



# **Instructions Manual**

## **Oil Diffusion Pump**

### **MODEL**

**ULK-04A**

**ULK-06A**

**ULK-10A**

**ULK-14A**

Be sure to read the manual before using this product.  
In addition, keep it in a safe and readily available  
place.

**ULVAC, INC.**  
**Components Division**  
**<http://www.ulvac.co.jp/>**

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## 0. Before Use

We are sincerely appreciate your decision to purchase our product.

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

This manual describes appropriate ways to handle and maintain the product for the safe use and effective performance. Before using the product, read this instructions manual for the correct use of the pump.

Install and operate this product 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 that are valid in the country and the local area at the site. No one who hasn't take the classes can handle the product. 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 product 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 product built-in doesn't follow the same regulations, or if any changes are made to the product 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 product modifications you have done are not covered by our warranty and we are not responsible for them.

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

All the parts of this product 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 product. 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 to make preventive maintenance measures, the likelihood of the trouble on this product attributed to malfunctions caused by worn parts will decrease and that of the risk, such as downtime, fire, and influence on other processes, attributed to the trouble on this product will also decrease.

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.

## 0.1 Safety symbol mark

This instructions manual and the product warning labels indicate safety symbol marks for the understanding of compliance rules. The signs for the symbols are classified as follows.

## 0.2 Definition of safety symbol mark



**DANGER**

This indicates an imminently hazardous situation which, if the product is misused, will result in operator's death or serious injury.



**WARNING**

This indicates a potentially hazardous situation which, if the product is misused, could result in operator's death or serious injury.



**CAUTION**

This indicates a potentially hazardous situation which, if the product is misused, may result in operator's moderate injury or serious damage to the machinery. This indicates a potentially hazardous situation which could result in damage to the machinery or malfunctions.

**IMPORTANT**

"IMPORTANT" is indicated if there is information or content which needs to be known especially for operation and maintenance work of this system.



Work that needs training on electrical safety due to the risk of an electric shock.



Work that is done after checking that the pump temperature decreases because that part is high in temperature immediately after the pump stops.

## 0.3 Safety precautions

This section describes a way to avoid dangers and dangerous behavior to be avoided for each work.

### About this product and this instructions manual

**DANGER**

To use this product for many years, be sure to read this instructions manual before installation, operation, inspection, or maintenance of this product and fully understand the safety precautions, specifications, and operation method of this product.

**DANGER**

If toxic and combustible/flammable gases other than inactive gas are discharged by the vacuum pump, it cannot be used since leakage may occur from the pump body.

**DANGER**

If combustible/flammable gas and materials other than inactive gas are discharged by the vacuum pump, it cannot be used since ignition/explosion may occur in the vacuum pump.

**DANGER**

If toxic gas is sucked in the vacuum pump, it goes without saying that not only the pump body but also the pump oil will be toxic. Take care during the maintenance work.

**WARNING**

If the details on the hazardous substances you have used are not disclosed, or if substances that are hard to detoxify are exhausted, we may refuse maintenance and other operations at your site.

**WARNING**

Note that the specifications, prices, etc. of the product and the description of the instructions manual are subject to change without prior notice for improvement. When any changes are made, the document number at the upper right of the front cover of the instructions manual is updated and the document is released as a revised version.

**WARNING**

Be sure to give this instructions manual to the end user of the product.

**WARNING**

For export of this product to countries other than Japan, it shall be examined by the Foreign Exchange and Foreign Trade Control Act, and government ordinances, ministerial ordinances, directives, etc. related to the act.  
Contact the nearest sales office, agency, or our Components Division.

**CAUTION**

In no case, all or part of this instructions manual may be copied for any third party without our permission.

## Installation/Storage



- (1) Instruct operators to lift and carry it using cargo-handling equipment when taking the product out of the wooden frame or lifting the pump.
- (2) Any person other than those having technical qualifications shall not perform cargo handling operation and operate cargo handling equipment.
- (3) Unreasonable operation or insufficient maintenance of equipment may cause the pump to fall or turn over. Never get under the pump.
- (4) Instruct operators to wear leather gloves and use appropriate tools, or they may get injured by broken pieces of crates and nails.

## Transportation



The pump mass is as follows.

ULK-04A : 7.5kg  
ULK-06A : 13.5kg  
ULK-10A : 47kg  
ULK-14A : 56kg

A load over the safety standard value is required for transportation, and therefore you may strain your back. Transport it by hanging with cargo handling equipment (such as a mobile crane), or put and fix it on a pallet and transport it on a pallet track.

**Seismic countermeasure****WARNING**

If not securely fixed, it may turn over or move, damaging the peripheral equipment. Vacuum pipes and electric wires shall be structured not to rapture, not to be disconnected, and to absorb vibration by a specified vibration.

**Intake and exhaust piping <Mounting>****WARNING**

Before starting work, check that all dangerous energies are shut out.

**Cooling Water Piping <Mounting>****WARNING**

Before starting work, check that all dangerous energies are shut out.

**Power Cable <Mounting>****WARNING**

Before starting work, check that all dangerous energies are shut out.

Wiring work shall be performed only by qualified personnel. Wrong wiring work may trigger fire.

Wiring work shall be performed correctly according to the safety laws and regulations (such as fire laws, electric wiring codes, and indoor wiring regulations) of the country and the local area where you use this product.

Securely connect to ground.

We recommend installing a dedicated earth leakage breaker. There is a risk of an electric shock.

Be sure to attach an overload protective device. If not, it may result in a heater, power cable burnout or fire.

For the primary cable, be sure to use heat-resistant power cable (LKGB, KGB).

**Operation****WARNING**

- (1) During the operation, do not touch the vacuum pump body, heater, and pipes since they are subjected to high temperature. If your body comes into contact with them, you may get burned.
- (2) Do not operate the vacuum pump with any devices that cause clogging of the exhaust attached on the exhaust port side in such a way that they disturb the gas flow. Otherwise the inner pressure of the vacuum pump may increase and cause a rupture of the casing and the oil level gauge, resulting in oil leakage and an overload of the heater.
- (3) This unit is not pressure-proofed. When feeding gas, be sure to open the valve on the exhaust outlet side.

**CAUTION**

- (1) Do not use in a hazardous area (where a hazardous atmosphere may occur by explosive gas). Otherwise injury or fire may occur.
- (2) Do not put your fingers or any objects in the opening of the heater. Otherwise an electric shock, injury, fire, etc. may occur.
- (3) Never place any flammable object in the area within 1m from the vacuum pump. Otherwise fire may occur.

**WARNING**

Before inspection/repair, be sure to turn off the power switch. Otherwise the vacuum pump suddenly starts to operate and you may get injured.

Any person other than service engineers is not allowed to disassemble or repair/modify at all. Otherwise ignition or abnormal action may occur and you may get burned or an electric shock.

Do not touch the heater and the vacuum pump/piping when the vacuum pump body is high in temperature while the vacuum pump is running or shortly after it stops. Otherwise you may get burned.

If the product does not work or there is an error, immediately turn off the power switch to prevent any accidents and please always ask the shop you purchased it or the nearest service center to inspect/repair.

Never put flammable substances at a radius of 1m of an electric motor and a vacuum pump.  
Otherwise fire may occur.

Be sure to supply water during the operation. The required amount of cooling water is as follows:



- Amount of cooling water
  - ULK-04A/D-11(0.55kW) : 1.0 L/min or more
  - ULK-04A/D-31(0.73kW) : 1.0 L/min or more
  - ULK-06A/D-11(0.9kW) : 1.0 L/min or more
  - ULK-06A/D-31(1.2kW) : 1.5 L/min or more
  - ULK-10A/D-11(2.0kW) : 2.5 L/min or more
  - ULK-10A/D-31(2.4kW) : 3.0 L/min or more
  - ULK-14A/D-11(2.25kW) : 2.5 L/min or more
  - ULK-14A/D-31(2.4kW) : 3.5 L/min or more
- Cooling water pressure: 0.1~ 0.3MPaG (Gauge pressure)
- Cooling water temperature: 19 ~ 25°C

We recommend using water with the low amount of impurities (such as industrial water shown in the table below) for cooling water of this product. Water stain, such as calcium carbonate, accumulates in the cooling water system of this product depending on the water quality, which reduces the cooling efficiency. In addition, chlorine ions may corrode from the inner wall, causing cooling water leakage. Note that in such a case, the repair will be charged.



Established by: Japan Industrial Water Association (Industrial Water Quality Criteria Establishment Committee)

Turbidity (mg/L)	pH	Alkali level CaCO <sub>2</sub> mg/L	Hardness Mg, CaCO <sub>3</sub> mg/L	Evaporation residue mg/L	Chlorine ion Cl <sup>-1</sup> Mg/L	Iron Fe mg/L	Manganese Mn mg/L
20 or less	6.5-8.0	75 or less	120 or less	250 or less	80 or less	0.3 or less	0.2 or less

[Reference] Supplied Standard Water in Japanese Industrial Water Service

**Power Cable <Removal>**



Before removal, be sure to disconnect it from the power supply.

The pump keeps its temperature extremely high while the pump is running or for a while after it stops. If someone's body comes into contact with it, the person may get burned. Supply the cooling water until the pump temperature becomes low.



**Cooling Water Piping <Removal>**

If the joints for cooling water are removed immediately after the pump operation stops, the cooling water remaining in the pump may come to a boil and spout. Supply the cooling water until the pump temperature becomes low.



**WARNING**

The pump keeps its temperature extremely high while the pump is running or for a while after it stops. If someone's body comes into contact with it, the person may get burned. Supply the cooling water until the pump temperature becomes low.

With a visually observable flowmeter (HWFM: such as a flow sight) of the cooling water supply source for devices, check that no water flows.

**Intake and exhaust piping <Removal>**

Remove according to the installation manual of the device.



**WARNING**

The pumping lines stay at extremely high temperatures for a while even after the pump stops. Make sure that the pump temperature is low before removing it.

Fully seal the intake and exhaust ports using shutoff flanges etc.

**Transportation**

The pump mass is as follows.

