such as rusting inside this unit and damage to the parts due to freezing







■ Drain of this unit

When draining the cooling water from the pump, follow the procedure below:

1. Introduce compressed air from "Cooling Water Inlet" of the pump cooling water pipe.
Set the supply pressure of compressed air to 0.3 MPaG or less.
2. When compressed air is discharged from "Cooling Water Outlet," this drain work is completed.

▶ 4.4 Gas Ballast Function





This unit comes equipped with the gas ballast function as standard. If the target gas contains a condensable gas and moisture, use the gas ballast gas to prevent liquid from accumulating inside the main unit. When air or nitrogen is introduced from the gas ballast valve immediately before the compression process of the pump, the condensable gas is discharged together through the exhaust valve without being liquefied.

 Warning	<p>Do not touch any place other than the valve during gas ballast operation.</p>
 	<p>During operation of this unit, the main unit is at a high temperature. Do not touch any place other than the valve during gas ballast operation.</p>
<p>Notice</p>	<p>Wear protective gloves.</p>
 	<p>During operation of this unit, the main unit is at a high temperature. When working with this unit, wear protective gloves.</p>
<p>Notice</p>	<p>If no condensable gas is sucked, close the gas ballast valve.</p>
	<p>If no condensable gas is sucked, close the gas ballast valve. If the unit is used with the valve open, oil scatters, a power loss occurs, and the ultimate pressure increases.</p>

MEMO

- The condensable gas is sucked and then liquefied in the compression process of the pump, mixed with the oil, and starts to circulate in the pump with oil. This is the same as using oil with high vapor pressure, increasing the ultimate pressure of the pump. In addition, the oil lubricity decreases, shortening the life of the shaft seal.
- When using the gas ballast valve, it is recommended to warm up the unit for approx. 20 minutes before sucking condensable gas. The higher the pump temperature, the greater the "gas ballast effect" will be. The "gas ballast effect" at a low temperature is less than the specified processing capacity.

■ Operating procedure of gas ballast function

 Warning  	Close the gas ballast valve before starting operation. Be sure to close the gas ballast valve before starting operation. In high pressure regions, oil may blow out from the gas ballast valve.
Notice 	Do not introduce compressed air into the gas ballast port. Do not introduce compressed air (CDA with a dew point of -60°C or nitrogen) into the gas ballast port under positive pressure conditions. If CDA or nitrogen needs to be introduced, adjust to atmospheric pressure before introducing it.

1. Close the vacuum valve, leak valve, and gas ballast valve, and start operation.
 2. After the pressure drops, introduce air or nitrogen from the gas ballast valve.
 3. Continue operation for approx. 20 minutes to sufficiently increase the temperature of the main unit.
 4. Open the vacuum valve and start operation.
- If a lot of moisture enters the pump at a time and cannot be processed, the moisture is built up at the bottom of the oil tank. In that case, open the oil drain port a little to drain the water.
 - There is a limit to the processing capacity of gas ballast gas for condensable gas. After discharging a large amount of condensable gas or discharging condensable gas without opening the gas ballast valve, the condensable gas remains in the oil. In this case, oil can be purified by following the procedure below









■ How to purify oil

1. Close the vacuum valve and gas ballast valve, and start operation.
2. After the pressure drops, introduce air or nitrogen from the gas ballast valve and operate the unit at idle.
3. Close the gas ballast valve and check whether the specified ultimate pressure is provided. If it is provided, purification is completed. If not, repeat Step 2.

MEMO

- The oil temperature increases and oil can be purified by the gas ballast effect. If purification does not proceed even after a long period of time, it is necessary to change the oil.

5. Removal







 Danger	<p>Before installation or removal work, disconnect this unit from all energy sources.</p>
	<p>Before installation or removal work, disconnect this unit from all energy sources (such as electricity, compressed air, and cooling water).</p> <p>* If you are using compressed air, nitrogen gas, or other gases, remove it.</p>
 Warning	<p>Wait for the temperature of the main unit to decrease.</p>
 	<p>Immediately after operation is stopped, the main unit is at a high temperature. Wait for a while until the temperature of the main unit decreases and then remove and check the parts. Otherwise, you may get burned.</p>
 Danger	<p>Do not suck toxic gases into this unit.</p>
	<p>If toxic gases are sucked into this unit, not only this unit but also the oil becomes toxic. Take care during maintenance.</p>
Notice	<p>If a special gas is exhausted, replace it sufficiently with nitrogen gas.</p>
	<p>If a special gas is exhausted, replace the gas inside the pump sufficiently with nitrogen gas before removal.</p>

To remove this unit, follow the procedure below:

1. Stop this unit and release the inside of the pump to atmospheric pressure.
 - * For details on how to stop this unit, refer to "4.3.2 Stop" on page 57.
 2. Turn off the power and disconnect the wiring.
 3. Drain the oil.
 - * Refer to "6.2.1 Check/Replacement of Oil" on page 65.
 4. Drain the cooling water inside this unit and remove the cooling water piping. (For water cooling type)
 - * Refer to "4.3.3 Drain of this unit" on page 58.
 5. Remove the inlet/outlet piping and seal the inlet/outlet port of this unit with a blind flange.
 - * Remove the inlet piping following the installation manual of the equipment.
- If the piping to the gas ballast valve or to the oil filler/drain port is installed, remove it as well.

▶ 5.1 Removal of Piping






5.1.1 Cooling Water Piping (for Water Cooling Type)

  	<p>Wait for the temperature of the main unit to decrease.</p> <p>Immediately after operation is stopped, the main unit is at a high temperature. Wait for a while until the temperature of the main unit decreases and then remove and check the parts. Otherwise, you may get burned.</p>
<p>Notice</p> 	<p>Close the cooling water supply valve on the primary side and then the drain valve.</p> <p>Make sure that the temperature of the main unit has dropped and then close the cooling water supply valve on the primary side. After that, close the drain valve. If this is done in reverse order (closing the drain valve and then the supply valve), residual pressure remains in the piping. When you remove the piping, the cooling water blows out vigorously. Therefore, close the valves in the correct order.</p>
<p>Notice</p> 	<p>Make sure using a visually recognizable flow meter that the cooling water does not flow.</p> <p>Check that the cooling water does not flow using the visually recognizable flow meter (e.g. flow sight) at the cooling water supply source on the primary side.</p>
<p>Notice</p> 	<p>Drain water in this unit.</p> <p>Drain water in this unit. Accumulated water may cause a failure, such as rusting inside this unit and damage to the parts due to freezing</p> <p>* For drain work, refer to "4.3.3 Drain of this unit" on page 58.</p>

MEMO

- During operation, cooling water cools down oil circulating in the pump using a heat exchanger. When the pump stops, oil stops circulating at the same time and the main unit of the pump and the oil tank are naturally-cooled. This cooling takes time.

5.1.2 Inlet/Outlet Port Piping







<p>Notice</p> 	<p>Remove according to the installation manual for the equipment on the primary side.</p> <p>Remove according to the installation manual for the equipment on the primary side.</p>
<p>Warning</p>  	<p>After the temperature of the main unit decreases, remove the piping for the inlet/outlet port.</p> <p>The unit remains at a high temperature for a while after operation stops. Make sure that the temperature of the main unit has decreased and then remove the piping for the inlet/outlet port</p>
<p>Caution</p> 	<p>After the temperature of the main unit decreases, remove protective cover.</p> <p>The temperature of the inlet/outlet piping is 70°C or more. Make sure that the temperature of the main unit has decreased and then remove the protective cover.</p>
<p>Notice</p> 	<p>Fully seal the inlet/outlet port with a blind flange or cap, or by other means.</p> <p>After removing the inlet/outlet piping, fully seal the inlet/outlet port of this unit with a blind flange or cap, or by other means.</p>

▶ 5.2 Transportation

- For transportation, refer to "3.3 Transportation" on page 22.

6. Maintenance/Inspection

Daily and regular inspection and maintenance work are required to maintain the original performance of this unit and ensure safe use.

 <p>Danger</p> 	<p>Before inspection/relocation, turn off the primary power.</p> <p>Before inspection/relocation, be sure to turn off the primary power.</p> <p>There is the risk of electric shock.</p>
 <p>Danger</p> 	<p>Wear protective equipment.</p> <p>Before making an inspection etc., wear personal protective equipment suitable for toxic substances for use.</p>
 <p>Danger</p> 	<p>No one other than a service engineer is allowed to disassemble, repair, or modify.</p> <p>No one other than a service engineer must be allowed to disassemble, repair, or modify. You may get injured due to ignition or abnormal operation, or get an electric shock.</p>

▶ 6.1 Daily Inspection

Check the following items to extend this unit's life by preventing it from malfunctioning. For the visual inspection levels and utility-related items, it is recommended to check them on a daily basis to see the condition of the unit. Check more frequently during high-load operation (continuous operation at 1,000 Pa or more in a repeated cycle between atmospheric pressure and a vacuum).

Item	Check item	Troubleshooting
Oil amount	Is the oil level between the level lines of the oil level gauge during operation?	Adjust the oil level so that it is between the level lines of the oil level gauge.
Oil color*1	Is oil discolored?	If discolored, change the oil.
Oil leak	Is there any oil leak around the pump?	Refer to "6.2.2 " on page 67.
Cooling water (for water cooling type)	Is cooling water at the specified flow rate?	Check the water pressure and piping.
Water leakage (for water cooling type)	Is the floor wet?	Check the water pressure and piping.
Abnormal Noise/Vibration	Is there any abnormal noise or vibration?	Refer to "6.2.4 Checking Abnormal Noise/Vibration" on page 69.
V-belt pulley	Is the belt tension appropriate?	Refer to "6.2.5
	Are there any abnormal wear or cracks on the belt and pulley?	6.2.5 Belt Tension Check/Re-Tightening/Replacement" on page 70.

Item	Check item	Troubleshooting
	Is there any deposition of water or oil?	Wipe off water/oil. Check water and oil for leakage.
Current/Voltage value	Is the pump loaded?	Check the inlet-side pressure and exhaust piping.









*1: The oil level gauge attached to this unit is for checking the amount of oil. There is a little circulation with oil inside the pump case and, even after the long-time operation, the oil inside the oil level gauge may be less contaminated or discolored. Drain approx. 50 ml of oil from the oil drain port and check it.






▶ 6.2 Regular Check

The check items need to be changed depending on the use conditions of the pump, but the following points need to be checked regularly. It is effective in avoiding failures to extend the life of the pump.

6.2.1 Check/Replacement of Oil

The oil is not only contaminated by suction gas but also gradually deteriorated by a temperature rise during the pump operation. Check the degree of contamination and viscosity and change the oil regularly.

 	<p>Thoroughly read the SDS.</p> <p>Obtain the SDS and thoroughly read it in advance.</p> <p>If oil comes into contact with your skin or eyes, follow the SDS's first aid section.</p>
 	<p>Use the specified oil.</p> <p>The use of any oil other than the specified ones affects the performance and life of this unit, which is not covered by the warranty.</p>
 	<p>The first oil change is to be done within 10 days.</p> <p>Depending on the application purpose, oil may deteriorate in a very short period of time. It is recommended that the first pump oil change be performed within 10 days and decide the oil change cycle after judging the degree of oil contamination.</p> <p>* For the oil change interval, refer to "Table 10: Guideline for oil change interval" on page 66.</p>
 	<p>Do not suck toxic gases into this unit.</p> <p>If toxic gases are sucked into this unit, not only this unit but also the oil becomes toxic. Take care during maintenance.</p>

  	<p>For continuous operation at high suction pressures, change oil frequently.</p> <p>Continuous operation at high suction pressures causes an extremely high oil temperature. Consequently, the oil rapidly deteriorates, resulting in poor ultimate pressure and displacement, rapid wear of the parts, or failures such as seizing up. Change oil frequently. It is also effective to install an oil cooler to cool the oil inside the pump.</p>
 	<p>When exhausting a large amount of water etc., change oil frequently.</p> <p>When exhausting a gas containing a large amount of moisture etc., change oil frequently. When operating with a large amount of water mixed in oil, the ultimate pressure first increases and then the oil lubricity deteriorates. This may lead to failures such as oil leaks through oil seals, internal corrosion, breakage of displacement plate, and seizure inside the pump.</p>

■ Oil change procedure

1. Stop the pump, open the oil drain port, and drain the oil from the oil tank.
 2. After the completion of draining the oil, close the oil drain port once, operate the pump at idle for approx. 5 seconds, and also drain the oil coming out from the cylinder.
 3. If necessary, replace the oil filter.
 4. Close the oil drain port and add new oil from the oil cap so that the oil level is between the level lines of the oil level gauge (MAX, MIN indicated on the model nameplate next to the oil level gauge). * Refer to "3.5.1 Oil Filling" on page 27.
- If the oil is extremely dirty, add new oil and operate for a few minutes to clean the inside of the pump. Also repeat this process several times depending on the degree of contamination of the oil.
 - After changing the oil with new one, operate the pump, wait for the pump to warm up, and then check the ultimate pressure.

☰ MEMO

- If any substance of low boiling point (such as water and organic solvents) mixes with oil or any slime foreign substance (sludge) is accumulated at the bottom of the pump case, the oil needs to be changed not only once but several times to recover the ultimate pressure. If the desired ultimate pressure is not obtained even after changing the oil, an overhaul is necessary. Contact your nearest ULVAC TECHNO or ULVAC service center.

Table 10: Guideline for oil change interval

Application purpose	Replacement interval
Research/Experimental vacuum equipment, small vacuum equipment	Within 6 months to 1 year
Production vacuum equipment, vacuum deposition	Within 3 months to 6 months
Tube exhaust equipment, large-sized vapor deposition equipment	Within 3 months

Metallurgical vacuum equipment for heat treatment, melting, or other purposes	Within 1 month
High vacuum drying, vacuum impregnation, vacuum forming, vacuum packaging equipment	Within 1 month
Low vacuum drying, clay kneaders, food packaging units	Within 1 week

6.2.2 Oil Leakage Check

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

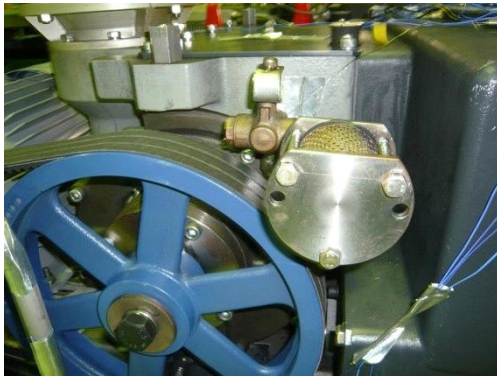
6.2.3 Gas Ballast Function Check

When using the gas ballast function, the air filter element may be clogged with dust or the like. Check that there is no clogging. If it seems to be clogged, contact your nearest ULVAC TECHNO or ULVAC service center.

■ Inspection of air filter element

1. Stop the pump.
2. Remove the front panel.
3. Visually check the outer surface of the air filter element.

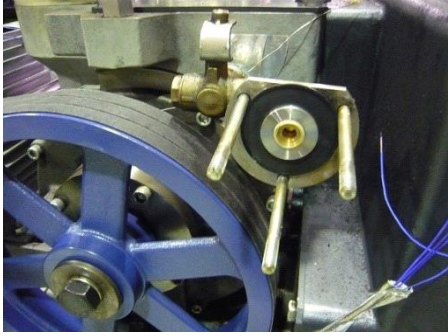
(As a guideline, if the outer surface of the air filter element is discolored black, it may be clogged.)



4. If no clogging is found, install the panel in reverse order.

■ Replacement of air filter element

1. Stop the pump.
2. Remove the front panel.
3. Remove the three nuts and replace the air filter element.



4. Install the three nuts and then the panel in reverse order.

6.2.4 Checking Abnormal Noise/Vibration

If any abnormal noise or vibration occurs in the pump, check the following. If the trouble persists even after checking these items, contact the nearest service center.