- ULK-04A : 7.5kg
- ULK-06A : 13.5kg
- ULK-10A : 47kg
- ULK-14A : 56kg



**WARNING**

For transfer, loading equal to or higher than the safety standards is necessary depending on the model and you may damage your back.

Transport it by hanging with cargo handling equipment (such as a mobile crane), or put and fix it on a pallet and transport it on a pallet track.

### 0.4 Type/Description and position of warning label on this machine

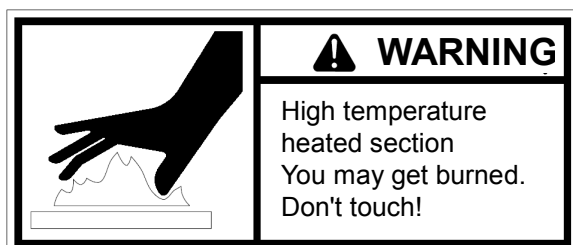
On this machine, warning labels are attached to the points to warn. Be sure to check before operating the pump.



In the area around where this warning label is attached, you may get an electric shock.

At the time of piping/maintenance, be sure to turn off the power before operation.

Be sure to close the lid of the terminal box before operation.



During the operation of this pump, the entire body becomes high in temperature.

Do not touch the pump body when it is high in temperature while the vacuum pump is running or shortly after it stops.

## 0.5 Acceptance and storage of pump

### 0.5.1 Acceptance of unpacked pump

**WARNING**

- (1) This product is packed in a wooden crate. Please ask a professional contractor to dismantle it. During the work, there is the risk of cutting your hands by nails or wooden chips used to fix the wooden crate. Therefore, instruct the person who dismantles the crate to wear leather gloves and use an appropriate dismantling tool, such as a crowbar.
- (2) If the product needs to be taken out from the crate or the pump needs to be lifted, instruct the operator to use cargo handling equipment, such as a crane, please to transportation to lift for it.
- (3) Any person other than those having technical qualifications shall not perform cargo handling operation and operate cargo handling equipment.
- (4) Unreasonable operation or insufficient maintenance of equipment may cause the pump to fall or turn over. Never get under the pump.
- (5) Instruct operators to wear leather gloves and use appropriate tools, or they may get injured by broken pieces of crates and nails.

Upon receipt of the product, please confirm first the contents included are the same as you ordered and check the product for any damage attributed to transportation etc. If you notify us after the product is used, it may be charged.

The product is shipped with due care but, after you unpacked, please check the following just in case.

**IMPORTANT**

- (1) Is the product as you have ordered?
- (2) Are the accessories supplied (Instruction manual, 1 unit packaging of pump oil, and option parts)?
- (3) Are there any damaged parts during the transportation?
- (4) Are screws and nuts loosened during the transportation? Are there any screws and nuts dropped?
- (5) The pump air inlet is bolted with aluminum foil and lid to prevent dust and dirt from entering. First, remove the lids on both sides and check the inside.  
Note that it is not necessary to pull out the nozzle.
- (6) Pull up gaskets for the air inlet and air outlet, flange toward you and check the sealing surface of the flange for any damage.
- (7) If the pump is not used soon, return the lids of the air inlet and the air outlet to their original positions and tighten them with bolts.

In the event of a failure, contact our sales department or your special agency.

**0.5.2 Transportation**

The pump mass is as follows.

ULK-04A : 7.5kg  
ULK-06A : 13.5kg  
ULK-10A : 47kg  
ULK-14A : 56kg



For transfer, loading equal to or higher than the safety standards is necessary depending on the model and you may damage your back.

Transport it by hanging with cargo handling equipment (such as a mobile crane), or put and fix it on a pallet and transport it on a pallet track.

### 0.5.3 Ambient conditions during storage, installation, and operation

This product is a machine with precision clearances. Therefore satisfy the following conditions during the storage, installation, and operation.

- a. Corrosive and explosive gas are not allowed.
- b. Freeze and condensation is not allowed.
- c. Dust is not allowed.
- d. The room shall be ventilated.
- e. The pump is not allowed to double stack and turn over, and the heater and the oil level gauge are not allowed to stand with their ends facing down.
- f. Direct sunlight shall be avoided.
- g. Keep away from heat sources.

**CAUTION**

**Do not give an impact to or overturn the pump. Otherwise the pump operation gets into trouble.**

At the time of installation, turn up the pump air inlet flange (loose type flange) and fix it with bolts so that the flange is in a horizontal position without looseness.

## 0.6 Protective equipment

This machine comes equipped with a single-phase heater for 200 VAC or 220 VAC.

This heater has no protection equipment. Be sure to connect the heater to the power supply through an overload protector. The electrical equipment technical standards (The government ordinance No. 61, the Ministry of International Trade and Industry, 1965) mandate installation of an overload protector.

For selection of an overload protector, see "3.6 Electrical connection."

It is recommended to install protectors other than the overload protector (such as a ground-fault interrupter) together.



**Be sure to attach overload protective equipment.**

**If you do not attach the overload protection equipment, then burned the heater, power cable, it may result in a fire.**

**For the electric wiring and the overload protector, select, install, and manage the wiring materials following the safety rules, laws and regulations (such as fire laws and electric wiring rules) in the country where you use the product.**

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Pollution certificate

Sales, Service Department, and their contact information



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# 1. For Safe Use


## 1.1 Product-specific risk and safety measure

Be sure to carefully read this section and fully understand potential hazards and how to avoid them before operation or inspection of this unit.


### 1.1.1 **DANGER** Leakage of hazardous gas and substances

Factor	How to avoid / Measure
 Intake and Exhaust of Hazardous Gas/Substance	Exhaust of toxic gas, combustion gas, flammable gas, corrosive gas, and explosive gas is extremely dangerous. Do not exhaust any gas with these properties.
You get injured by touching pump oil, pump, products, and aspiration materials which have become toxic at the time of inspection/disposal.	(1) Wear protective equipment to toxic materials you use, before starting work, such as inspection. (2) At the time of overhaul/disposal, please ask a professional contractor for the waste disposal to detoxify. (3) Ask a waste disposal company with an administrative approval to dispose of the product.
 You get injured by ignition/explosion due to residual gas or products.	If combustion/flammable/explosive gas is sucked in the vacuum pump, it is extremely dangerous because the residual gas or products may cause ignition/explosion not only in operation but also after a stop. Do not exhaust any gas with these properties.


### 1.1.2 **WARNING** Transportation of heavy load items

Factor	How to avoid / Measure
 Injury during the pump transportation. Mass of the pump ULK-04A : 7.5 kg ULK-06A : 13.5 kg ULK-10A : 47 kg ULK-14A : 56 kg	(1) Any person other than those having technical qualifications shall not perform cargo handling operation and operate cargo handling equipment. (2) Unreasonable operation or insufficient maintenance of equipment may cause the pump to fall or turn over. Never get under the pump.


1.1.3  **Electric shock**

Factor	How to avoid / Measure
 Get an electric shock caused by touching a live part.	(1) Before establishing electrical connections, be sure to turn off the power. Be sure to connect to ground. (2) Be sure to close the cover of the heater terminal box first and then operate the pump. Do not open the cover during the operation. (3) Before inspection/relocation, be sure to turn off the power. (4) Do not put your hands, any thin rods, etc. in the opening of the heater.
The terminal burns out.	Securely tighten the terminal. Check the tightened conditions once a month. (See 3.6 Electric Connection.)


1.1.4  **High temperature**

Factor	How to avoid / Measure
 Getting burned at high temperature part	(1) During the operation the pump becomes high in temperature. Attach a cover as necessary to prevent operators from touching the surface. (2) The surface temperature is high and operators may get burned when accidentally touching by hand etc. Do not touch the pump during the operation. Make sure that the temperature is thoroughly low after the pump stops before the inspection work.


1.1.5  Leakage of high-temperature cooling water


Factor	How to avoid / Measure
 <p>High-temperature steam generated by boiling cooling water spouts from the inlet and outlet of the pump cooling water due to operation without supplying the cooling water.</p>	<p>(1) Provide an interlock. In the route of the system, install a flowmeter to stop the pump when the supply of cooling water stops.</p> <p>(2) If the operation is started without supplying the water, stop the pump and keep away from the pump.</p> <p>(3) Stop the pump and make sure that the pump temperature becomes low. Then remove the pump for inspection.</p>

1.1.6  Rise of oil

Factor	How to avoid / Measure
 <p>The pump's back pressure is high and the pumping action is lost, causing back-flow of the oil.</p> <p>Critical back pressure            ULK-04A(D-11) :40Pa            ULK-04A(D-31) :60Pa            ULK-06A(D-11) :40Pa            ULK-06A(D-31) :60Pa            ULK-10A(D-11) :35Pa            ULK-10A(D-31) :40Pa            ULK-14A(D-11) :30Pa            ULK-14A(D-31) :30Pa</p>	<p>An oil diffusion vacuum pump loses its pumping action if the pump outlet pressure becomes higher than the critical back pressure. In this case, the oil steam spouts scattering and back-flows to the high vacuum section.</p> <p>(1) For the auxiliary pump, use one that has sufficient pumping performance.</p> <p>(2) Do not operate this unit with the outlet clogged or with any equipment installed on the outlet side which prevents gas from passing.</p> <p>(3) Make sure that the valve for evacuation is open before evacuation.</p> <p>(4) Make sure that the back pressure and the pressure in the high vacuum section are sufficiently low before operating this unit.</p>

1.1.7  **Explosion**

Factor	How to avoid / Measure
<div style="text-align: center;">  <p>The pump's internal pressure increases and the pump bursts.</p> </div>	<p>This pump is not designed for pressurization and, if pressurized, may burst, scattering broken pieces.</p> <p>Do not pressurize not only during the operation but also under any circumstances.</p>

Factor	How to avoid / Measure
<div style="text-align: center;">  <p>Explosion hazard</p> </div>	<p>Do not operate if there is no vacuum pump oil poured or its level is extremely low such that you cannot see the oil through the inspection window.</p> <p>Otherwise the oil is decomposed, causing a higher risk of explosion.</p> <p>Be sure to check through the inspection window that the oil level is appropriate before operation and periodically.</p>

## 1.2 Material safety data sheet (SDS)

**IMPORTANT****Chemicals used for this pump**

(1) ULVOIL D-11

or

(2) ULVOIL D-31

The material safety data sheet describes the hazards and harmfulness of the chemical substances, measures against them, etc. which may be used or come into contact with operators for operation of this unit.