	Description	Troubleshooting
Checking the areas around the pump	Is there any looseness in the nuts and bolts that fix the pump?	Provide additional tightening.
	Is there any looseness in the bolts that fix the panel?	Provide additional tightening.
	Is there any looseness in the fixed piping connected to the inlet/outlet ports?	Provide additional tightening.
	Is there any leakage from the piping or valves?	Stop leakage.
	Is there any looseness in the bolts for fixing the main unit or the bolts for the motor base?	Provide additional tightening.
Checking the pump	Refer to "7. Troubleshooting" on page 84.	

6.2.5 Belt Tension Check/Re-Tightening/Replacement

The belt connecting between the pump body and the motor is made of rubber. Continuous operation with insufficient tension wears the belt wear in a short time.

■ Initial break-in

In early stages of operation, the belt tension is loosened due to the elongation of the belt itself and the fit with the pulley (the belt falling into the groove of the pulley). **Be sure to** re-tighten the belt after operating for 24 hours to allow the pulley and belt to fit each other well.

■ Regular Re-Tightening

Check it once every 6 months and re-tighten the belt if necessary. In addition, if there are abnormalities found in the belt, replace it.

■ Belt check

1. Stop the pump.
2. Remove the front panel, back panel, and top panel in order.
3. As shown in the figure below, sag the center of the belt by 7.5 mm using a spring scale. When the spring scale indicates a load value between 20 to 40 N, the tension is within the specified values. Do this procedure for all three belts.
4. If the tension is within the specified values, install the panel in reverse order.

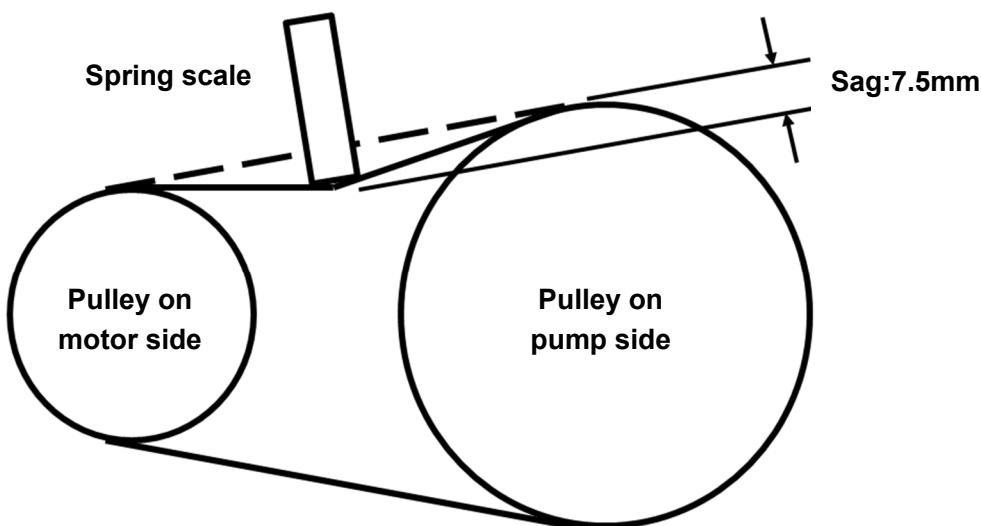
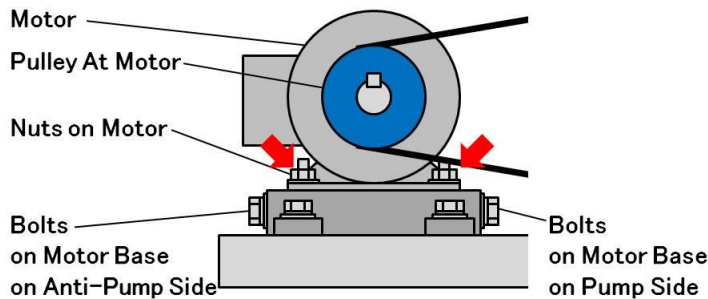


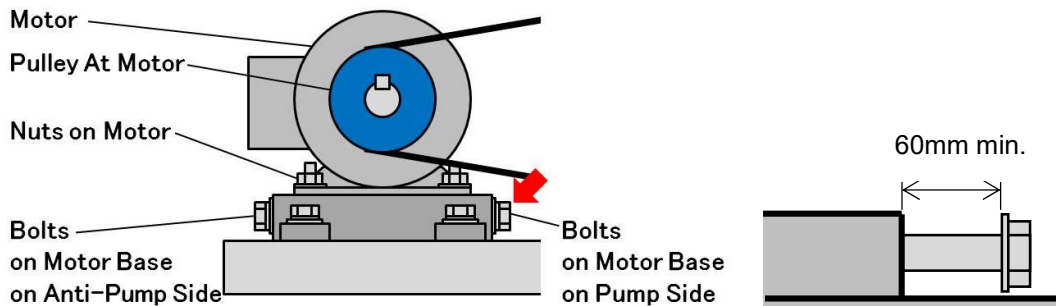
Figure 22: Belt tension measurement

■ Re-tightening of belt

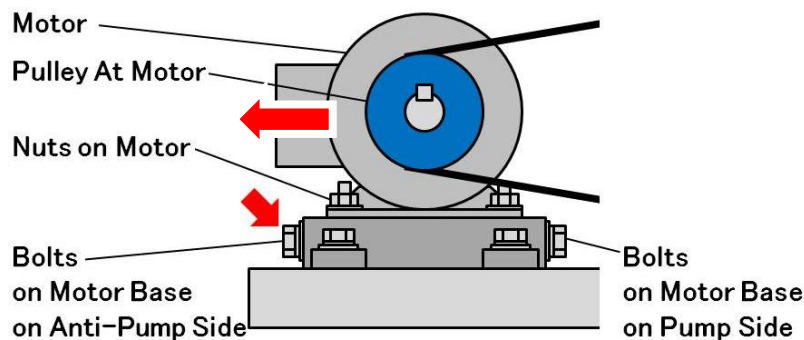
1. Stop the pump.
2. Remove the front panel, back panel, and top panel in order.
3. Loosen the four nuts (nuts indicated by the arrows) that fix the motor.



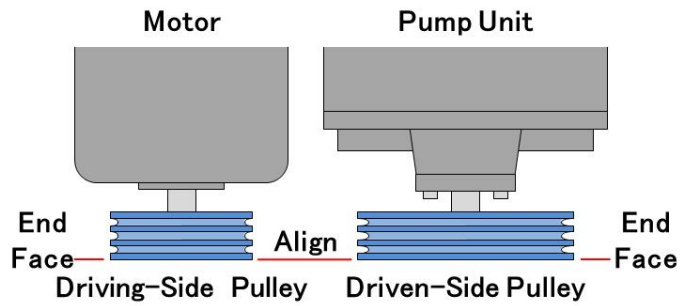
4. Fully loosen the two bolts (indicated by the arrows) for the motor base on the pump side. Leave a space of 60 mm or more between the seating faces.



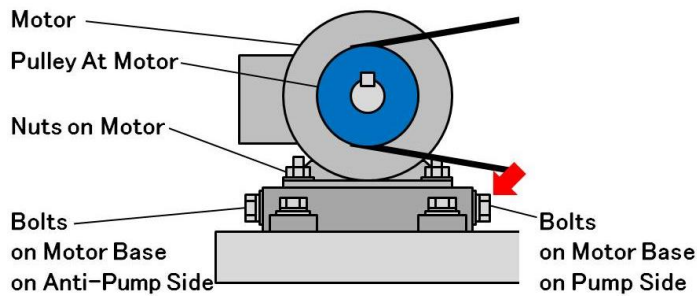
5. When loosening the two bolts (indicated by the arrows) for the motor base on the side opposite to the pump, the motor moves in the direction where the belt is tightened. Gradually tighten the bolts in the order of front -> rear -> front -> rear -> ...



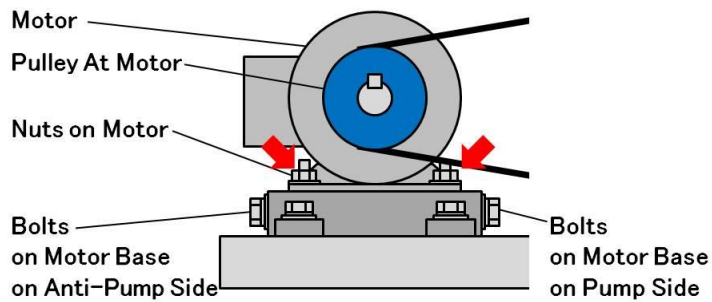
- Check that the belt tension is within the specified values and that the pulleys are parallel. If not, make adjustments again in Step 5.



- Tighten the two bolts (indicated by the arrows) for the motor base on the pump side to a torque of 50 Nm. It is not necessary to tighten anymore.

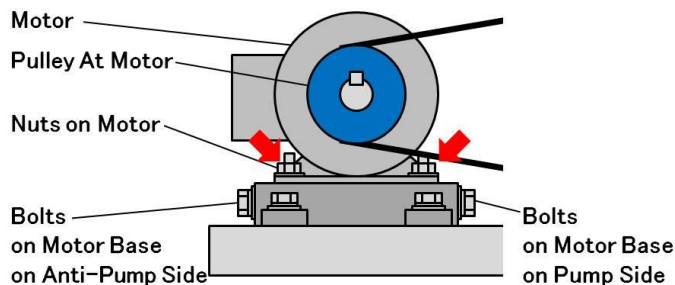


- Tighten the four bolts (nuts indicated by the arrows) that fix the motor to 42 Nm.

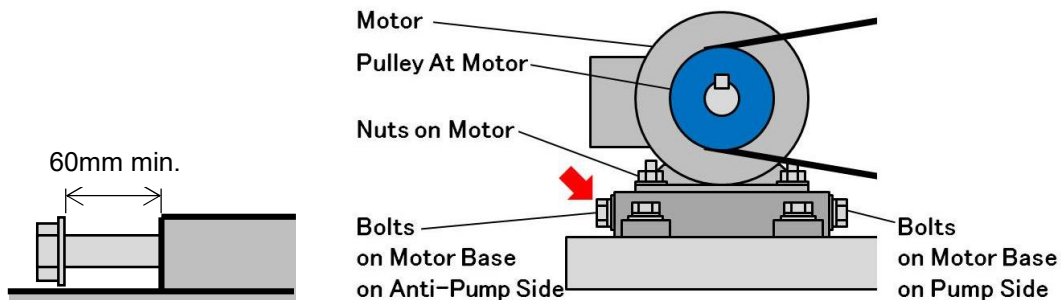


■ Replacement of belt

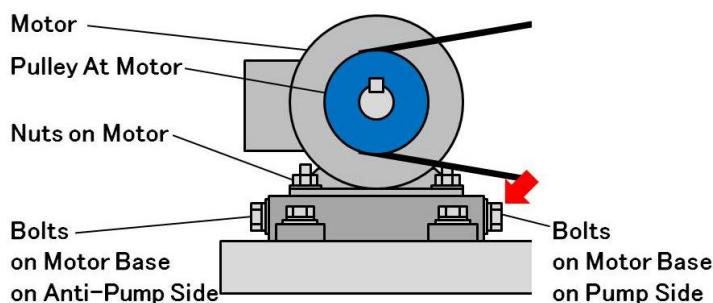
1. Stop the pump.
2. Remove the front panel, back panel, and top panel in order.
3. Loosen the four nuts (nuts indicated by the arrows) that fix the motor.



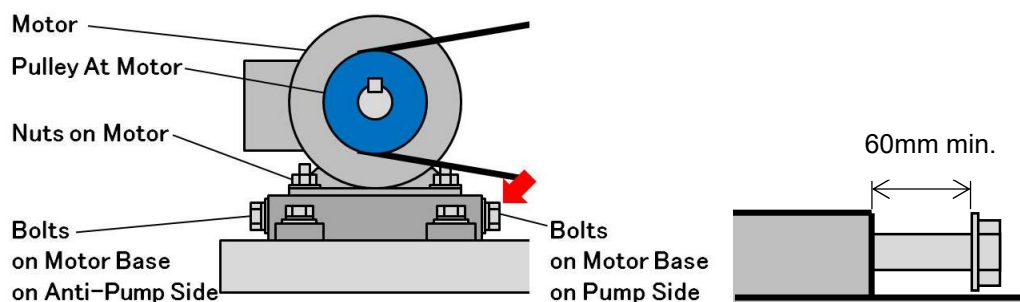
4. Fully loosen the two bolts (indicated by the arrows) for the motor base on the pump side. Leave a space of 60 mm or more between the seating faces.



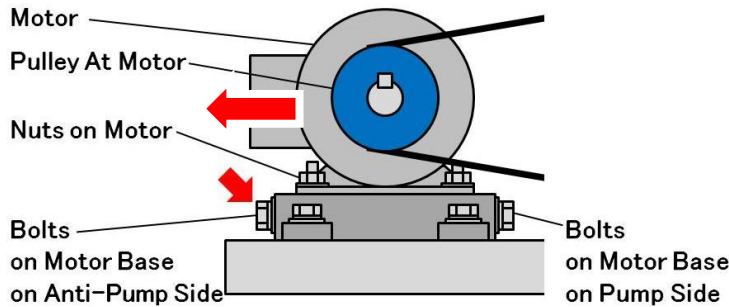
5. When tightening the two bolts (indicated by the arrows) for the motor base on the pump side, the motor moves to the motor body side. Gradually tighten the bolts in the order of front -> rear -> front -> rear -> ... until the belt is removed from the pulleys.



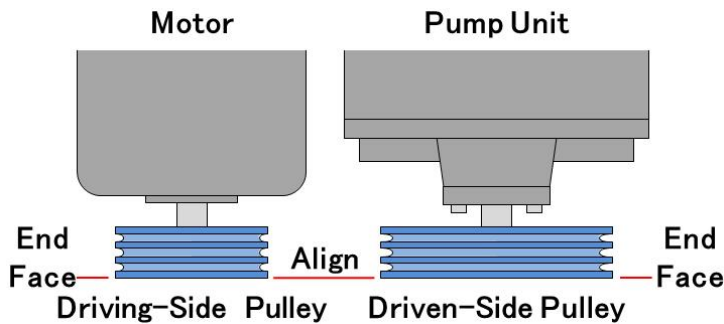
6. Replace the belt.
7. Fully loosen the two bolts (indicated by the arrows) for the motor base on the pump side. Leave a space of 60 mm or more between the seating faces.



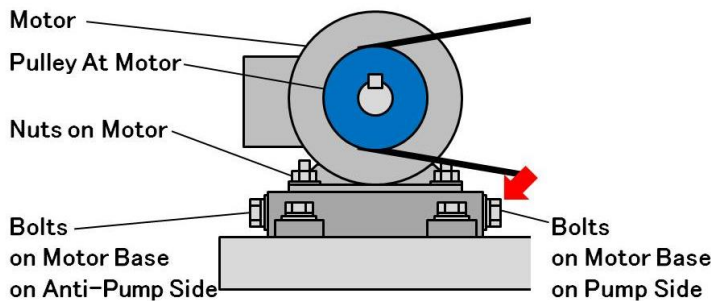
- When loosening the two bolts (indicated by the arrows) for the motor base on the side opposite to the pump, the motor moves in the direction where the belt is tightened. Gradually tighten the bolts in the order of front -> rear -> front -> rear -> ...