If needed, please contact our sales office.

Please carefully read the SDS to understand the hazardous characteristics described therein.

Any use of chemical substances other than those described in this document (Vacuum pump oil: ULVOIL D-11) is not covered under the warranty.



The SDS is provided as information for your reference for the safe handling of hazardous chemical substances. In reference to the SDS, operators who use pump oil need to understand the importance on taking appropriate practical action, such as in use of individual oils, under their own responsibility before use. Therefore the SDS itself does not constitute a warranty for safety.

## 2. Overview

### 2.1 About oil diffusion pump

The principle of an oil diffusion pump is that gas molecules coming into the pump inlet are captured by injected stream and flow downstream with the injected stream. The gas molecules flowing downstream by the injected stream cannot pass through the thick upstream layer of injected stream and further flow downstream. The injected stream then comes into collision with the water-cooled pump case surface, condenses there, discharges thermal energy, turns into liquid again.

The oil diffusion pumps under the ULK series are each largely classified into the following four parts:

- 1) Four-stage injection nozzle (Aluminum)
- 2) Pump case with cooling water pipe (Stainless)
- 3) Boiler to heat oil up
- 4) Air outlet baffle nozzle to prevent oil consumption

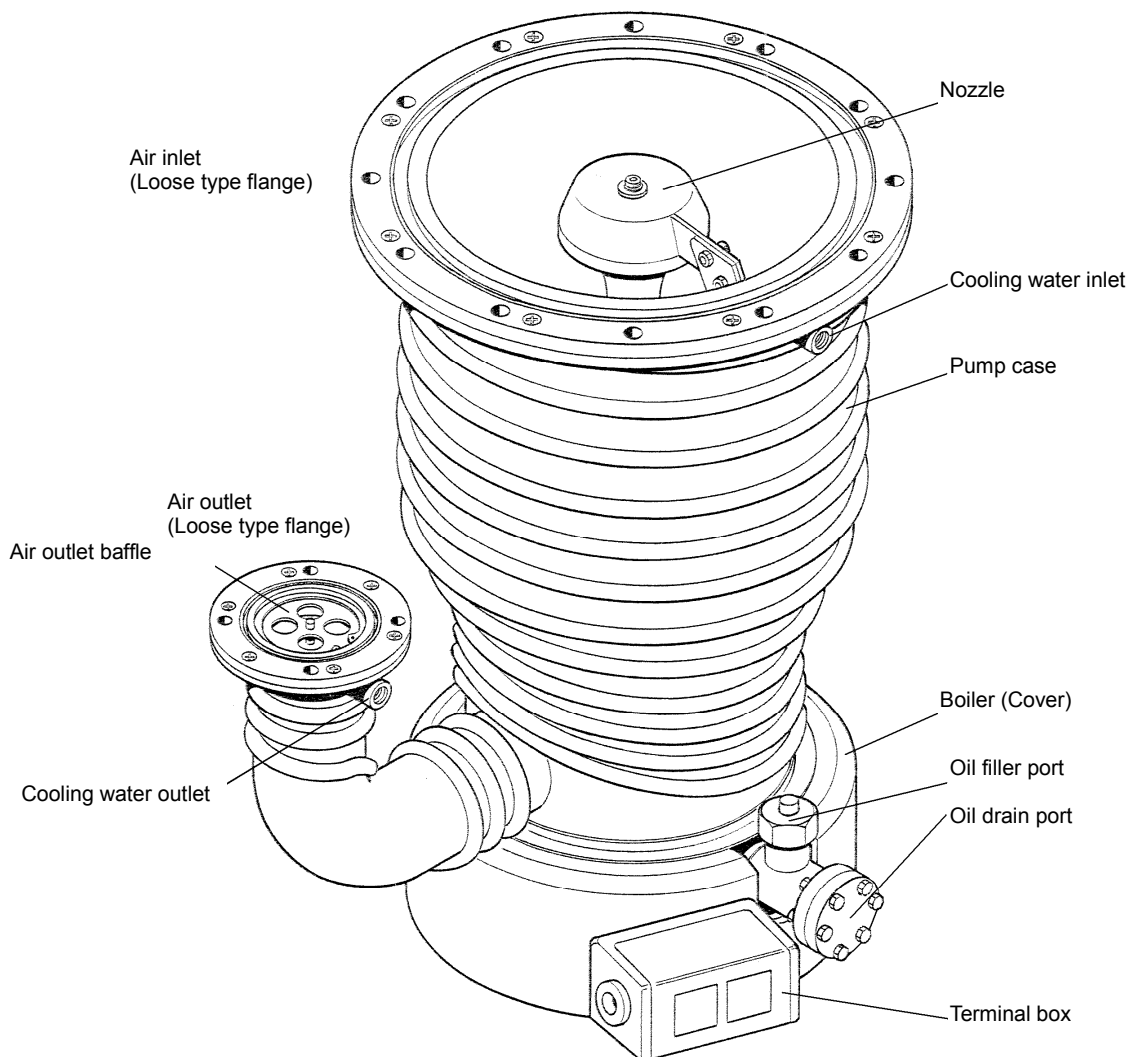


Figure 1: Part name of ULK type oil diffusion pump

## 2.2 Performance specifications

Table 1 Performance specifications

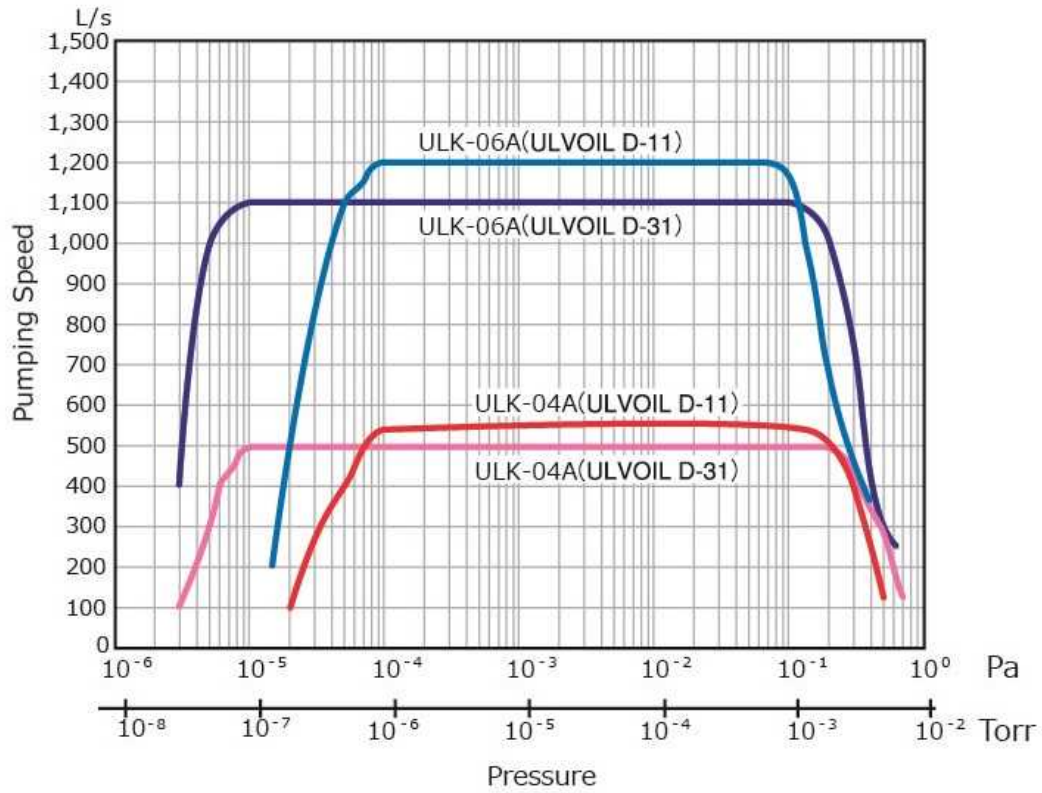
Specification		Model		ULK-04A		ULK-06A	
				ULVOIL D-11	ULVOIL D-31	ULVOIL D-11	ULVOIL D-31
Oil							
Pump Power*1	kW		0.55	0.73	0.90	1.2	
Ultimate pressure	Pa		$<2.6 \times 10^{-5}$	$<2.6 \times 10^{-6}$	$<2.6 \times 10^{-5}$	$<2.6 \times 10^{-6}$	
Maximum forepressure	Pa		40	60	40	60	
Evacuation speed	L/s		550	500	1200	1100	
Maximum air outlet volume	Pa·m <sup>3</sup> /s		0.086	0.13	0.15	0.20	
Heating up time	min		9	8.5	16.5	15	
Oil capacity	L		0.15	0.15	0.35	0.35	
Water capacity	L/min		1.0	1.0	1.0	1.5	
Standard backing pump			VD151,VD201,PVD-180,PVD360		VD30C,VD40C,VD60C		

Specification		Model		ULK-10A		ULK-14A	
				ULVOIL D-11	ULVOIL D-31	ULVOIL D-11	ULVOIL D-31
Oil							
Pump Power*1	kW		2.0	2.4	2.25	2.4	
Ultimate pressure	Pa		$<2.6 \times 10^{-5}$	$<2.6 \times 10^{-6}$	$<2.6 \times 10^{-5}$	$<2.6 \times 10^{-6}$	
Maximum forepressure	Pa		35	40	30	30	
Evacuation speed	L/s		3400	3000	5400	4900	
Maximum air outlet volume	Pa·m <sup>3</sup> /s		0.35	0.43	0.35	0.47	
Heating up time	min		20	20	25	25	
Oil capacity	L		0.8	0.8	1.5	1.5	
Water capacity	L/min		2.5	3.0	2.5	3.5	
Standard backing pump			PKS-030,PKS-016,VD90C,VS1501		PKS-030,VS1501,VS2401		