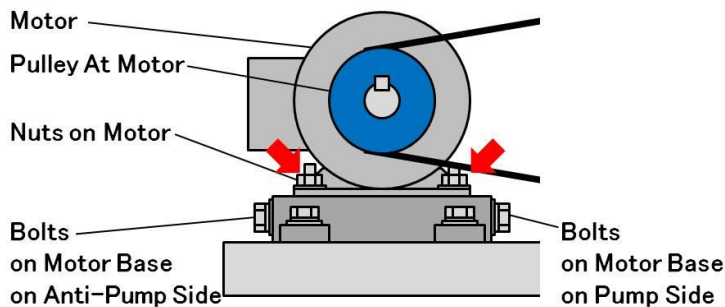
- Check that the belt tension is within the specified values and that the pulleys are parallel. If not, make adjustments again in Step 8.



- When the belt tension reaches the specified value, tighten the two bolts (indicated by the arrows) for the motor base on the pump side to a torque of 50 Nm. It is not necessary to tighten anymore.



- Tighten the four bolts (nuts indicated by the arrows) that fix the motor to 42 Nm.

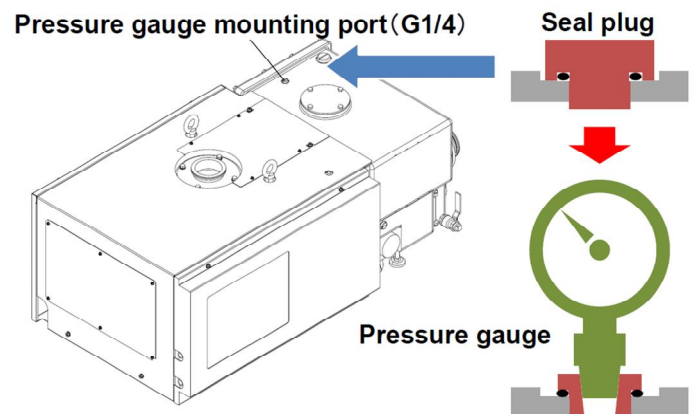


6.2.6 Inspection/Replacement of Oil Mist Separator

This unit comes equipped with an oil mist separator as standard. The oil mist separator separates oil from the gas discharged from the pump. Severe clogging of the separator can prevent exhaust gas from passing through the filter, increasing the pressure inside the pump and causing the pump and oil mist separator to burst.

Oil mist separator check

The limit value of the internal pressure of the pump is 0.03 MPaG (0.3 kg/cm²G). It is recommended to remove the seal plug from the pressure gauge mounting port and install a pressure gauge.

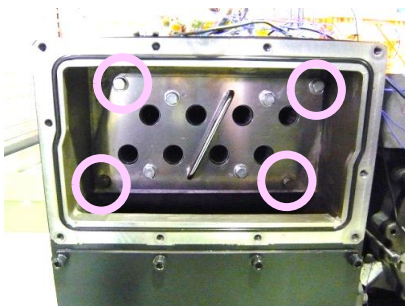


Replacement of oil mist separator

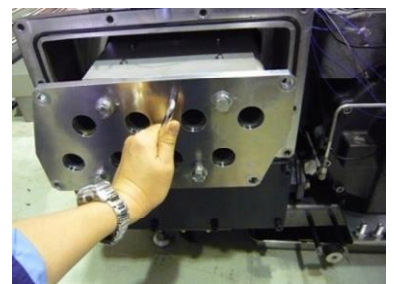
1. Stop the pump.
2. Remove the oil tank cover circled below.



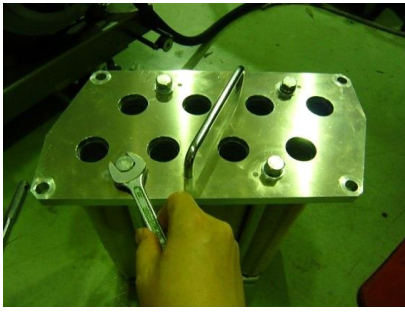
3. Remove the four inner bolts circled.



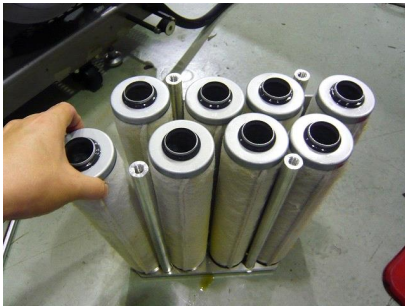
4. Draw out the oil mist separator. The oil mist separator is approx. 10kg including oil. Take care not to drop or make an impact. In addition, oil deposited on the oil mist separator streams down. Therefore, when removing the oil mist separator, it is recommended to put an oil pan on the floor.



- Remove the four bolts on the side of the end plate with a handle of the oil mist separator.



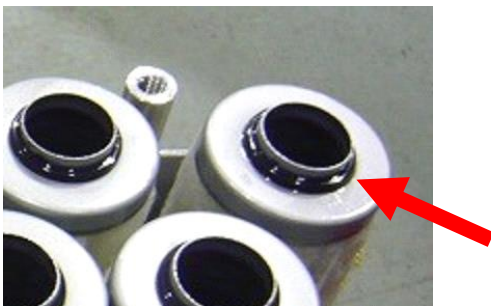
- Remove the oil mist separator.



- Before installing a new oil mist separator, make sure that there are three washers in each hole.



- Install an O-ring to the outer regions of the opening of the new oil mist separator. After that, carefully arrange the oil mist separator on the washer.



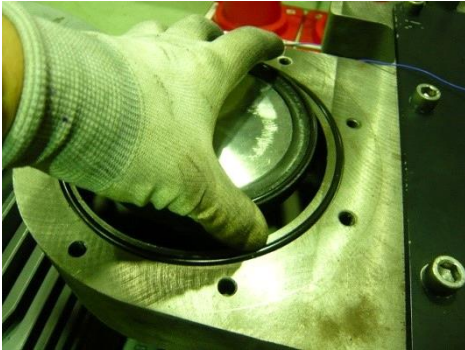
- Place the end plate with a handle on the oil mist separator, align the opening with the eight holes, and tighten the four bolts.

- Then install the oil mist separator and cover in reverse order.

6.2.7 Checking Check Valve

This unit comes equipped with a check valve at the inlet port as standard. The check valve has a function to prevent oil from flowing into the chamber and maintain the inside of the chamber in a vacuum when the pump is stopped.

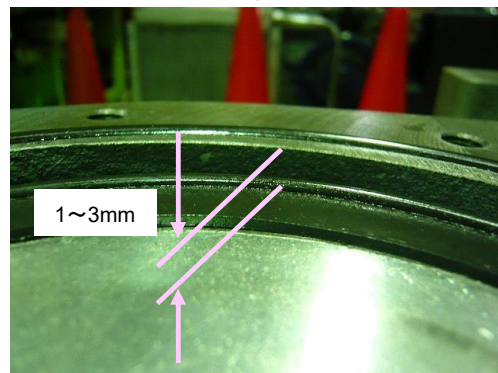
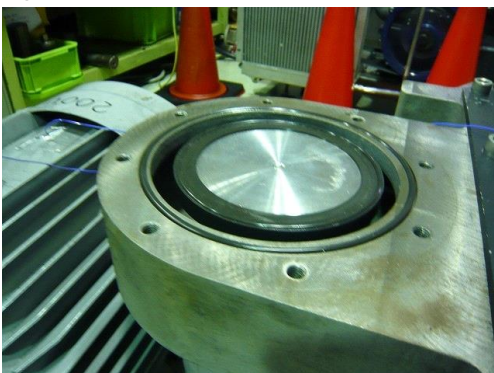
1. Stop the pump.
2. Remove the inlet piping and inlet port.
3. Remove the check valve and spring. Take extreme care not to drop the spring.



4. Carefully wipe off any deposits. Take special care when wiping off the rubber seal part of the check valve.



5. Adjust the spring so that the rubber protrusion of the check valve is approx. 1 to 3 mm below the mounting surface of the inlet port, and install the check valve and spring.



6. Install the other parts in reverse order.

6.2.8 Replacement of Exhaust Valve Plate

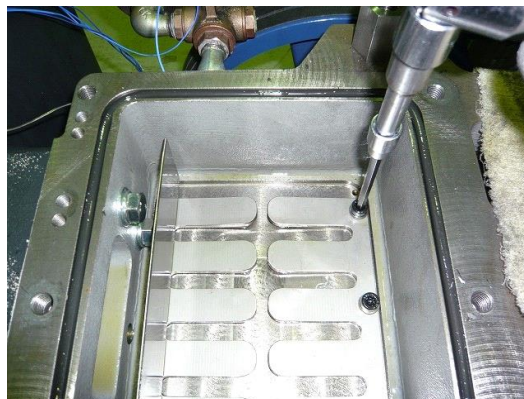
Replace the exhaust valve plate every 8,000 hours. It may break early due to suction of foreign matter and water.

■ Replacement of Exhaust Valve Plate

1. Stop the pump.
2. Remove the front panel, back panel, and top panel in order.
3. Remove the exhaust valve chamber cover.
4. Remove the bolts that fix the exhaust valve guide, exhaust valve plate, and oil fence. At this time, do not remove the exhaust valve plate until all bolts are removed. This prevents bolts and spring washers from dropping into the cylinder through the outlet port. If any parts drop into the cylinder, an overhaul is required.



5. Replace the exhaust valve plate and fix the exhaust valve guide and oil fence. At this time, place all the exhaust valve plates to close the outlet port first and then install the bolts. This prevents bolts and spring washers from falling into the cylinder through the outlet port. If any parts drop into the cylinder, an overhaul is required. In addition, the tightening torque of the bolts is 30 N · m.



6. Then install the other parts in reverse order.

6.2.9 Cleaning of Oil Tank

The sucked foreign matter, products, sludge of pump oil, etc. are accumulated inside the oil tank. If the amount of deposit increases, it cannot be removed only by changing oil, which may cause damage to the pump as the contaminated/degraded pump oil is used for lubrication.

In such a case, open the oil tank, and remove and clean the deposit.

1. Stop the pump.
2. Remove the oil tank cover circled below.



3. Scrape out the foreign matter, products, sludge of pump oil, etc. accumulated in the oil tank.
4. Install the cover in reverse order.

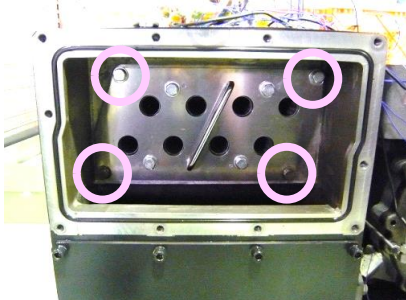
6.2.10 Checking Automatic Drain Valve

If the ultimate pressure does not drop from several hundred Pa or so, it can be a fault in the automatic drain valve. Check the automatic drain valve.

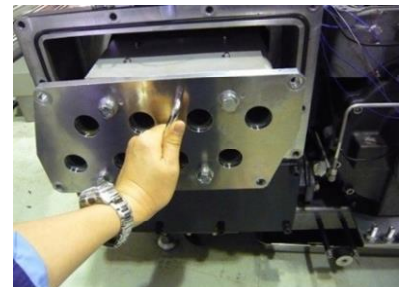
1. Stop the pump.
2. Remove the oil tank cover circled below.



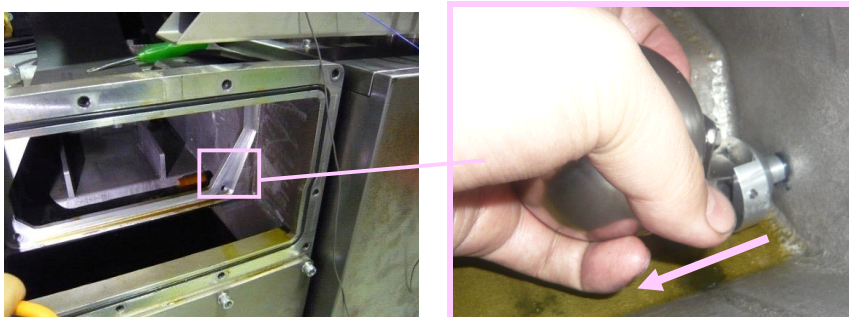
3. Remove the four inner bolts circled.



4. Draw out the oil mist separator. The oil mist separator is approx. 10 kg including oil. Take care not to drop or make an impact. In addition, oil deposited on the oil mist separator streams down. Therefore, when removing the oil mist separator, it is recommended to put an oil pan on the floor.



5. Pull out the automatic drain valve in the direction of the arrow.



6. Carefully wipe off any deposits. Take special care when wiping off the rubber seal part of the sealing section.
7. Install the other parts in reverse order.

6.2.11 Replacement of Oil Filter

This unit comes equipped with an oil filter as standard. The oil filter removes impurities contained in oil that circulates in the pump. If the amount of oil circulation is reduced due to a clogged oil filter, it may cause failures such as rapid wear or seizing up of the parts. This is highly likely to occur especially in high pressure regions. Take care.

■ Replacement of oil filter

1. Stop the pump.
2. Drain oil from the oil drain port.
3. The oil filter is removed when turned in the direction of the arrow. Note that oil leaks out of the oil filter. Therefore, when removing the oil filter, it is recommended to put an oil pan on the floor.



(It is recommended to use a belt wrench)

4. Install a double union to the new oil filter body.



5. Install the new oil filter to the oil tank.



6. Add the specified amount of oil into the pump from the oil cap.

6.2.12 Cleaning of Oil Pan

This unit is a belt-driven pump and the shaft is pulled out from the inside to the outside of the pump. The area where the shaft is pulled out is oil-sealed but the possibility of oil leak is not zero. For this reason, an oil pan is installed at the bottom of the oil seal.

Regularly check the oil pan whether or not oil is accumulated. If oil is accumulated, wipe it off. If oil accumulates frequently, the oil seal may be deteriorated. Contact your nearest ULVAC service center for an overhaul.

1. Stop the pump.
2. Remove the front panel.
3. Check the oil pan whether or not oil is accumulated. If oil is accumulated, wipe it off.



4. Install the parts in reverse order.

6.2.13 Maintenance/Cleaning of Heat Exchanger (for water-cooling type)

This unit uses cooling water to cool down oil circulating in the pump in a heat exchanger. If the heat exchanger is clogged with impurities, such as scale and iron, the amount of cooling water decreases, causing failures such as rapid wear or seizing up of the parts. When using cooling water with a large amount of impurities, such as scale and iron, filter them with a filter installed in the prior stage before use.

■ Maintenance

During maintenance, supply a flow rate of 1.2 times or more the steady flow rate for a few minutes to discharge foreign matter inside the heat exchanger. Feeding compressed air at the same time increases the effect.

■ Cleaning

If the flow rate drops or the pressure loss increases, blow compressed air or fresh water vigorously from the cooling water pipe outlet to forcibly discharge foreign matter inside. (Pressure of compressed air or fresh water: 0.8 MPa or less)

If the flow rate and pressure loss do not recover even after taking the above measures, contact your nearest ULVAC service center for an overhaul.





▶ 6.3 Inspection after Long-Term Storage

When this unit is stored without operation for a long period of time (6 months), problems with operation may occur due to the occurrence of rust or for other reasons. If the unit has not been used for a long period of time, contact your nearest ULVAC TECHNO or ULVAC service center for inspection before operating it again.

▶ 6.4 Overhaul

If the pump is contaminated or its performance deteriorates to the significant extent due to the operating conditions, it is recommended to overhaul it regularly.

Overhauls are necessary to maintain the performance (including safety) and to continue scheduled production.

 Warning 	<p>When exhausting dangerous gases or substances, ask a specialized company to detoxify it.</p> <p>When exhausting dangerous gases or substances and then overhaul or dispose of them, ask a specialized waste disposal company to detoxify it.</p>
 Caution 	<p>Perform an overhaul once a year.</p> <p>Perform an overhaul once a year.</p> <p>In addition, if this unit is contaminated or its performance deteriorates to the significant extent due to the operating conditions, perform an overhaul even within one year.</p> <p>Note that when performing an overhaul, it is necessary to replace at least the parts described in "Appendix: Major Replacement Parts."</p>

For overhauls, contact your nearest ULVAC TECHNO or ULVAC service center. Note that when making a request to overhaul, be sure to complete and submit the contamination certificate at the end of this document. If details on the dangerous substances in use is not disclosed or if difficult-to-detoxify substances are exhausted, ULVAC TECHNO or the ULVAC service center may refuse to perform maintenance or other operations.

7. Troubleshooting

▶ 7.1 Trouble with Basic Operation

Table 11: Trouble with basic operation

Problem	Cause	Measures	Reference
The pump does not rotate.	The motor is not properly wired.	Check wiring connection.	3.7.1
	The motor pulleys and pump pulleys do not rotate.	Check whether or not electricity is provided.	—
	The electromagnetic switches or other safety circuits are not set correctly.	Adjust the safety circuits to the motor specifications.	3.7
	A belt is loosened.	Re-tighten the belt.	6.2.5
	A belt is cut.	Replace the belt.	6.2.5
	The pulley key is loosened.	Correct looseness.	—
	Deteriorated oil increased its viscosity.	Change oil.	6.2.1
	Foreign matter entered the pump and the rotors or other components seized up.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Replacement of cylinders, rotors, vanes, and covers)	End of Document
	After exhausting the reactive gas, reaction products was built up inside the pump while the pump was stopped.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Cleaning inside the pump, removal of reaction products)	End of Document
	The power capacity is short.	Secure the recommended power capacity. Or switch to starting with an inverter (sold separately).	3.7
	The thermostat tripped.	Make sure that the pump temperature is low enough and that the power to the pump is turned off, and then remove the panel and press down the protrusion at the center of the thermostat.	3.7.2
	Not connected to power supply.	Connect to the power supply.	3.7.1
	The power switch is not ON.	Turn ON the power switch.	—
	Abnormal voltage of input power supply	Set the voltage within the range of the rated voltage of $\pm 5\%$. (Allowable fluctuations: within $\pm 10\%$)	—
	The overload protector is activated.	Eliminate the cause why the overload protector was activated. Press the reset button.	—
The electromagnetic switches or other safety circuits are faulty.	Checking/Replacement of safety circuits	—	
Faulty motor	Contact your nearest ULVAC TECHNO or ULVAC service center. (Replace the motor.)	End of Document	
The pump does not rotate.	Moisture, solvents, or other substances were sucked in and built up inside the pump. / Rust occurred.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Cleaning inside the pump, removal of reaction products)	End of Document

Problem	Cause	Measures	Reference
	Moisture, solvents, or other substances were sucked in and vane swelling occurred.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Replacement of vanes, checking/replacement of cylinders/rotors)	End of Document
	In addition, the internal parts of the pump were damaged.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Replacement of damaged parts)	End of Document
	The ambient temperature is low.	Jog the pump (short-time ON-OFF operation) several times. / Warm up oil. / Start while performing a slow leak and operate for several minutes.	3.5.1
	After the pump stopped, it was not released to the atmosphere.	Jog the pump (short-time ON-OFF operation) several times.	—
	The specified amount of oil is not contained. The oil amount is outside the range of the level gauge. a. Oil leakage outside the pump	Control the oil level. Add the specified amount of oil. a. Contact your nearest ULVAC TECHNO or ULVAC service center. (Replacement of O-rings)	End of Document
	b. Oil entry into a pump cylinder* ¹	b. Jog the pump (short-time ON-OFF operation) several times.	—
Abnormal noise is occurring.	The motor rotates in the opposite direction.	Connect wires again so that it rotates in the correct direction.	3.7.1
	The pump continuously operates at high suction pressures.	The sound becomes louder when operating at high suction pressure	—
	There is a sizzling sound of air leaking	Close the leak valve. Or eliminate the cause of leakage.	—
	The slow leak hole is clogged.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Cleaning the slow leak hole in the oil tank)	End of Document
	There is a "clattering" sound when starting/stopping the unit.	The phenomenon caused by the temporary irregular movement of the vanes in the pump, with no particular problems.	—
	The vanes do not work. a. There are deposits on the vane. b. Vane swelling	Contact your nearest ULVAC TECHNO or ULVAC service center. a. Cleaning the deposits on the vanes b. Replacement of vanes	End of Document
	The screws on the panel are loosened.	Tighten the screws.	—
	The air cooling fan is not rotating.	Install the air cooling fan correctly. If the abnormal sound does not stop even when the air cooling fan is rotating, contact your nearest ULVAC TECHNO or ULVAC service center.	End of Document
Abnormal noise is occurring.	The specified amount of cooling water does not flow. (Cooling water type only)	Supply the specified amount of cooling water. If the abnormal sound does not stop even when the cooling water is supplied, contact your nearest ULVAC TECHNO or ULVAC service center.	3.6.3 End of Document

Problem	Cause	Measures	Reference
	The specified amount of oil is not contained. The oil amount is outside the range of the level gauge.	Control the oil level. Add the specified amount of oil. If the abnormal sound does not stop, contact your nearest ULVAC TECHNO or ULVAC service center (Replacement of cylinders, rotors, vanes, and covers).	3.5 End of Document
	There is foreign matter in the pump.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Removal of foreign matter, replacement of damaged parts)	End of Document
	Oil does not circulate. a. An oil hole is clogged. b. The oil filter is clogged.	a. Contact your nearest ULVAC TECHNO or ULVAC service center. (Cleaning of oil hole) b. Cleaning of oil filter	End of Document 6.2.11
	In addition, the internal parts of the pump were damaged.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Replacement of damaged parts)	End of Document
	The foundation bolts (pump fixing bolts) are loosened.	Additionally tighten the bolts.	—
	The bolts for the motor base are loosened.	Additionally tighten the bolts.	—
	The installation surface is uneven.	Install on a horizontal surface.	—
	A belt is loosened.	Re-tighten the belt.	6.2.5
	The pulley key is loosened.	Correct looseness.	—
	Oil punching sound (operation at the ultimate pressure)	When a slow leak is performed to fix it, it is not abnormal.	—
Pressure does not drop.	The pumping speed of the pump is lower than the amount of the vacuum chamber.	Pump reselection	—
	The method of measuring pressure is incorrect.	Measure the pressure in the correct way.	—
	The vacuum gauge is not appropriate.	Measure using a vacuum gauge that matches the pressure range to be measured and is calibrated correctly.	—
	The connection pipe for the inlet port is thin or the piping distance is long.	Connect with a pipe larger than the inlet port diameter to shorten the distance to the vacuum chamber.	—
	The check valve at the inlet port is contaminated or does not work.	Check the check valve.	6.2.7
	The automatic drain valve does not work properly.	Check the automatic drain valve.	6.2.10
Pressure does not drop.	The specified amount of oil is not contained. The oil amount is outside the range of the level gauge.	Control the oil level. Add the specified amount of oil.	3.5
Pressure does not drop.	Oil is deteriorated. a. Moisture system is evacuated. b. Dust is evacuated. c. Solvent fume is sucked in. d. Foreign matter enters.	Change oil. ² a. Insert a trap into the prior stage of the pump. b. Insert a filter/trap into the prior stage of the pump. c. Insert an application-specific trap into the prior stage of the pump. d. Insert a filter into the prior stage of the pump.	6.2.1

Problem	Cause	Measures	Reference
	The leak valve is open.	Close the leak valve.	—
	There is leakage in piping connecting the pump.	Locate the leak point using a leak detector or other detectors for leakage and stop the leak.	—
	Our genuine oil is not used.	Contact your nearest ULVAC TECHNO or ULVAC service center. (After an overhaul, replace with our genuine oil.)	End of Document
	Just after new oil has been added	Operate at no load for a while.	—
	The gas ballast valve / leak valve is open.	Close the gas ballast valve / leak valve.	4.4
	The motor rotates in the opposite direction.	Connect wires again so that it rotates in the correct direction.	4.2.1
	The speed is incorrect (the power frequency does not match the applicable frequency of the motor pulleys).	Contact your nearest ULVAC TECHNO or ULVAC service center. (Replace with motor pulleys of appropriate frequency.)	—
	Oil does not circulate. a. An oil hole is clogged.	a. Contact your nearest ULVAC TECHNO or ULVAC service center. (Cleaning of oil hole)	End of Document
	b. The oil filter is clogged.	b. Cleaning of oil filter	6.2.11
	The exhaust valve plate is broken (VS650B only).	Replacement of the exhaust valve plate	6.2.8
	Water is mixed in the pump.	Change oil.	6.2.1
	The pump does not rotate.	Check the electric wiring.	3.7.1
	A belt is loosened.	Re-tighten the belt.	6.2.5
	A belt is cut.	Replace the belt.	6.2.5
	The protective cap for the inlet port is still attached.	Remove the protective cap.	3.6.1
	Cooling water does not flow.	Supply cooling water.	3.6.3
	There is a failure in the exhaust valve.	Check/Replacement of the exhaust valve plate	6.2.8
The temperature on the pump surface is abnormally high.	The pump continuously operates at high suction pressures.	When continuous operation is performed with a high suction pressure, the pump surface temperature becomes about 100 ° C, but there is no particular problem.	—
The temperature on the pump surface is abnormally high.	The specified amount of oil is not contained. The oil amount is outside the range of the level gauge. (A small amount of oil reduces the cooling effect of the pump.)	Control the oil level. Add the specified amount of oil.	3.5
	Oil is deteriorated. a. Moisture system is evacuated. b. Dust is evacuated. c. Solvent fume is sucked in. d. Foreign matter enters.	Change oil.*2 a. Insert a trap into the prior stage of the pump. b. Insert a filter/trap into the prior stage of the pump. c. Insert an application-specific trap into the prior stage of the pump. d. Insert a filter into the prior stage of the pump.	6.2.1
	Suction gas is at a high temperature.	Install a gas cooler or another cooling device on the inlet side.	—

Problem	Cause	Measures	Reference
	The area surrounding the pump is sealed.	Provide ventilation.	—
	The air cooling fan is not rotating. (For air cooling type only)	Install the air cooling fan correctly. If the abnormal sound does not stop even when the air cooling fan is rotating, contact your nearest ULVAC TECHNO or ULVAC service center.	End of Document
	The specified amount of cooling water does not flow. (For water cooling type only)	Supply the specified amount of cooling water. If the abnormal sound does not stop even when the cooling water is supplied, contact your nearest ULVAC TECHNO or ULVAC service center.	End of Document
	The ambient temperature is high.	Use in an air-conditioned environment.	—
	The leak valve is open.	Opening the leak valve increases the pump temperature.	—
	There is leakage in piping connecting the pump.	Locate the leak point using a leak detector or other detectors for leakage and stop the leak.	—
	Oil does not circulate. a. An oil hole is clogged. b. The oil filter is clogged.	a. Contact your nearest ULVAC TECHNO or ULVAC service center. (Cleaning of oil hole) b. Cleaning of oil filter	End of Document 6.2.11
	The gas ballast valve is open.	Opening the gas ballast valve increases the pump temperature.	3.6.4
	The speed is incorrect (the power frequency does not match the applicable frequency of the motor pulleys).	Contact your nearest ULVAC TECHNO or ULVAC service center. (Replace with motor pulleys of appropriate frequency.)	—
Pump vibrates.	The foundation bolts (pump fixing bolts) are loosened.	Additionally tighten the bolts.	—
	The bolts for the motor base are loosened.	Additionally tighten the bolts.	—
	A belt is loosened.	Re-tighten the belt.	6.2.5
Pump vibrates.	The pulley key is loosened.	Correct looseness.	—
Oil leaks outside the pump	Deterioration of the oil tank, O-rings of cylinders, oil seals.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Checking/Replacement of O-rings, oil seals)	End of Document
	Looseness of a plug such as for the oil cap	Re-tighten the plug.	—
	The valve of the oil drain port is open.	Close the valve at the oil drain port.	—
The motor current value is abnormal	Foreign matter entered the pump and the rotation of the rotors becomes heavy.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Removal of foreign matter, replacement of damaged parts)	End of Document
	The leak valve is open.	Opening the leak valve increases the load on the motor and increases the current value.	—
	There is leakage in piping connecting the pump.	Locate the leak point using a leak detector or other detectors for leakage and stop the leak.	—

Problem	Cause	Measures	Reference
	Abnormal sliding of the rotors, vanes.	Contact your nearest ULVAC TECHNO or ULVAC service center. (Internal inspection/repair)	End of Document
	Continuous operation at a high suction pressure.	Pressure regulation	—
	Cooling water does not flow.	Supply cooling water.	3.6.3
	Oil is deteriorated. a. Moisture system is evacuated. b. Dust is evacuated. c. Solvent fume is sucked in. d. Foreign matter enters.	Change oil.* ² a. Insert a trap into the prior stage of the pump. b. Insert a filter/trap into the prior stage of the pump. c. Insert an application-specific trap into the prior stage of the pump. d. Insert a filter into the prior stage of the pump.	6.2.1
A lot of oil smoke blows out from the outlet port	The specified amount of oil or more is contained.	Drain oil so that it is the specified amount.	6.2.1
	Continuous operation at a high suction pressure.	Pressure regulation	—
	The exhaust valve plate is broken.	Replacement of the exhaust valve plate	6.2.8
	Clogged oil mist separator.	Replacement of oil mist separator	6.2.6
Water leaks outside the pump	Deterioration of the liquid gasket.	Re-coating of liquid gasket.	—
	Looseness of joints in the cooling water system.	Checking of joints in the cooling water system.	—
Oil level gauge comes out	The piping in the posterior stage is clogged.	Install the piping larger than the outlet port diameter. Check whether or not it is blocked.	3.6.2
Pump rotation varies and pump gradually becomes unable to rotate	The motor pulleys and pump pulleys do not rotate.	Check whether or not electricity is provided.	3.7
	A belt is loosened.	Re-tighten the belt.	6.2.5
	The pulley key is loosened.	Correct looseness.	—
Pump rotation varies and pump gradually becomes unable to rotate	The foundation bolts (pump fixing bolts) are loosened.	Additionally tighten the bolts.	—
	The bolts for the motor base are loosened.	Additionally tighten the bolts.	—
Grease in the motor bearings drips	Faulty bearing	Replacement of the bearing or motor.	—

Problem	Cause	Measures	Reference
The performance is satisfied in early stages but the ultimate pressure is getting worse	Oil is deteriorated. a. Moisture system is evacuated. b. Dust is evacuated. c. Solvent fume is sucked in. d. Foreign matter enters.	Change oil.*2 a. Insert a trap into the prior stage of the pump. b. Insert a filter/trap into the prior stage of the pump. c. Insert an application-specific trap into the prior stage of the pump. d. Insert a filter into the prior stage of the pump.	6.2.1
	There is leakage in piping connecting the pump.	Locate the leak point using a leak detector or other detectors for leakage and stop the leak.	—
	Just after new oil has been added.	Operate at no load for a while.	—
	Oil does not circulate. a. An oil hole is clogged. b. The oil filter is clogged.	a. Contact your nearest ULVAC TECHNO or ULVAC service center. (Cleaning of oil hole) b. Cleaning of oil filter	End of Document

*1: If the pump is left stopped for a long period of time (3 days or more), oil enters the pump cylinder even when the inside of the pump was kept at atmospheric pressure at the last stop. If the pump is restarted without change, the overload protector may be activated due to an overload. In such a case, jog the pump (short-time ON-OFF operation) several times.

*2: If the pressure does not drop even after the oil is changed, internal cleaning is required. Contact your nearest ULVAC TECHNO or ULVAC service center.