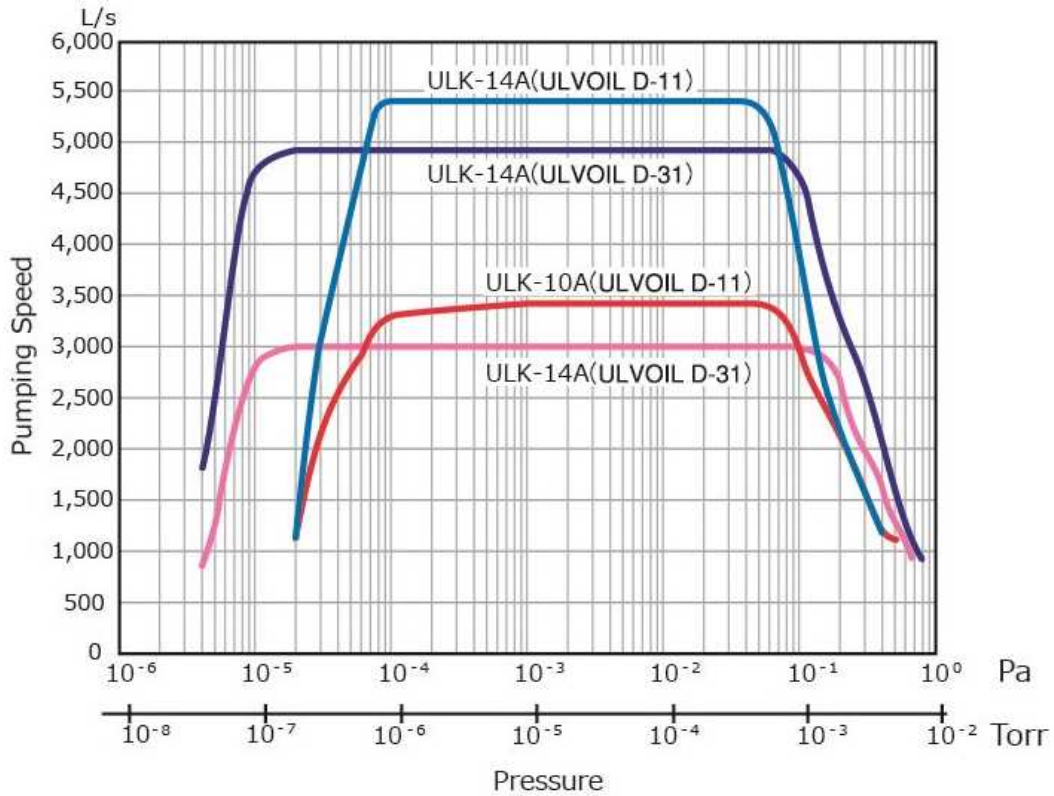
\*1: The power requires 1φ-200V or 1φ-220V. Pay attention to a heater applicable to the voltage you specified when purchasing is attached.

\*2 Cooling water temperature: 19 to 25°C; Cooling water pressure: 0.1 to 0.3MPaG (gauge)





Graph 1: Pumping speed curve for ULK-04A/ULK-06A



Graph 2: Pumping speed curve for ULK-10A/ULK-14A

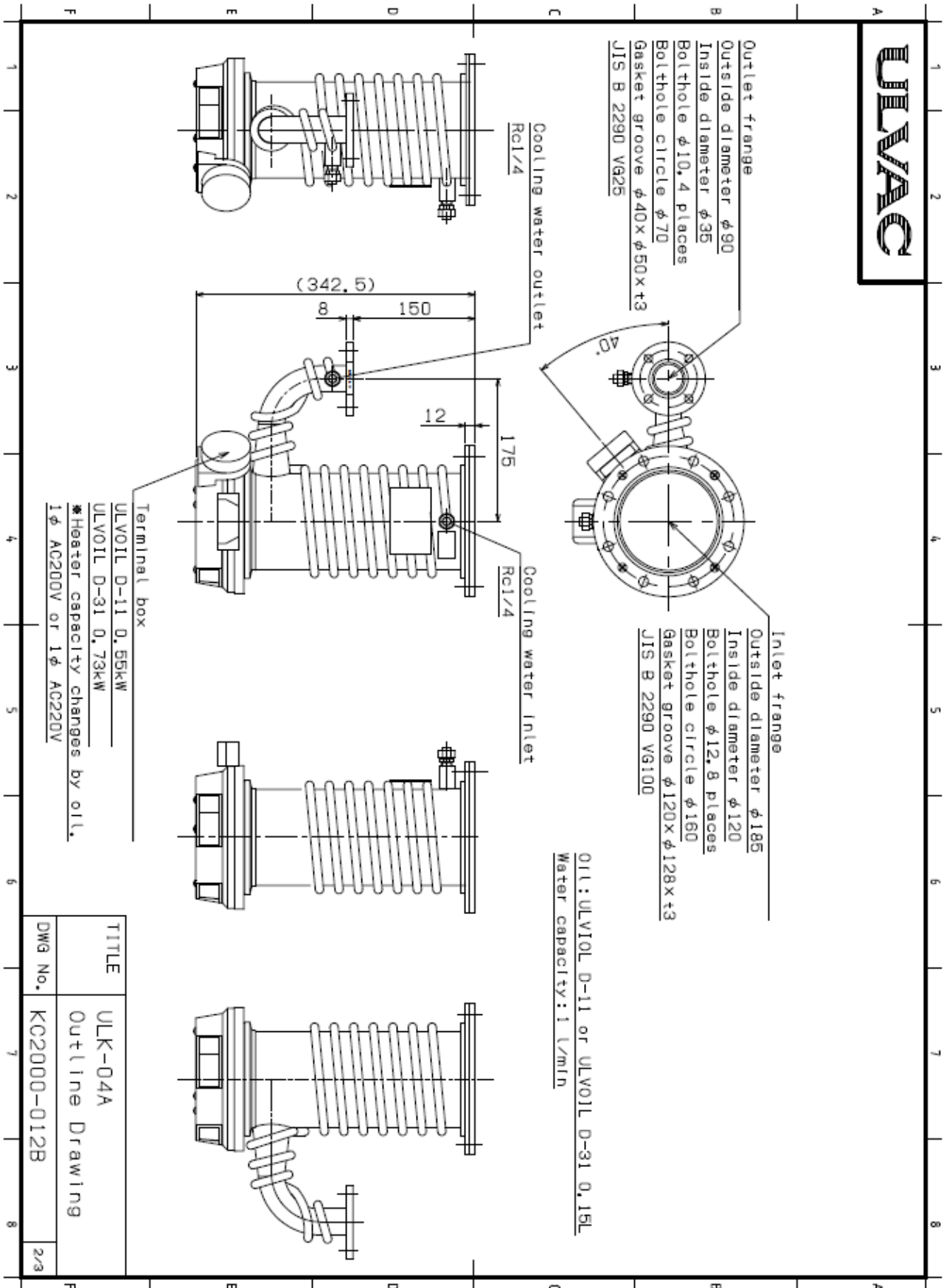


Figure 2: Oil diffusion vacuum pump Model No. ULK-04A, Dimensional appearance drawings

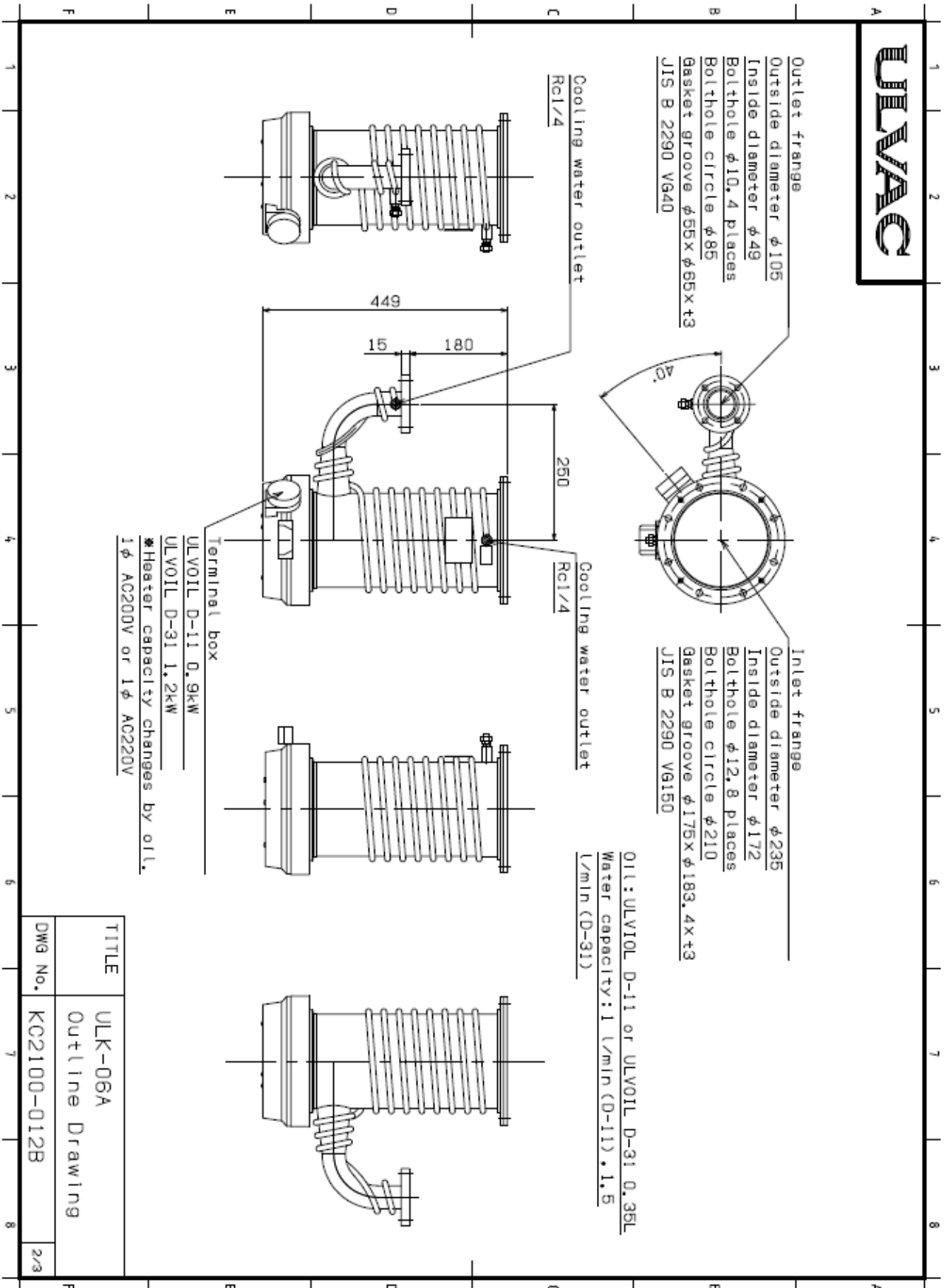


Figure 3: Oil diffusion vacuum pump Model No. ULK-06A, Dimensional appearance drawings