8. Specifications

8.1 Performance Specifications

Model		VS650B-A	VS650B-W	VS650B-WL	VS750B-A	VS750B-W	
Maximum Pumping Speed m ³ /h (L/min)	50Hz	650 (10833)		600 (10,000)	750 (12500)		
	60Hz	750 (12500)			Can Not Use		
Ultimate Pressure Pa *1	GP Closed	≦ 8					
	GP1 Opened	≦ 70					
	GP2 Opened	≦ 200					
Maximum Water Vapor Tolerance	GP1 Opened	50Hz	4500	2500	2,500	5500	2500
		60Hz	5500	2500		Can Not Use	
	GP2 Opened	50Hz	6000	3800	3,800	7500	4000
		60Hz	7500	4000		Can Not Use	
Maximum Water Vapor Capacity kg/h *2	GP1 Opened	50Hz	17	11	11	24	13
		60Hz	24	13		Can Not Use	
	GP2 Opened	50Hz	26	15	15	34	19
		60Hz	34	19		Can Not Use	
Motor *3	Type	Totally enclosed fan cooled 3 phase AC motor					
	Output kW (Poles)	50Hz	22 (4)				
		60Hz	25 (4)			Can Not Use	
	Power consumption kW *5	50Hz	8			11	
		60Hz	11			Can Not Use	
Voltage	50Hz	AC200~240V/380~415V			AC200~240V/380~415V		
	60Hz	AC200~230V/380~460V			Can Not Use		
Pump Oil	ULVOIL R-72						
Oil Capacity L	23~27		25~30		23~27	25~30	
Cooling Method	Air Cooled		Water Cooled		Air Cooled	Water Cooled	
Cooling Water	Primary Side Pressure MPa	-		≦ 0.5	-		
	Inlet/Outlet Differential	-		≧ 0.1	-		
	Capacity L/min	-		≧ 3.0	-		
	Temperature °C	-		5~30°C	-		
Inlet	DN100ISO-K / JIS VG100 (Option)						
Outlet	DN100ISO-K / JIS VG100 (Option)						
Weight kg	855		855		855	855	
External Dimensions W×D×H mm	1490×905×705		1490×841×705		1490×905×705	1490×841×705	
Applicable Standard	-						
Standard Accessories	Oil for one pump, 1 set of instruction manual						
Optional	Flame-proof motor, specified voltage motor, JIS inlet/outlet flange *4, Gas ballast solenoid valve 1 place, No oil filter Base for hand lifter (with anti-vibration rubber) *6						

Note : SI Units are used in this catalog. The following conversion can be used for non-SI units : Ultimate Pressure 8.0Pa = 6 × 10⁻²Torr

*1 Measured with a Pirani vacuum gauge.

*2 Water vapor tolerance and capacity are measured under following cooling water capacity. Cooling water temperature at inlet port is :

		VS650B-W/VS650B-WL		VS750A-W
GP1 Opened	50Hz	3 L/min		5 L/min.
	60Hz	5 L/min		-
GP2 Opened	50Hz	3 L/min		5 L/min.
	60Hz	5 L/min		-

*3 Flame-proof motor is available as option. However, multiple voltage cannot be selected.

*4 Size to connect pipe changes when JIS flange is selected for inlet/outlet port.

*5 At ultimate pressure

*6 When base for hand lifter is selected, casters and adjuster foot are not included.

8.2 External Dimensions

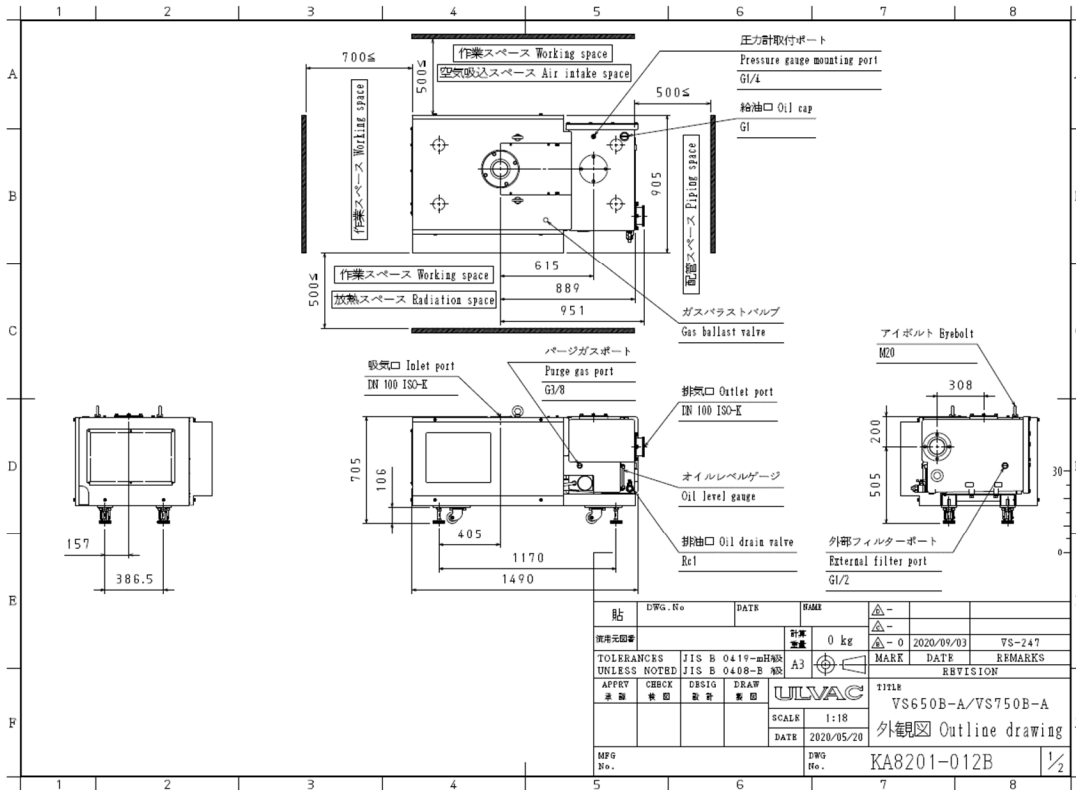


Figure 23: Outline drawing (VS650B-A, VS750B-A)

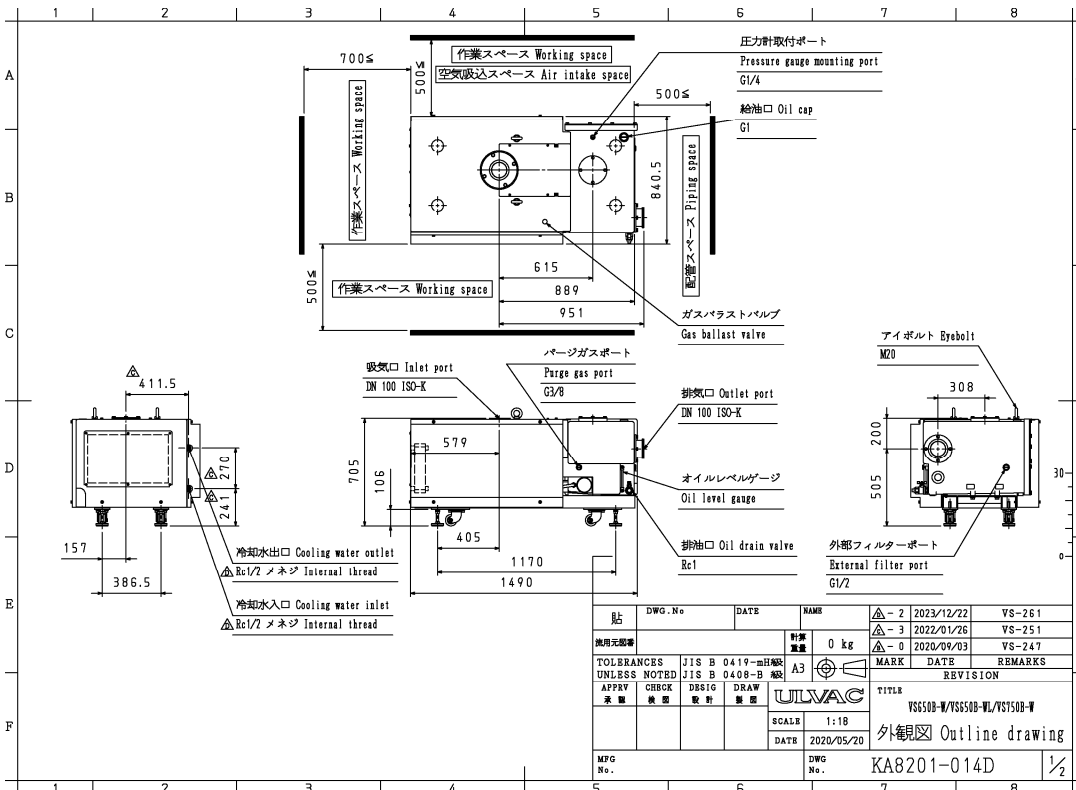


Figure 24: Outline drawing (VS650B-W, VS650B-WL, VS750B-W)

Appendix

Major replacement parts

This shows the parts list for replacement through an overhaul:

Bird's-eye view No.			Required amount	Parts name	Specifications
6	1	4	1	O-ring	Shared
6	1	5	1	O-ring	Shared
6	1	6	1	O-ring	Shared
6	7		4	O-ring (P8)	Shared
6	7		2	O-ring (P10)	Shared
6	13	4	8	O-ring	Shared
6	13	8	1	O-ring	Shared
6	24		1	O-ring (P7)	Shared
6	24		1	Valve seat	Shared
6	27		1	O-ring	Shared
6	40		1	O-ring	Shared
6	42		1	O-ring	Shared
6	44		1	O-ring	Shared
12	1	3	2	O-ring	Shared
12	1	4	1	O-ring	Shared
12	1	5	2	O-ring	Shared
12	1	11	4	O-ring	Shared
12	2	2	3	O-ring	Shared
12	3	3	2	Oil seal	Shared
12	3	8	1	O-ring	Shared
12	4	3	2	Oil seal	Shared
12	4	8	1	O-ring	Shared
12	6		2	Bearing	Shared
12	9	3	1	Oil seal	Shared
200	2		1	Pulley retainer	Shared
200	2	2	1	Hexagon head bolt	Shared
200	2	3	1	Spring washer	Shared
201	4		3	V-belt	Pumping speed 650 m ³ /h model Pumping speed: 600 m ³ /h (50 Hz) model
202	4		3	V-belt	Pumping speed 750 m ³ /h model
204	2		3	V-belt	Pumping speed: 600 m ³ /h (60 Hz) model
401	1		1	Oil filter	Oil filter model
402	3		1	O-ring	Non oil filter model
500	1		1	O-ring (P20)	Shared
600	2		2	O-ring	Shared
600	3		1	O-ring	Shared
700	5	5	1	Rubber packing	Shared

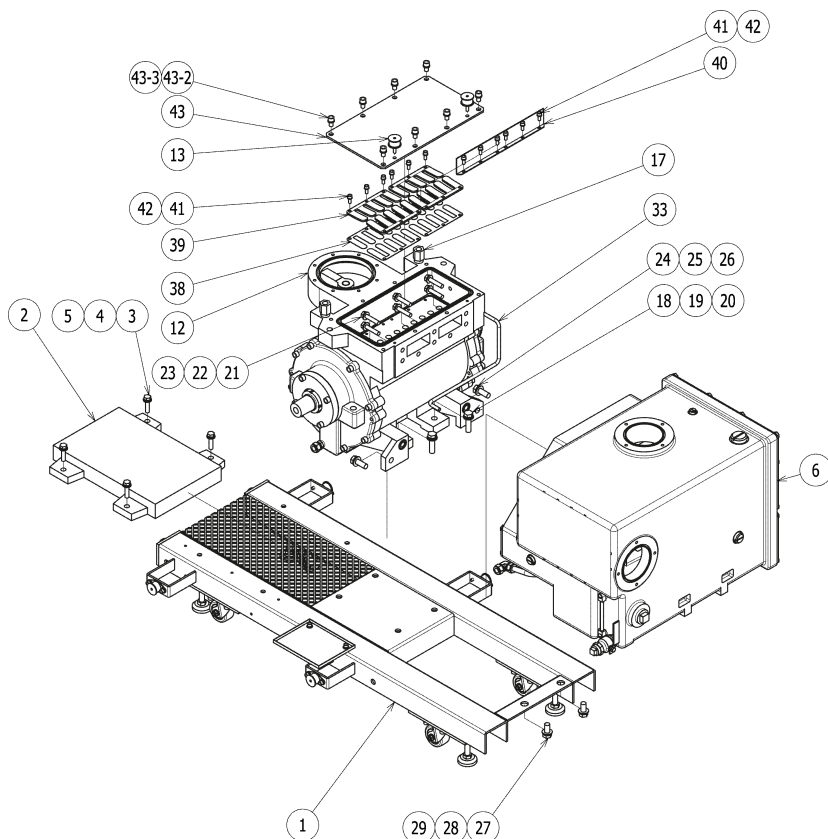
This shows the parts list for replacement at intervals of 8,000 hours.

Bird's-eye view No.			Required amount	Parts name	Specifications
38			4	Exhaust valve plate	Shared
38			4	Exhaust valve guide (shared)	Shared

Replace the parts shown below when it is deemed necessary to replace them due to scratches or clogging.

Bird's-eye view No.			Required amount	Parts name	Specifications
6	13	3	8	Oil mist separator	Shared
6	13	6	24	Spring washer	Shared
12	5		3	Seal sleeve	Shared
12	14		3	Vane	Shared
700	4		1	Check valve	Shared
700	5	1	1	air filter element	Shared

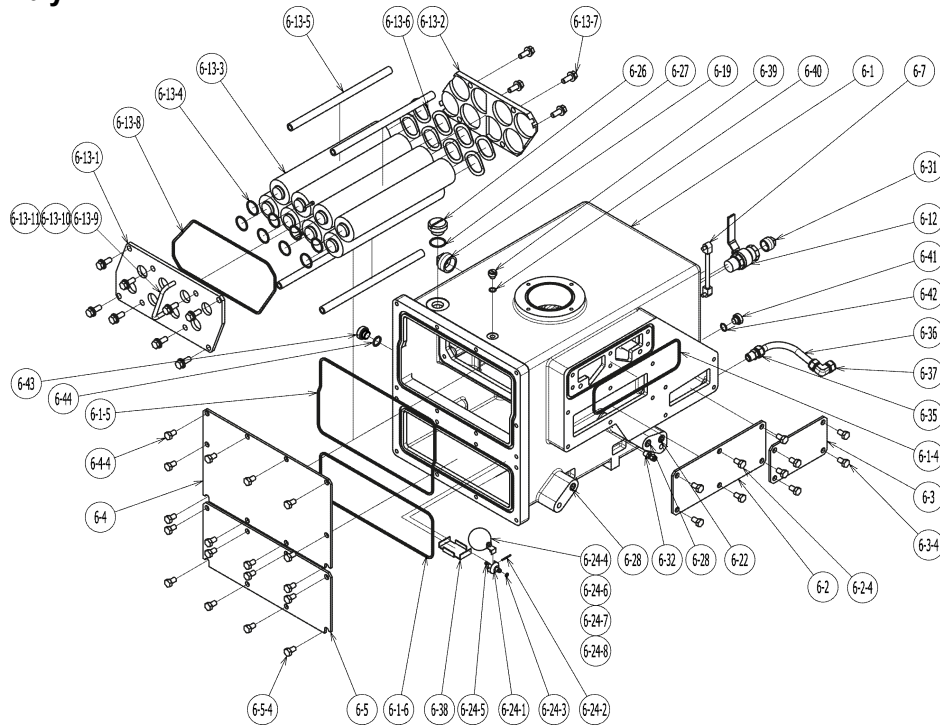
Base Unit Assembly



Base Unit Assembly						
Position	Q'ty	Parts Name	Material	Dimensions	Replace	
1	1	Base Assembly				
1	2	4	Caster			
1	3	6	Rubber Mount			
2	1	Motor Base	FC	180M		
3	4	Hexagon Head Bolt	SS400	M12x50		
4	4	Plain Washer	SS400	M12		
5	4	Spring Lock Washer	SS400	M12		
6	1	Oil Tank Assembly				
12	1	Pump Assbly				
13	2	Rubber Mount				
17	2	Spacer	SS400	L=45		
18	4	Hexagon Head Bolt	SS400	M16x60		
19	4	Plain Washer	SS400	M16		
20	4	Spring Lock Washer	SS400	M16		
21	6	Hexagon Head Bolt	SS400	M12x60		
22	6	Plain Washer	SS400	M12		
23	6	Spring Lock Washer	SS400	M12		
24	2	Hexagon Head Bolt	SS400	M16x45		
25	2	Plain Washer	SS400	M16		
26	2	Spring Lock Washer	SS400	M16		
27	2	Hexagon Head Bolt	SS400	M16x35		
28	2	Plain Washer	SS400	M16		
29	2	Spring Lock Washer	SS400	M16		
33	1	Drain Tube	SUS304	φ10x1.0		
38	4	Exhaust Valve Vane		t0.4	@@	
39	4	Valve Guide	SUS304	t5.0	@@	
40	1	Oil Fence	SPHC	t3.5		
41	12	Hexagon Socket Head Cap Screw	SCM435	M8x20		
42	12	Spring Lock Washer	SS400	M8		
43	1	Cover	ZAM	t6		
43	2	8	Hexagon Socket Head Cap Screw	SS400	M12x20	
43	3	8	Spring Lock Washer	SS400	M12	

@@: replace every 8000hr ↑ .