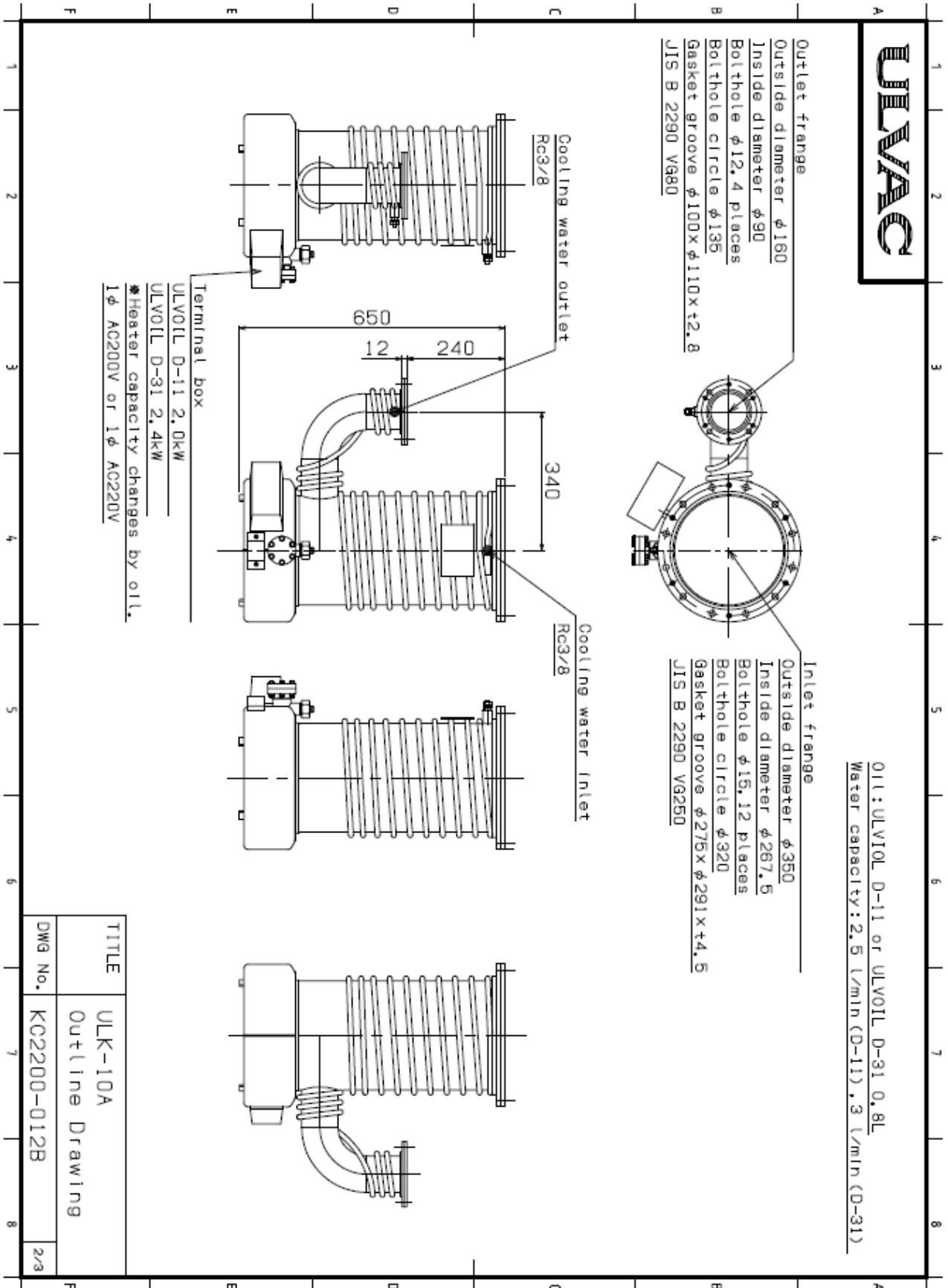


Figure 4: Oil diffusion vacuum pump Model No. ULK-10A, Dimensional appearance drawings

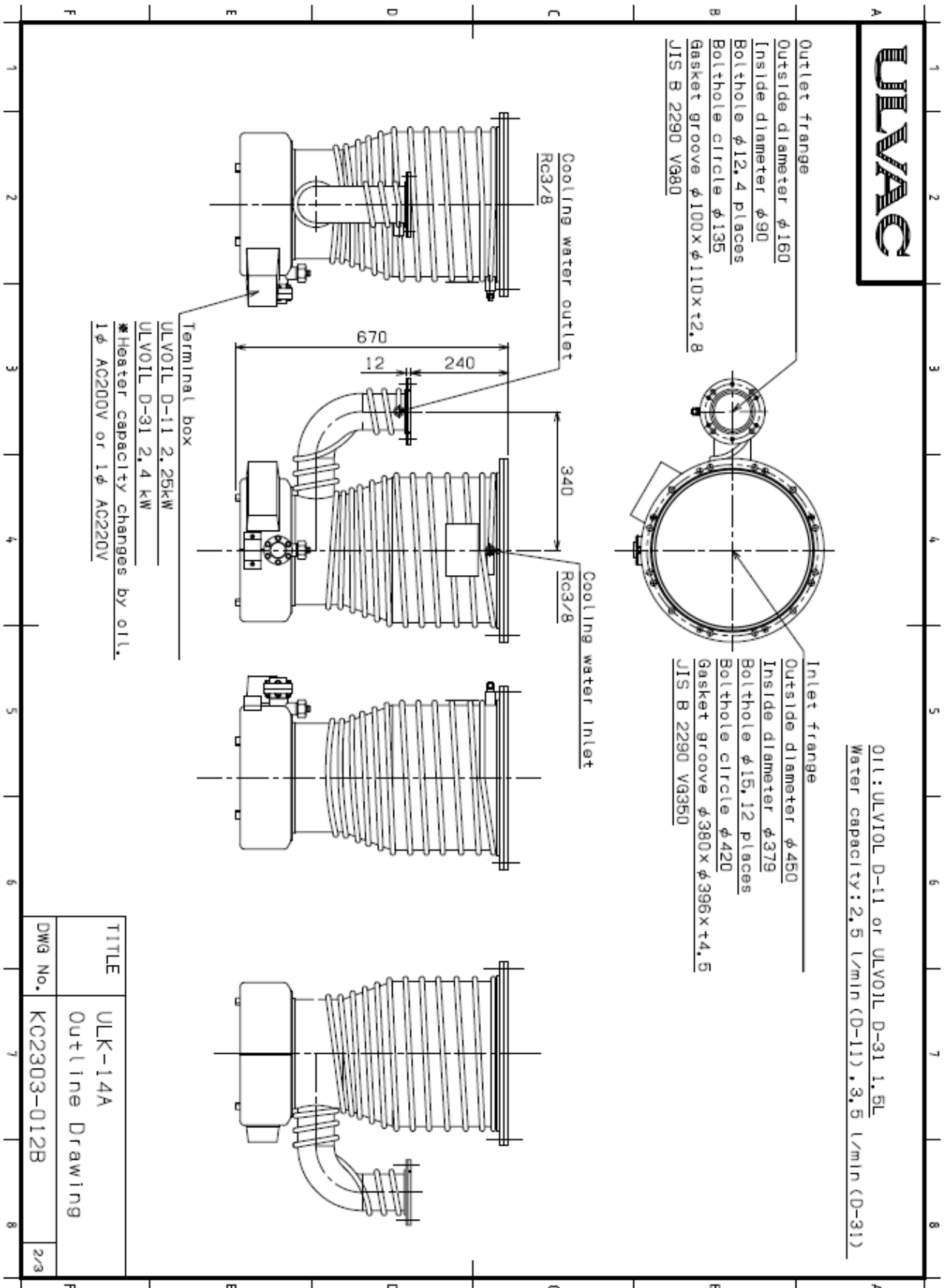


Figure 5: Oil diffusion vacuum pump Model No. ULK-14A, Dimensional appearance drawings

### 3 Mounting

Please read "0.5 Pump acceptance and storage" and check the pump for any defects.



**WARNING**

**Install and operate this product 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 that are valid in the country and the local area at the site. No one who hasn't take the classes can handle the product.**

**The operator is required to have taken such trainings.**

**In addition, the operator has expertise, skills, qualifications in electrics, mechanics, cargo handling, vacuum, etc.**

**Before installing/removing, keep the product from all the energy sources (electricity, cooling water, etc).**

### 3.1 Installation

For installation, select a site with less dust and moisture, turn up the air inlet flange (loose type flange) and install the flange in a horizontal position.

Lay out in consideration of installation, removal, inspection, cleaning, etc. of the pump (See Figs 2 to 5).

For the ambient conditions, see "0.5.3 Ambient conditions during storage, installation, and operation."

#### 3.1.1 Preparation

- 1) Remove the tape around the lead-in connection port for cooling water, and protection materials for the inlet port of the baffle and the pumping ports (where the inlet and outlet ports are blocked with protection materials), and then check the pump and the jet for damage.
- 2) Wipe the flange dry with alcohol etc.
- 3) Oil is poured at the factory but check the presence of the oil before use. (See section 3.2 Oil filling)

Heating without oil may cause a break in a cable of the heater or damage to the boiler.