Oil Tank Assembly



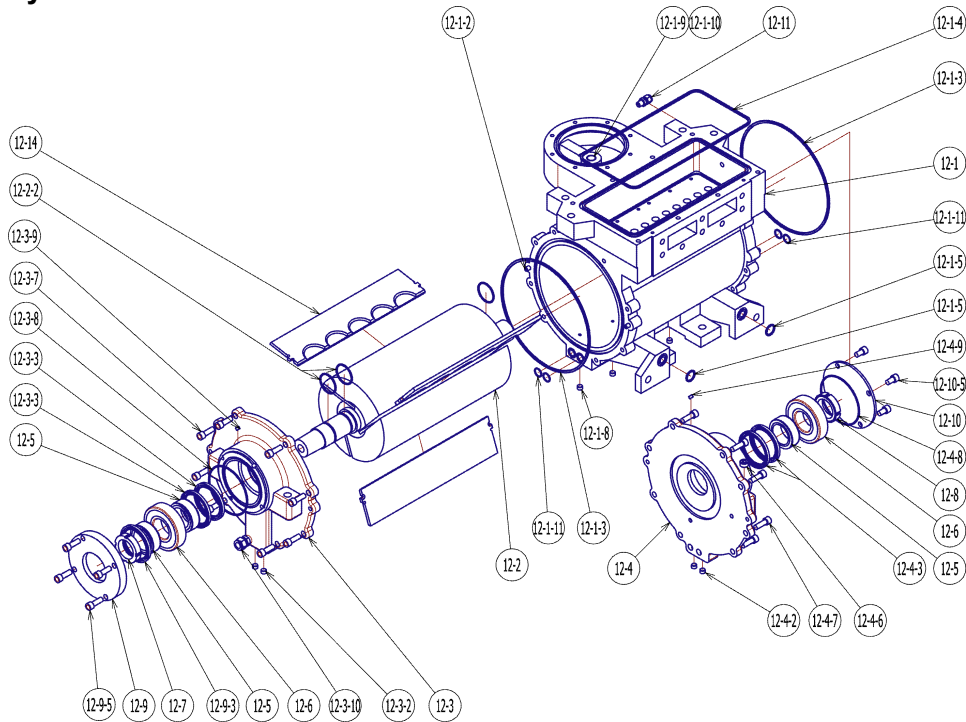
Oil Tank Assembly (1/2)

Position	Q'ty	Parts Name	Material	Dimensions	Replace
6 1	1		AC4A		
6 1	4	O-ring	FKM	G240	@
6 1	5	O-ring	FKM	G405	@
6 1	6	O-ring	FKM	G335	@
6 2	1	Oil Tank Cover 1	ZAM	t6	
6 2	4	Hexagon Head Bolt	SS400	M12x20	
6 3	1	Oil Tank Cover 2	ZAM	t6	
6 3	4	Hexagon Head Bolt	SS400	M12x20	
6 4	1	Oil Tank Cover 3	ZAM	t6	
6 4	4	Hexagon Head Bolt	SS400	M12x20	
6 5	1	Oil Tank Cover 4	ZAM	t6	
6 5	4	Hexagon Head Bolt	SS400	M12x20	
6 7	1	Oil Level Gauge			(@)
6 12	1	Oil Drain	BRASS	R1	
6 13 1	1	Plate 1	AL	t15	
6 13 2	1	Plate 2	AL	t15	
6 13 3	8	Oil Mist Filter Element		φ72x377	@@@
6 13 4	8	O-ring	FKM	P35	@
6 13 5	4	Round Bar	AL	φ20-L371	
6 13 6	24	Wave Washer	Fe	OD53	@@@
6 13 7	12	Hexagon Head Screw with Captive Washer	SS400	M12x35	
6 13 8	1	O-ring	FKM	G305	@
6 13 9	1	U-Handle	Fe		
6 13 10	2	Hexagon Socket Head Cap Screw	SS400	M5x25	
6 13 11	2	Spring Lock Washer	SS400	M5	
6 19	1	Square Head Tapered Pipe Plug	SUS	R1-1/2	
6 22	1	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/2	
6 24	1	Automatic discharge drain valve			(@)
6 26	1	Seal Plug	AL	G1	
6 27	1	O-ring	FKM	P36	@
6 28	2	Hexagon Socket Set Screw with Orifice	SS400	M20x20	

Oil Tank Assembly (2/2)						
Position	Q'ty	Parts Name	Material	Dimensions	Replace	
6	31	1	Square Head Tapered Pipe Plug	SUS	R1	
6	32	1	Fitting	SUS304	for φ10-R1/4	
6	35	1	Fitting	SUS304	for φ16-R1/2	
6	36	1	Oil Cooling IN Tube 1	SUS304	φ16xt1.0	
6	37	1	Fitting	SUS304	for φ16	
6	38	1	Block	SPHC	t3.0	
6	39	1	Seal Plug	AL	G1/4	
6	40	1	O-ring	FKM	P14	@
6	41	1	Seal Plug	AL	G3/8	
6	42	1	O-ring	FKM	P18	@
6	43	1	Seal Plug	AL	G1/2	
6	44	1	O-ring	FKM	P22A	@

@: replace whenever overhauling / @@@: replace when judged / (@): replace only seal parts ↑ .

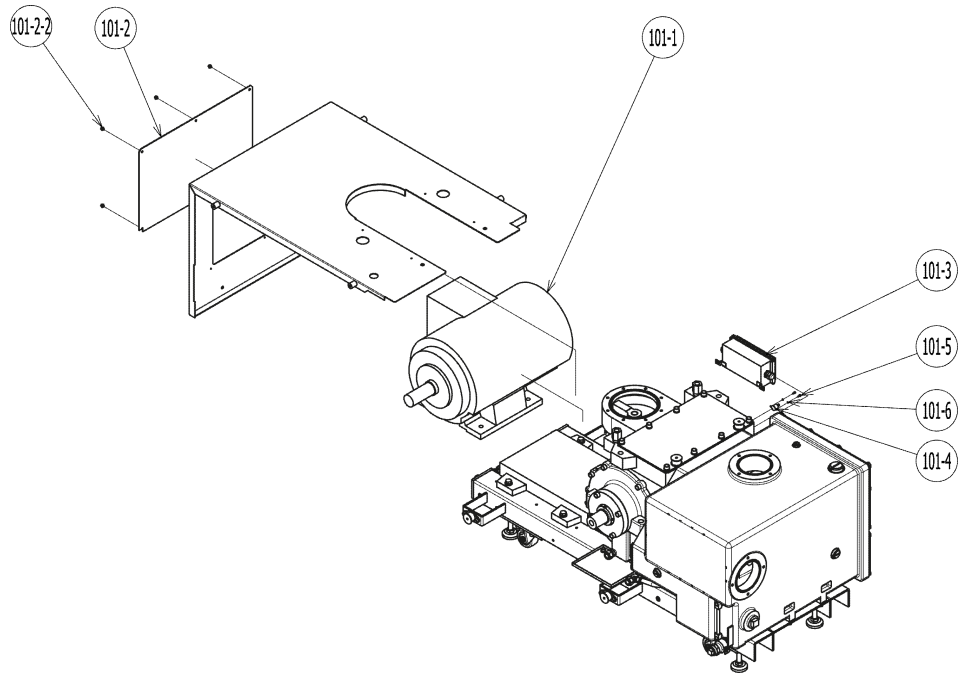
Pump Assembly



Pump Assembly						
Position	Q'ty	Parts Name	Material	Dimensions	Replace	
12 1	1	Cylinder	FC250			
12 1	2	Parallel Pin	S45C			
12 1	3	O-ring	FKM	G300	@	
12 1	4	O-ring	FKM	G370	@	
12 1	5	O-ring	FKM	P24	@	
12 1	8	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/4		
12 1	9	Bush		L=20		
12 1	10	Bush		L=30		
12 1	11	O-ring	FKM	P20	@	
12 2	1	Rotor-Shaft	FCD450			
12 2	2	O-ring	FKM	G50	@	
12 3	1	Pulley Side Cover	FC250			
12 3	2	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/4		
12 3	3	Oil Seal	FKM		@	
12 3	7	Hexagon Socket Head Cap Screw	SS400	M12x35		
12 3	8	O-ring	FKM	G130	@	
12 3	9	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/8		
12 3	10	Fitting	SUS304	for φ16-R1/2		
12 4	1	Opposite Pulley Side Cover	FC250			
12 4	2	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/4		
12 4	3	Oil Seal	FKM		@	
12 4	6	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/2		
12 4	7	Hexagon Socket Head Cap Screw	SS400	M12x35		
12 4	8	O-ring	FKM	G130	@	
12 4	9	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/8		
12 5	3	Seal Sleeve	SCM435H	L=28	@@@	
12 6	2	Bearing		6311C3	@	
12 7	1	Bearing Nut		右ねじ		
12 8	1	Bearing Nut		左ねじ		
12 9	1	Pulley Side Bearing Cover	SS400	t25		
12 9	3	Oil Seal	FKM		@	
12 9	5	Hexagon Socket Head Cap Screw	SS400	M12x35		
12 10	1	Opposite Pulley Side Bearing Cover	SPHC	t6		
12 10	5	Hexagon Socket Head Cap Screw	SS400	M12x20		
12 11	1	Fitting	SUS304	for φ10-R1/4		
12 14	3	Vane			@@@	

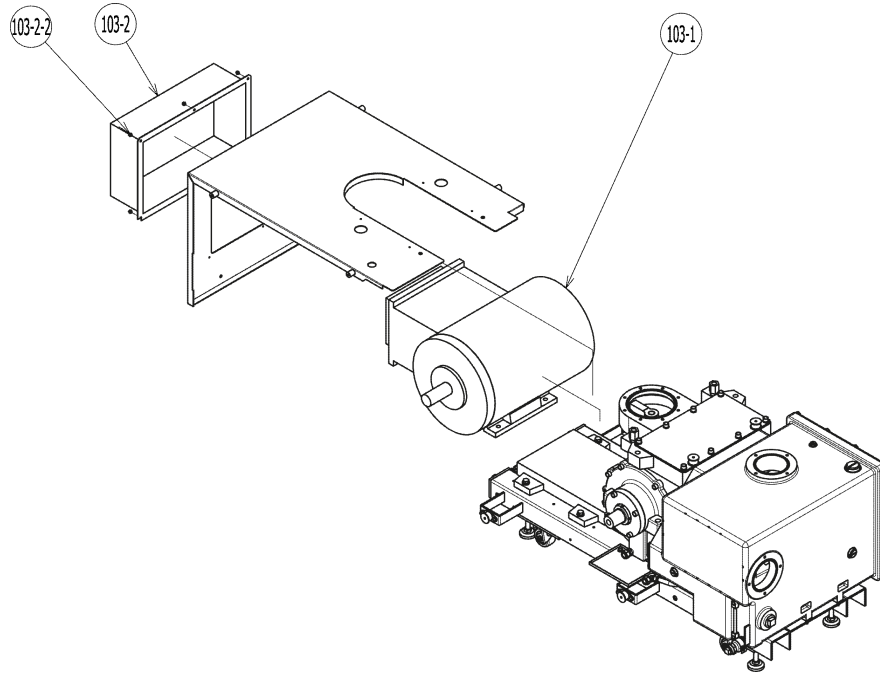
@: replace whenever overhauling / @@@: replace when judged ↑ .

Totally Enclosed External Fan Cooled Motor Type Assembly [Standard]



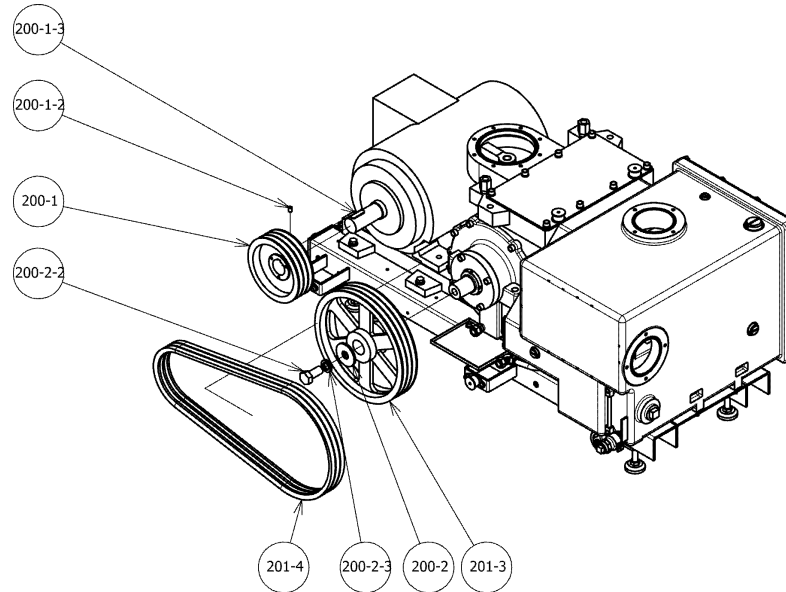
Totally Enclosed External Fan Cooled Motor Type Assembly						
Position	Q'ty		Parts Name	Material	Dimensions	Replace
101	1	1	Totally Enclosed External Fan Cooled Motor			
101	2	1	Panel 4 (Soundproof material inside)	SPHC	t2.0	
101	2	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M5x8	
101	3	1	Electrical Box			
101	4	1	Thermostat			
101	5	2	Hexagon Socket Head Cap Screw	SS400	M3x8	
101	6	2	Spring Lock Washer	SS400	M3	

Flame-Proof Motor Type Assembly [External Option]



Flame-Proof Motor Type Assembly						
Position		Q'ty	Parts Name	Material	Dimensions	Replace
103	1	1	Flame-Proof Motor			
103	2	1	Panel 5 (Soundproof material inside)	SPHC	t2.0	
103	2	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M5x12	

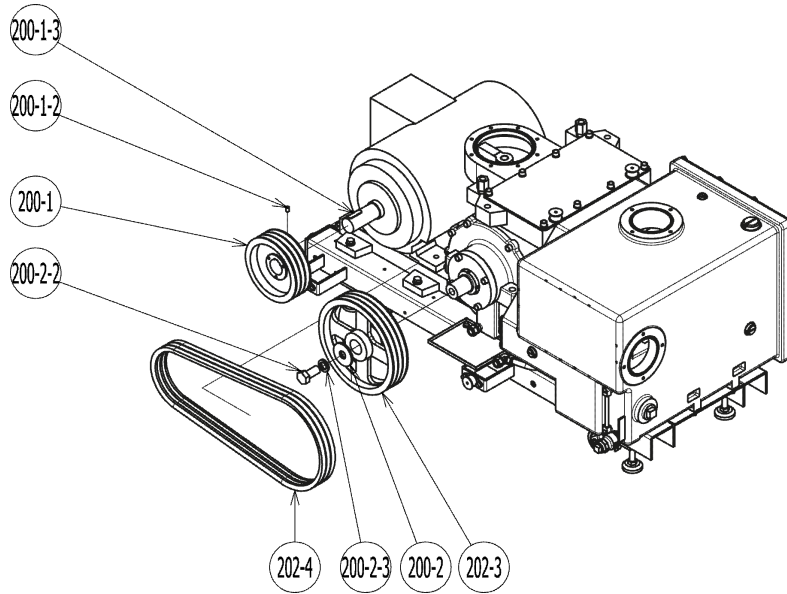
Pumping Speed 650m³/h Type Assembly [Standard Select]



Pumping Speed 650m ³ /h Type Assembly						
Position	Q'ty		Parts Name	Material	Dimensions	Replace
200	1	1	Pulley	FC	φ200-B-3	
200	1	2	Hexagon Socket Set Screw	SCM435	M10x16	
200	1	3	Key	S45C	14x9	
200	2	1	Pulley Disk	SPHC	t6	@
200	2	2	Hexagon Head Bolt	SCM435	M24x50	@
200	2	3	Spring Lock Washer	SS400	M24	@
201	3	1	Pulley	FC	φ355-B-3	
201	4	3	V-belt	Mitsuboshi e-Power BX-71		@

@: replace whenever overhauling ↑ .

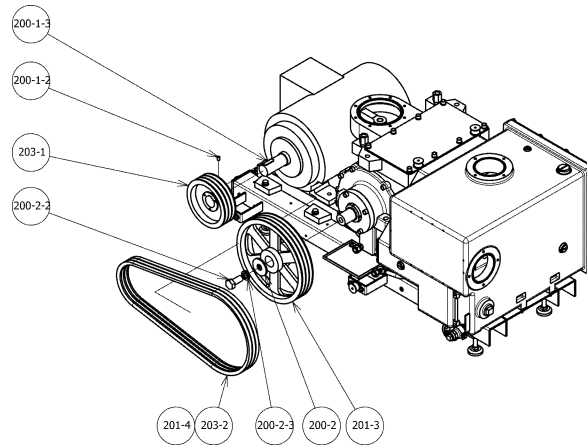
Pumping Speed 750m³/h Type Assembly [Standard Select]



Pumping Speed 750m ³ /h Type Assembly						
Position		Q'ty	Parts Name	Material	Dimensions	Replace
200	1	1	Pulley	FC	φ200-B-3	
200	1	2	Hexagon Socket Set Screw	SCM435	M10x16	
200	1	3	Key	S45C	14x9	
200	2	1	Pulley Disk	SPHC	t6	@
200	2	2	Hexagon Head Bolt	SCM435	M24x50	@
200	2	3	Spring Lock Washer	SS400	M24	@
202	3	1	Pulley	FC	φ300-B-3F	
202	4	3	V-belt	Mitsuboshi e-Power BX-67		@

@: replace whenever overhauling ↑ .

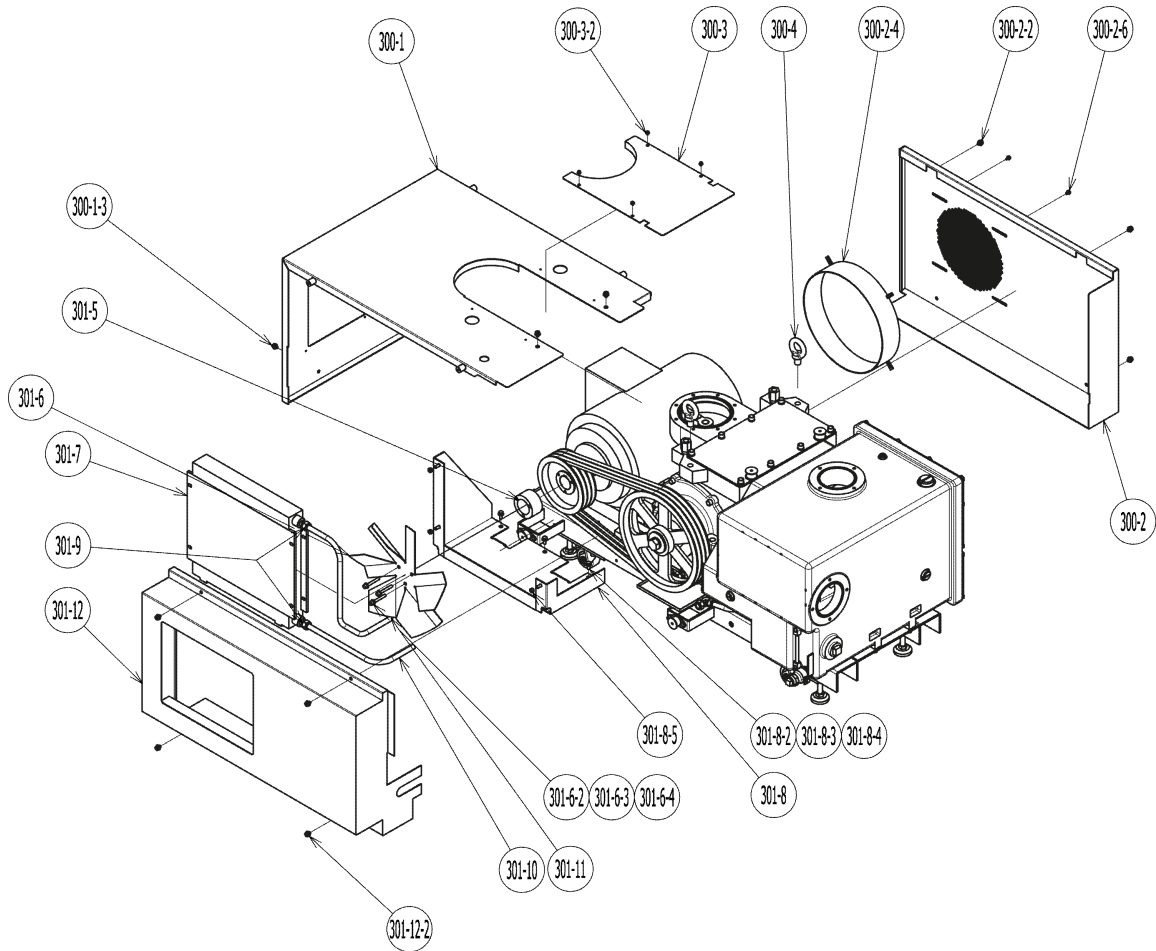
Pumping Speed 600m³/h Type Assembly [Standard Select]



Pumping Speed 750m ³ /h Type Assembly					
Position	Q'ty	Parts Name	Material	Dimensions	Replace
200	1	Drive Pulley (for 50Hz)	FC	φ192	
200	1	Hexagon Socket Set Screw	SCM435	M10x16	
200	1	Key	S45C	14x9	
200	2	Pulley Disk	SPHC	t6	@
200	2	Hexagon Head Bolt	SCM435	M24x50	@
200	2	Spring Lock Washer	SS400	M24	@
201	3	Driven Pulley	FC	φ355	
201	4	V-belt (for 50Hz)	Mitsuboshi e-Power BX-71		@
204	1	Drive Pulley (for 60Hz)	FC	φ160	
204	2	V-belt (for 60Hz)	Mitsuboshi e-Power BX-69		@

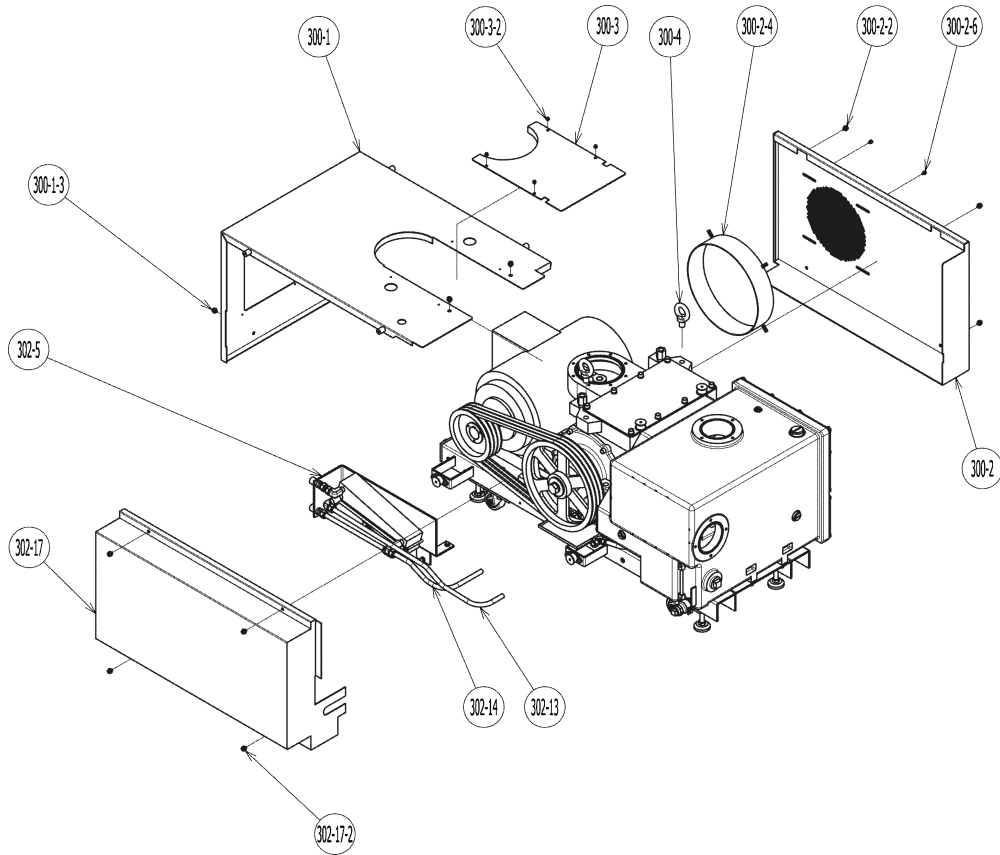
@ : replace whenever overhauling ↑ .

Air Cooling Type Assembly [Standard Select]



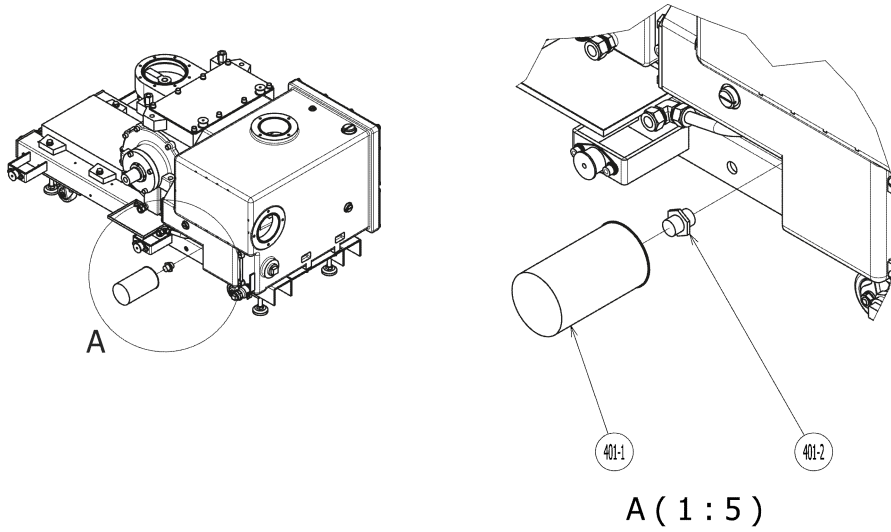
Air Cooling Type Assembly						
Position	Q'ty	Parts Name	Material	Dimensions	Replace	
300 1	1	Panel 1 (Soundproof material inside)	SPHC	t2.0		
300 1	3	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x12		
300 2	1	Panel 3 (Soundproof material inside)	SPHC	t2.0		
300 2	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x12		
300 2	3	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x20		
300 3	1	Panel 6 (Soundproof material inside)	SPHC	t2.0		
300 3	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M5x8		
300 4	2	Eyebolt	Fe	M20		
301 5	1	Fan Spacer	A1000			
301 6	1	Fan	SS400+PP			
301 6	2	Hexagon Socket Head Cap Screw	SS400	M8x60		
301 6	3	Plain Washer	SS400	M8		
301 6	4	Spring Lock Washer	SS400	M8		
301 7	1	Oil Cooler				
301 8	1	Oil Cooler Bracket	ZAM	t3.0		
301 8	2	Hexagon Head Bolt	SS400	M8x20		
301 8	3	Plain Washer	SS400	M8		
301 8	4	Spring Lock Washer	SS400	M8		
301 8	5	Hexagon Nut	SS400	M8		
301 9	2	Fitting	SUS304	for φ16-R1/2		
301 10	1	Oil Cooling IN Tube 2	SUS304	φ16xt1.0		
301 11	1	Oil Cooling OUT Tube	SUS304	φ16xt1.0		
301 12	1	Panel 2 (Soundproof material inside)	SPHC	t2.0		
301 12	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x12		
301 12	3	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x20		

Water Cooling Type Assembly [Standard Select]



Water Cooling Type Assembly						
Position	Q'ty		Parts Name	Material	Dimensions	Replace
300	1	1	Panel 1 (Soundproof material inside)	SPHC	t2.0	
300	1	3	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x12	
300	2	1	Panel 3 (Soundproof material inside)	SPHC	t2.0	
300	2	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x12	
300	2	3	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x20	
300	3	1	Panel 6 (Soundproof material inside)	SPHC	t2.0	
300	3	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M5x8	
300	4	2	Eyebolt	Fe	M20	
302	5	1	Heat Exchanger			
302	13	1	Oil Cooling IN Tube 4	SUS304	for φ16-R1/2	
302	14	1	Oil Cooling OUT Tube	SUS304	for φ16-R1/2	
302	17	1	Panel 8 (Soundproof material inside)	SPHC	t2.0	
302	17	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x12	
302	17	3	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x20	

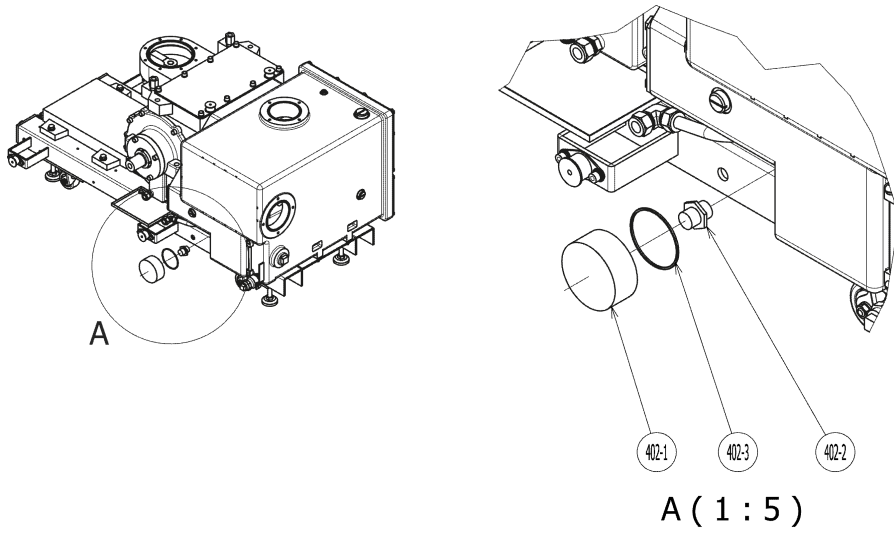
With Oil Filter Assembly [Standard]



With Oil Filter Type Assembly						
Position		Q'ty	Parts Name	Material	Dimensions	Replace
401	1	1	Oil Filter		φ96x170	@
401	2	1	Double Union			

@: replace whenever overhauling ↑ .