**CAUTION**

**The pump is damaged if operated in a tilted, overturned, or upside-down state. With the intake port facing upward (see Fig. 2, 3), install the pump body horizontally.**

### 3.2 Oil filling

- (1) Prepare a well washed and dry graduated cylinder (500 to 1,000cc).
- (2) Pour the specified amount (ULK-04A: 150cc; ULK06A: 350cc, ULK-10A: 800cc, ULK-14A: 1,500cc) of given oil (ULVOILD-11 or ULVOIL D-31) into the graduated cylinder.
- (3) Pour oil into the air outlet.

Be sure to pour the specified amount of oil. (See Table 1)

The heater capacity depends on the oil type. Be careful.

The hydraulic fluid is indicated on the air outlet flange. Confirm it at the time of your purchase.

Be sure to pour the specified amount (See Table 1.)



**WARNING**

**(Do not use fluorine-based oil.) An oil diffusion pump operates at a high temperature and therefore fluorine oil may be decomposed producing toxic gas.**



**CAUTION**

**Use a vacuum pump oil we specifies. Use of oil other than those specified is not covered by the warranty because it causes the pump performance to deteriorate, which results in a shorter pump life, or in some cases, causes risks, such as damage to or explosion of the pump.**



**CAUTION**

**Do not mix two or more vacuum pump oil types.**



**CAUTION**

- (1) **Wear protective gears, such as rubber gloves and protective glasses, when pouring oil.**
- (2) **Read "1.2 Material Safety Data Sheet" before pouring oil. In the event where the vacuum pump oil comes into contact with your hand or your eye, follow the FIRST AID MEASURES section in the material safety data sheet.**

### 3.3 Water piping

Make connections so that the cooling water enters from the cooling water inlet at the upper part of the pump body and then comes out of the cooling water outlet at the upper part of the evacuation pipe.

For the cooling water, see Table 1. The cooling water inlet and outlet is ULK-04A/ULK-06A: Rc1/4, ULK-10A/ULK-14A: Rc3/8. Attach the joints for water piping (nylon tubes etc.) to install the piping.

Use the supplied connectors.

Tube for connector supplied as standard: Outside diameter of 9.53 mm × Inside diameter of 6.99 mm.



- (1) Be sure to supply the cooling water equal to or more than the amount described in table 1. If the pump runs with an amount of water equal to or lower than that specified, the pump temperature increases, causing defects in the pump.

It is recommended to install a flowmeter for cooling water as an interlock that stops the pump when the amount of water becomes equal to or lower than that specified.

- (2) When operation is stopped during wintertime, water in the water pipes may be frozen, causing damage to them. When stopping the operation, drain the water in the system in such a way as to blow air in from the water inlet.



- (1) When using several pumps, connect the cooling water pipes in parallel. A series connection may make the cooling performance insufficient, causing defects.

- (2) It is recommend to set a filter in an upstream stage for filtration to remove impurities, such as fur and iron contained.

- (3) If the supply source and the drain port are apart or there is difference in height between the pipes (in such a case where the drain port is lifted to a position higher than the pump), a sufficient flow rate may not be provided. In such a case, change the piping layout, replace the pipes with larger ones, or increase the supply pressure within the range of the specifications to secure a sufficient flow rate.



**CAUTION**

- (1) It is designed to cause no leakage under the specified condition and water leakage tests have been done. However water leakage may occur under abnormal conditions outside the specifications (such as an abnormal increase in water pressure). In such a case, unless the supply from the unit stops, the water leakage continues. Do not install electrical equipment and wiring on the floor under or near the pump.
- (2) It is recommended to install a water leakage sensor on the floor below the pump and incorporate it into the interlock system of the unit. If water leakage is detected, immediately stop the pump and close the supply valve (HWSV) for cooling water. After closing the valve, attach a "Closed" tag to the handle.
- (3) Install a flowmeter to the cooling water supply source, such as the unit, so that it can be visually checked that water flows and an interlock can be installed in order to allow operators to check whether the water flows.

### 3.4 Intake port pipe (Connection to vacuum chamber side)

- (1) Thoroughly clean the inside of the vacuum chamber, piping, vacuum valves, etc. and then connect to the pump. If it is connected under a dirty condition, the ultimate pressure becomes higher or the time required for the pressure to decrease down to a given pressure becomes longer.  
Do not touch any part under vacuum by bare hands but wear clean nylon gloves.
- (2) Remove the gaskets set on the inlet and outlet port flanges, lightly wipe them with a cloth moistened with a solution, such as alcohol to remove dirt on the surface.
- (3) Do not apply even grease with a low vapor pressure to the gasket surfaces.  
Only wipe dirt off.
- (4) Also wipe the gasket grooves on the flange and the corresponding flange surfaces with a clean cloth.
- (5) Set gaskets in place.
- (6) Connect the inlet port with the piping using a JIS vacuum flange.

**CAUTION**

- (1) If the pump suctions solid substances or moisture, such as dust and fine powder, not only the ultimate pressure may deteriorate but also it is broken down.
- (2) For a leak valve on the inlet port side with respect to this unit, install as near the vacuum chamber as possible.

**CAUTION**

**Install a valve on the way to the vacuum chamber.  
When stopping this unit, keep the inside of this unit in vacuum.**

### 3.5 Exhaust port pipe (Piping to auxiliary pump)

- (1) Thoroughly clean the inside of the piping, vacuum valves, etc. and then connect to the pump. If it is connected under a dirty condition, the ultimate pressure becomes higher or the time required for the pressure to decrease down to a given pressure becomes longer.  
Do not touch any part under vacuum by bare hands but wear clean nylon gloves.
- (2) Remove the gaskets set on the inlet and outlet port flanges, lightly wipe them with a cloth moistened with a solution, such as alcohol to remove dirt on the surface.
- (3) Do not apply even grease with a low vapor pressure to the gasket surfaces.  
Only wipe dirt off.
- (4) Also wipe the gasket grooves on the flange and the corresponding flange surfaces with a clean cloth.
- (5) Set gaskets in place.
- (6) Connect the outlet port with the piping using a JIS vacuum flange.

**DANGER**

- (1) **Be sure to use pipes made of conductive material (allowing a current to flow).  
Use of a nonconductive material may cause static electricity when exhaust gas passes and charge itself with electricity, which makes a spark, resulting in a source of ignition.**
- (2) **In the process where combustion or flammable gas flows, use diluent gas. Supply the diluent gas from the intake port so that the exhaust gas concentration is lower than the explosion limit.**

**CAUTION**


- (1) For a leak valve on the outlet port side with respect to this unit, install as near the auxiliary pump as possible.
- (2) Install a valve on the way to the auxiliary pump.  
When stopping this unit, keep the inside of this unit in vacuum.
- (3) Install a vacuum gauge on the way to the auxiliary pump in order to monitor the back pressure.

**CAUTION**

Note that if the diameter of the piping is small or any foreign substances adhere to the inside of the piping when making connection to the outlet side, the back pressure of the pump may increase, causing trouble with the pump operation.

Use an auxiliary pump that has sufficient pumping performance.

### 3.6 Electric Connection

<p><b>IMPORTANT</b></p> 	<p>Loosen the screws of the retainer for the terminal box cover to remove the cover. Slightly twist the cover and you can easily pull it out. Connect electric wires for 200V or 220V to heater terminal shown in Fig. 6. Also check the screws on the heater side for looseness. When connecting wires, be sure to install a safety circuit, such as an electromagnetic switch.</p>
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 <p><b>CAUTION</b></p>	<p>(1) Use of a voltage (200V or 220V) other than that specified is not allowed. (2) For the primary cable, be sure to use heat resistance wires (LKGB, KGB).</p>
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Table 2: Oil diffusion vacuum pump: Current value of ULK series

Model number	Power consumption of heater (KW)	Oil type	Current value (A)*1	
			1φ 200V	1φ 220V
ULK-04A	0.55	ULVOIL D-11	2.8	2.5
ULK-04A	0.73	ULVOIL D-31	3.7	3.4
ULK-06A	0.9	ULVOIL D-11	4.5	4.1
ULK-06A	1.2	ULVOIL D-31	6.0	5.5
ULK-10A	2.0	ULVOIL D-11	10.0	9.1
ULK-10A	2.4	ULVOIL D-31	12.0	10.9
ULK-14A	2.25	ULVOIL D-11	11.3	10.2
ULK-14A	2.4	ULVOIL D-31	12.0	10.9

\*1) Within the range of ±5%

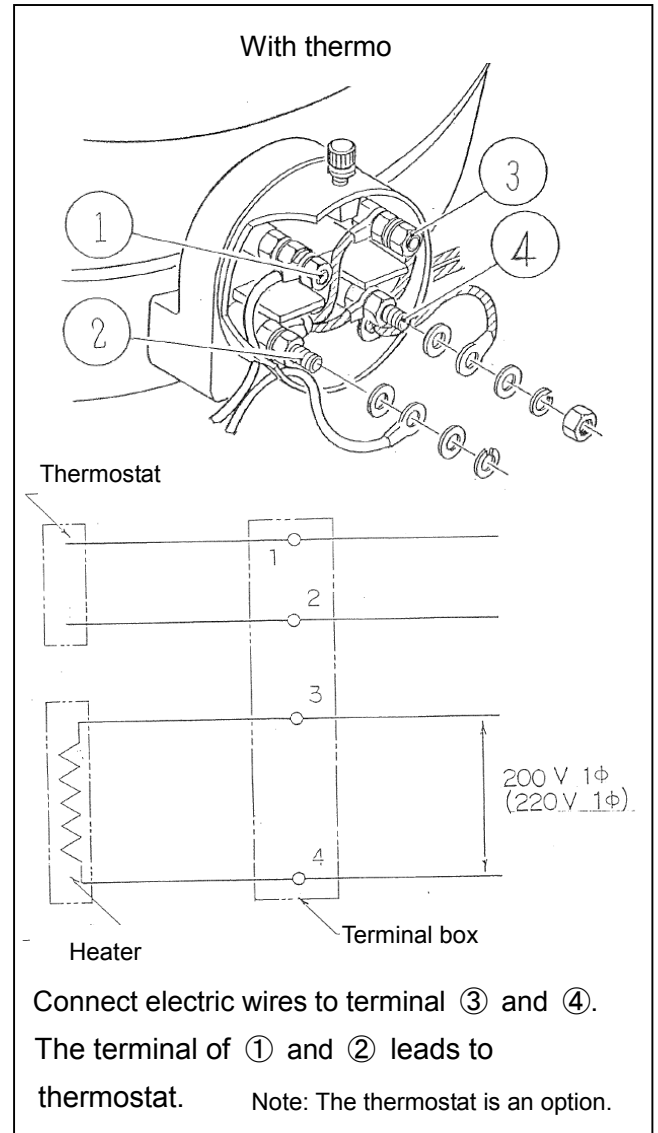
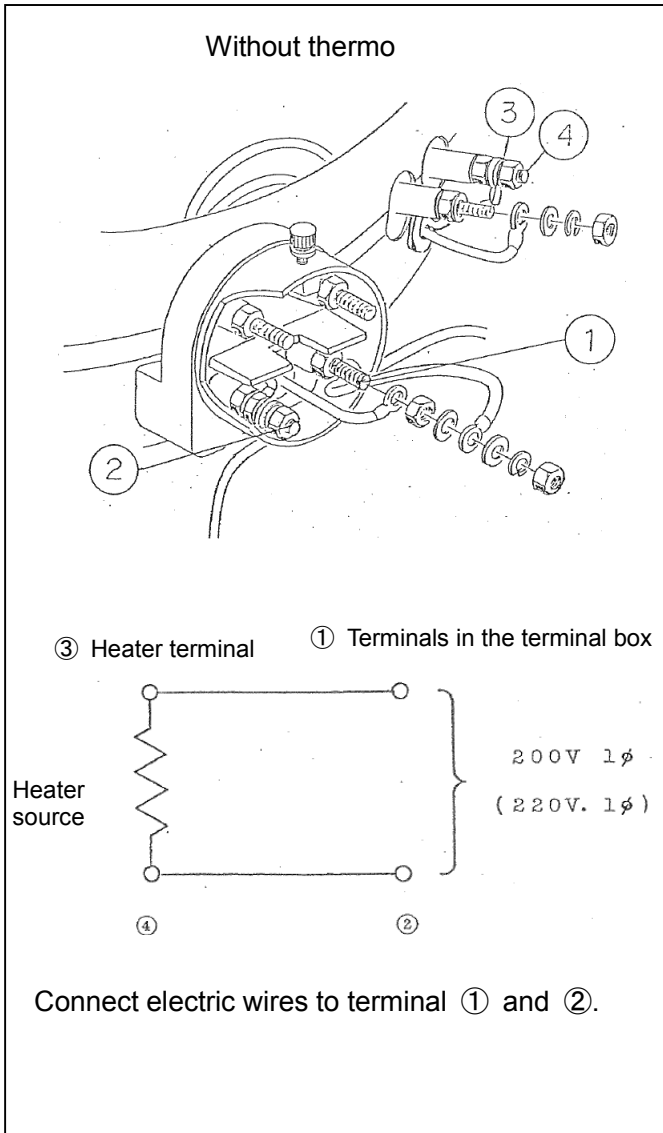
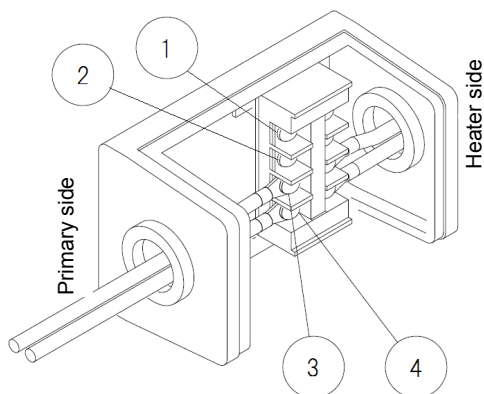
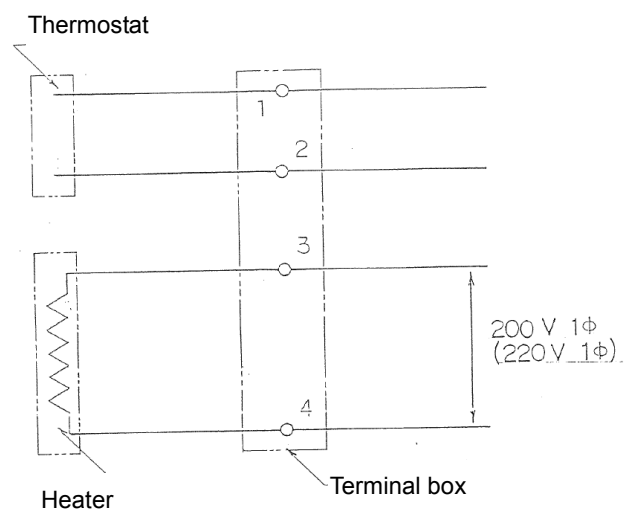


Figure 6: Connection of outside lines to terminal box for ULK-04A/ULK-06A



Connect electric wires to terminal ③ and ④.  
The terminal of ① and ② leads to thermostat.



Note: The thermostat is an option.

Figure 7: Connection of outside lines to terminal box for ULK-10A/ULK-14A

**WARNING**

Install and operate this product according to the local and national safety laws and regulations (such as fire laws and electric wiring code).

**WARNING**

- (1) Before connecting electric wires, be sure to turn off the power switch.  
Never do this work with voltage applied.
- (2) Securely connect to ground. There is a risk of an electric shock in the event of a breakdown or leakage of electricity. In addition, it is recommended to install a dedicated ground-fault interrupter.

**CAUTION**

- (1) Be sure to install overload protective equipment suitable for the heater capacity.  
If overload protective equipment is not installed or it is installed but not suitable for the heater capacity, a heater burnout or fire may occur.
- (2) Do wiring work in compliance with the national construction standards at your site. Wrong wiring work may trigger fire.

## 4. Operation

### 4.1 Operational precautions



For the auxiliary pump, use one that has sufficient pumping capacity.

An extremely high back pressure may cause loss of the pumping action of this unit, leading to a rise of oil (back-flow of oil) to the vacuum chamber or defects in this unit itself.

Do not operate this unit with the outlet clogged or with any equipment installed on the outlet side which prevents gas from passing. The internal pressure (and back pressure) of the pump may increase, causing the pump body and the oil filler and drain ports to burst.

This unit is not pressure-proofed. Do not pressurize under any circumstances because it is dangerous.

Make sure that the valve for evacuation is open before evacuation.  
Make sure that the back pressure and the pressure in the high vacuum section are sufficiently low before operating this unit.



Be sure to supply water during the operation. The required amount of cooling water is as follows:

▪ **Amount of cooling water**

- ULK-04A/D-11(0.55kW) : 1.0 L/min or more
- ULK-04A/D-31(0.73kW) : 1.0 L/min or more
- ULK-06A/D-11(0.9kW) : 1.0 L/min or more
- ULK-06A/D-31(1.2kW) : 1.5 L/min or more
- ULK-10A/D-11(2.0kW) : 2.5 L/min or more
- ULK-10A/D-31(2.4kW) : 3.0 L/min or more
- ULK-14A/D-11(2.25kW) : 2.5 L/min or more
- ULK-14A/D-31(2.4kW) : 3.5 L/min or more

▪ **Cooling water pressure: 0.1~ 0.3MPaG** (Gauge pressure)

▪ **Cooling water temperature: 19 ~ 25°C**



- (1) Depending on the use, the vacuum pump oil may deteriorate in a quite short period of time.  
It is recommended to do the first replacement of the vacuum pump oil within 10 days, evaluate the degree of contamination of oil, and then determine the oil replacement cycle.
- (2) If the pump suctions a large amount of water etc., replace the oil frequently. Continuous use of the pump with water suctioned accelerates corrosion of the pump part, which may result in defects.  
Do not store with water suctioned.
- (3) If it has suctioned chemical agents, such as acid, replace oil immediately after the suction since it is possible that the pump part is being corroded causing defects during one-night downtime. Durability to withstand chemical agents is not guaranteed.
- (4) Pay attention to increase in suction gas due to leakage from the outside, gas emitted from the workpiece, etc.
- (5) An extremely high back pressure may cause loss of the pumping action of this unit, leading to a rise of oil to the vacuum chamber.
- (6) When you pumping a lot of gas and drive with back pressure being high, oil may decrease early. Because there is individual difference to the limit quantity that can exhaust gas, the decrease of the oil changes.



## 4.2 Operation start

Check the following items again before operating the pump.

(1) Check that the piping and wire connections are complete.

(2) Leak check

The pump-specific leak check is performed by a helium leak detector.

The detectable minimum leak is  $6.5 \times 10^{-11}$  Pam<sup>3</sup>/s ( $5 \times 10^{-10}$  Torr·L/s).

For leakage from the flange connections on the high vacuum side or the other parts, follow the procedure below.

1. Check the presence of leakage with the helium leak detector.

2. If you do not have a helium leak detector, apply an organic solvent, such as a volatile substance like alcohol, to the seal area and check the pressure variation on the ionization gauge.

(3) Oil level check

Be sure to pour the specified amount of oil using a graduated cylinder etc. (See Section 3.2: Oil filling.)

(4) Cooling water flow rate check

Check that the cooling water is flowing at a flow rate equal to or more than that shown in table 1.


In addition, check that no cooling water leakage occurs.

(5) Operation of auxiliary pump


Close the main valve and do the rough-pumping of the vacuum chamber, diffusion pump, and connection piping to 13 to 1.3Pa (0.1 to 0.01 Torr).

(6) Turn on the power to the heater. If water cooling baffles, L-N traps, and valves are set at the top of the inlet port of the oil diffusion pump in use, close the valves, supply cooling water to the water cooling baffles and pour liquid nitrogen into the L-N traps.