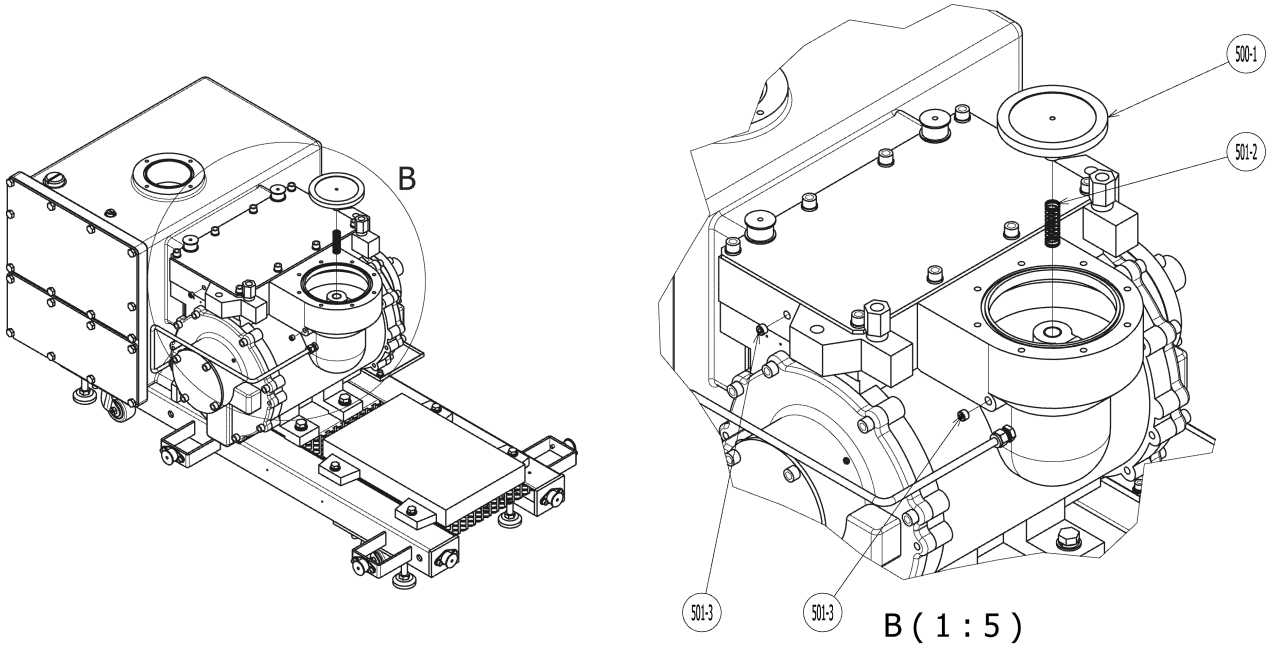
Without Oil Filter Assembly [External Option]



Without Oil Filter Type Assembly					
Position	Q'ty	Parts Name	Material	Dimensions	Replace
402	1	Oil Filter ByPass	A1000		
402	2	Double Union			
402	3	O-ring	FKM	G80	@

@: replace whenever overhauling ↑ .

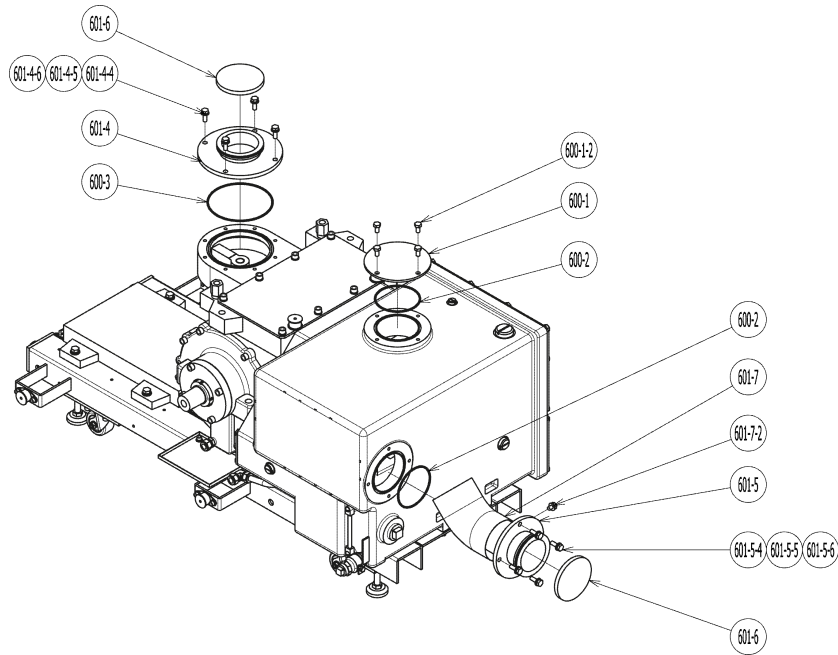
Back Flow Prevention Valve With Spring Assembly [Standard]



Back Flow Prevention Valve With Spring Assembly						
Position	Q'ty	Parts Name	Material	Dimensions	Replace	
500	1	Back Flow Prevention Valve			(@)	
501	2	Spring	SWPA	OD19xD17		
501	3	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/4		

(@): replace only seal parts ↑ .

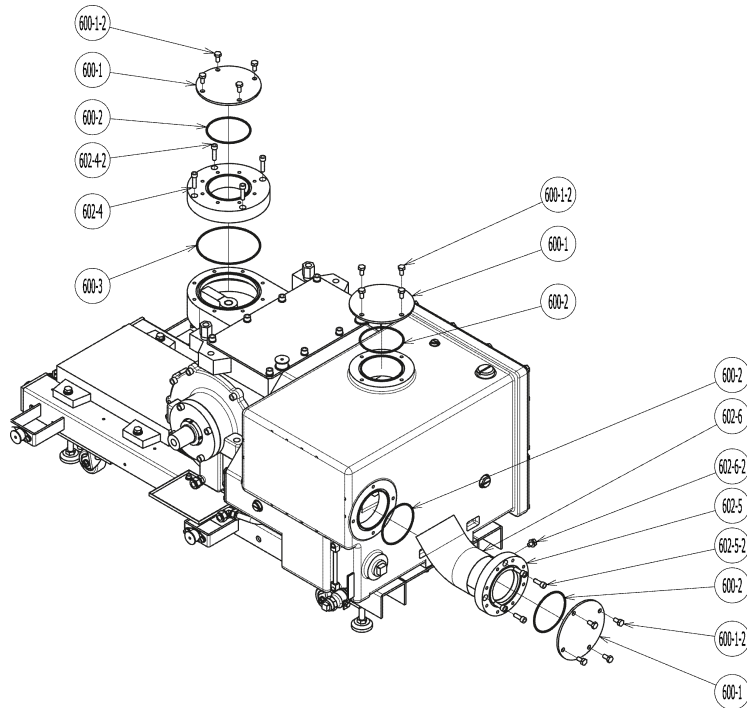
ISO Flange Type Assembly [Standard]



ISO Flange Type Assembly							
Position	Q'ty	Parts Name	Material	Dimensions	Replace		
600	1	1	Flange	ZAM	t6.0		
600	1	2	4	Hexagon Head Bolt	SS400	M10x20	
600	2	2	O-ring	FKM	V120	@	
600	3	1	O-ring	FKM	V175	@	
601	4	1	Inlet Port DN	SUS	VG150A-DN100ISO-K		
601	4	4	4	Hexagon Head Bolt	SS400	M10x30	
601	4	5	4	Plain Washer	SS400	M10	
601	4	6	4	Spring Lock Washer	SS400	M10	
601	5	1	Outlet Port DN	SUS	VG100A-DN100ISO-K		
601	5	4	4	Hexagon Head Bolt	SS400	M10x30	
601	5	5	4	Plain Washer	SS400	M10	
601	5	6	4	Spring Lock Washer	SS400	M10	
601	6	2	Flange Cover		DN 100 ISO-K		
601	7	1	Baffle	Fe	φ125-45deg.		
601	7	2	1	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x12	

@: replace whenever overhauling ↑ .

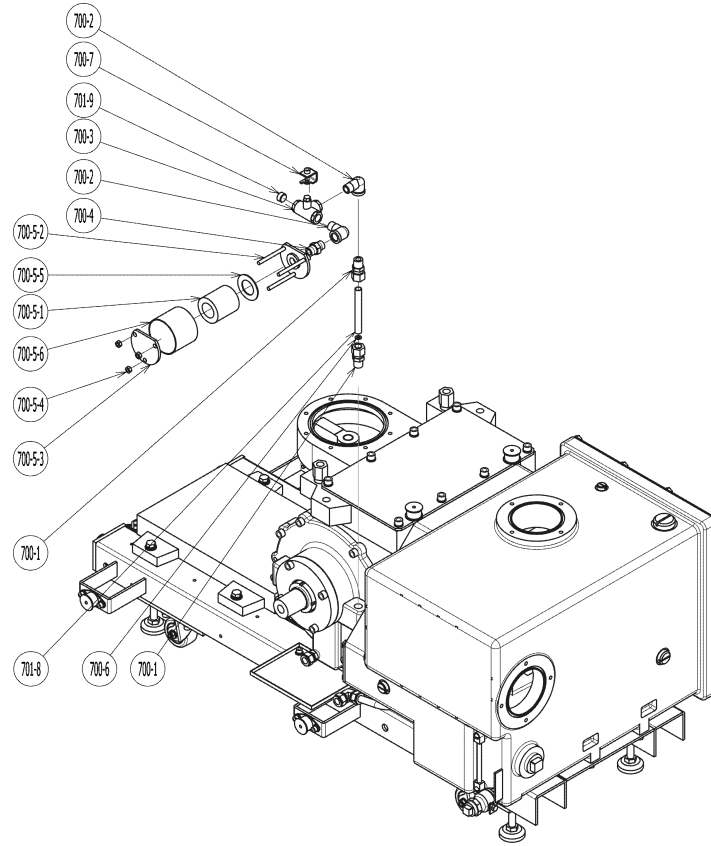
JIS Flange Type Assembly [External Option]



JIS Flange Type Assembly						
Position		Q'ty	Parts Name	Material	Dimensions	Replace
600	1	3	Flange	ZAM	t6.0	
600	1	12	Hexagon Head Bolt	SS400	M10x20	
600	2	4	O-ring	FKM	V120	@
600	3	1	O-ring	FKM	V175	@
602	4	1	Inlet Flange JIS	SUS	VG150A-JIS100A	
602	4	2	Hexagon Socket Head Cap Screw	SS400	M10x40	
602	5	1	Outlet Flange JIS	SUS	VG100A-JIS100A	
602	5	2	Hexagon Socket Head Cap Screw	SS400	M10x30	
602	6	1	Baffle	Fe	φ125-45deg.	
602	6	2	Cross Recessed Hexagon Head Screw with Captive Washer	SS400	M8x12	

@: replace whenever overhauling ↑ .

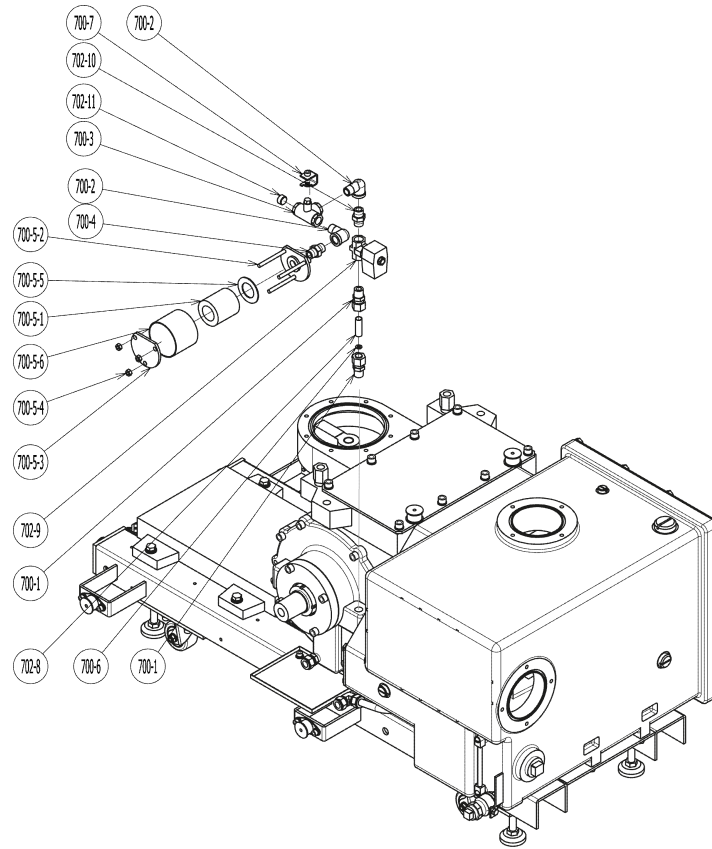
1 Gas Ballast Valve (Manual) Assembly [Standard]



1 Gas Ballast Valve (Manual) Assembly						
Position	Q'ty	Parts Name	Material	Dimensions	Replace	
700	1	2	Fitting	BRASS	for φ15-R1/2	
700	2	2	Street Elbow	Fe	R1/2	
700	3	1	3-Way 4Seats Ball Valve	BRONZE	R1/2	
700	4	1	Check Valve	SUS		@@@
700	5	1	Air Filter Element			@@@
700	5	2	Rear Plate	SPHC		
700	5	3	Front Plate	SPHC		
700	5	4	Hexagon Nut	SS400	M8	
700	5	5	Rubber Seal	NBR	t2.0	@
700	5	6	Filter Cover	SUS304	φ89xt2.0	
700	6	1	Orifice for Gas Ballast 1	SUS		
700	7	1	U-Handle	SS400	t3.0	
701	8	1	Tube for Gas Ballast Valve Manual	COPPER	φ15xt1.0	
701	9	1	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/2	

@: replace whenever overhauling / @@@: replace when judged ↑ .

1 Gas Ballast Valve (Solenoid Valve) Assembly [External Option]



1 Gas Ballast Valve (Solenoid Valve) Assembly						
Position	Q'ty	Parts Name	Material	Dimensions	Replace	
700	1	2	Fitting	BRASS	for $\phi 15$ -R1/2	
700	2	2	Street Elbow	Fe	R1/2	
700	3	1	3-Way 4Seats Ball Valve	BRONZE	R1/2	
700	4	1	Check Valve	SUS		@@@
700	5	1	Air Filter Element			@@@
700	5	2	Rear Plate	SPHC		
700	5	3	Front Plate	SPHC		
700	5	4	Hexagon Nut	SS400	M8	
700	5	5	Rubber Seal	NBR	t2.0	@
700	5	6	Filter Cover	SUS304	$\phi 89$ x $t 2.0$	
700	6	1	Orifice for Gas Ballast 1	SUS		
700	7	1	U-Handle	SS400	t3.0	
702	8	1	Tube for Gas Ballast Valve Auto	COPPER	$\phi 15$ x $t 1.0$	
702	9	1	Solenoid Valve		N.C. DC24V	
702	10	1	Hexagonal Nipple	Fe	R1/4	
702	11	1	Hexagon Socket Headless Tapered Pipe Plug	SUS	R1/2	

@: replace whenever overhauling / @@@: replace when judged ↑ .



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 12: 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.