(7) Check that a given flow rate of cooling water flows.

WARNING

**You may get burned. Do not touch the pump body and piping because they become high in temperature during the pump operation.**



- (1) Do not turn on the power to the heater with no supply of cooling water.

Turning on the power to the heater without supplying cooling water may cause damage to the pump as follows:



1. A break is caused in a heater cable.
2. Solder on the cooling water piping dissolves and falls.
3. Parts, such as the pump case and the jet, are damaged.
4. Oil is consumed or degraded faster, or burned.
5. Oil scatters to the high vacuum section, contaminating the chamber etc.

- (2) Be sure to supply a specified amount of cooling water and install an interlock that activates when the flow rate becomes insufficient. No supply of cooling water may cause damage to the pump or remaining water in the pump to evaporate to increase the pressure in the cooling system, causing high temperature steam to spout.

- (1) Do not turn on the power to the heater if the inside of the pump is at a pressure of  $1$  to  $3 \times 10^3$  Pa (a few Torr) or higher. Oil is oxidized, making a low ultimate pressure unable to reach.

- (2) If an amount of gas equal to or higher than the maximum throughput is fed through the pump or if the auxiliary pressure becomes higher than the critical back pressure, the pump stops evacuation.

Under this condition, oil may spout scattering to the inlet and outlet ports, contaminating the oil in the high vacuum system above the pump.



- (3) If oil heated during the operation is exposed to the atmosphere (in the event of an inflow of a large amount of air due to an accident etc.), the oil is oxidized and decomposed, which degrades the ultimate pressure of the pump.

Take great care during the operation that this kind of accident does not occur.

If it occurs, it is necessary to immediately close the valve on the air inlet side to exhaust the air introduced to the inside of the pump.

If the exposure time to the atmosphere is within a few minutes, the pump recovers to the original state after operation for a few hours in many

cases but, in the worst case, the oil must be replaced. For replacement of oil, see Section 3.2 Oil filling.

### 4.3 Operation stop

- (1) Turn off the power to the heater switch of the oil diffusion pump.
- (2) Close the valves on the inlet (above this unit) and outlet (below this unit) sides.  
If no valves are supplied, continuously operate the oil rotary pump for approx. 70 minutes until the oil temperature becomes 150°C or lower.
- (3) Stop the oil rotary pump Release the oil rotary pump to return to the atmospheric pressure.
- (4) Turn off the heater switch. After 70 minutes, stop the cooling water.  
Do not stop the cooling water because it may cause damage to the pump immediately after the heater switch is turned off.
- (5) If the operation stops and the ambient temperature becomes 5°C or lower, drain the water in the cooling water system.  
(Supply compressed air of 0.3MPaG (gauge) from the cooling water inlet port without stopping the cooling water outlet port.)  
If water is accumulated, it may be frozen and the cooling water pipe may be damaged.

**WARNING**

**During the operation the vacuum pump becomes high in temperature. Even after it stops, do not touch the pump body and boiler cover until they are cooled. Provide protection to avoid surface contact as necessary. Note that the heater and the internal jet take time to be cooled down.**

**CAUTION**

**To release air into the unit or the pump, make sure that it always enters from the high vacuum side. Never make it enter from the outlet port side. To make air enter from the outlet port side unavoidably, slowly do it.**

## 5. How to Handle Thermostat (Option)

### Thermostat

- (1) Set temperature: :250°C(ULK-04A,ULK-06A)  
180°C(ULK-10A,ULK-14A)
- (2) Contact arrangement: Open at set temperature (NORMAL CLOSE)
- (3) Switching capacity: 1,000W AC115/220V

A thermostat attached to the ULK series as an option is a device in which a contact is opened/closed by the thermal expansion of a metal cylinder.

Do not supply power equal to or higher than the switching capacity when in use.

When the contact of the thermostat is opened, arrange a circuit that shuts off the power to the heater. If the thermostat is activated to shut off the power to the heater during the pump operation, remove the cause of the abnormal increase in temperature (shortage of cooling water or oil, suspension of water supply, etc.) and then turn on the power to the heater. Note that turning on the power to the heater without removing the cause may cause defects.

Please refer to Clause 3.6 for the connection method.



**WARNING**

**The thermostat does not ensure detection of cooling water shortage.**

**An interlock for cooling water needs to be installed separately.**

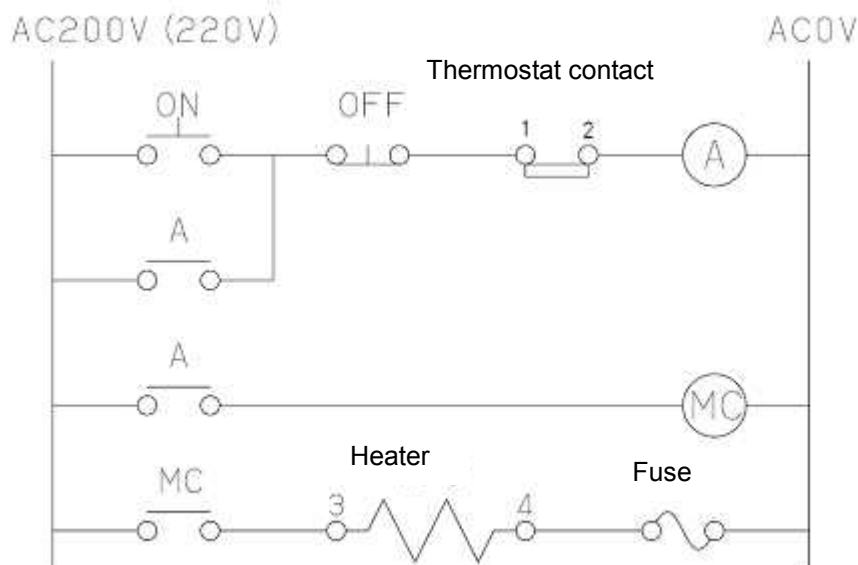


Figure 8: Example of thermostat connection circuit

## 6. Maintenance/ Inspection


### 6.1 Maintenance

- (1) During the operation, check the following items at least once every three days.
- (2) Is the oil level sufficient? (See Section 2.2 Performance specifications.)
- (3) Is the vacuum pump oil discolored?
- (4) Does a specified amount of cooling water flow? (See Section 2.2 Performance specifications.)
- (5) Is there any point of water leakage?
- (6) Is there an anomaly in the current value? (See Section 2.2 Performance specifications.)
- (7) Is there any anomaly in the ultimate pressure in the vacuum area higher than this unit, and in the ultimate pressure of the auxiliary pump?
- (8) Half once a year, please confirm that wiring and a terminal do not have the changes such as a change of color, rust, the gossan.


### 6.2 Periodical Inspection


The inspection items depend on the use conditions of the vacuum pump but periodically check the following items.

It is effective for avoiding defects or extending the pump life.


WARNING


**The pump stays at higher temperatures for a while after stopped, which may get you burned.  
Make sure that the pump body and piping is sufficiently low in temperature before touching.**





DANGER

**If it is used to exhaust hazardous gas, it goes without saying that not only the pump body but also the pump oil will be toxic. Take due care.**



CAUTION

**Wear protective equipment, such as rubber gloves and protective glasses.**



**Before starting the oil filling work, read "1.2 Material Safety Data Sheet" in advance. In the event that the vacuum pump oil contacts your hands or enters your eyes, follow the section about emergency measures in the Material Safety Data Sheet.**

**CAUTION**

Use oil we specify. Use of oil other than those specified may cause the pump performance to deteriorate or the life to be shortened.

### 6.2.1. Oil level

In oil replacement, be sure to pour the specified amount of oil using a graduated cylinder etc. Model No. ULK-10A and ULK-14A are equipped with inspection windows.  
Model No. ULK-04A and ULK-06A are not equipped with inspection windows.

### 6.2.2. Inspection of vacuum pump oil

The vacuum pump oil is not only contaminated by suction gas but also degraded gradually as the temperature increases during the pump operation. Check the degree of dirt and the oil condition, and replace oil periodically.

If the pump oil gets mixed with low-boiling substances (water, organic solvents, etc.) or if sludge accumulates at the bottom of the pump case, the ultimate pressure is not recovered even after replacement of oil and an overhaul is necessary.

### 6.2.3. Oil replacement

For ULK-04A, ULK-06A



#### Drain of working fluid

- (1) After stopping the pump following Section 4.3, check that the pump and oil are at a normal temperature again and then return the pressure in the pump to the atmospheric pressure.
- (2) Prepare a container of approx. 0.5L.
- (3) Pull out the nozzle in reference to Section 6.2.4.
- (4) After pulling out the nozzle, set the pump case to a horizontal position and drain the hydraulic fluid from the air inlet.
- (5) Return the nozzle to the pump in reference to Section 6.2.4.

#### Oil filling

- (1) Pour the specified amount of oil from the air inlet.
- (2) If the given ultimate pressure is not obtained even after the oil is replaced, sediments including sludge has accumulated in the pump case in some cases.  
In such a case, an overhaul is necessary.  
Please contact the nearest service center described at the end of this document.

**For ULK-10A,ULK-14A****Drain of working fluid (See Fig. 9)**

- (1) After stopping the pump following Section 4.3, check that the pump and oil are at a normal temperature again and then return the pressure in the pump to the atmospheric pressure.
- (2) Prepare an aluminum foil (approx. 100 × 160) and attach it as shown in (B).
- (3) Prepare a container of approx. 2L and place it under the drain.
- (4) Remove the hexagon bolt ④, remove the inspection window flange or the closure flange ② and metal gasket ③, and then drain the oil.
- (5) Attach a new metal gasket ③.  
When attaching it, see the instructions on how to tighten the metal gasket.

**How to tighten metal gasket (ConFlat type)**

- (1) Before attaching copper gasket, check that there are no flaws on the sealing surface.  
If you get snagged on a flaw when moving your nail tip in the circumferential direction, it is harmful to air tightness.
- (2) Wipe the sealing surfaces of the flange and the gasket well with alcohol.
- (3) Before tightening, apply a molybdenum disulfide lubricant to all the bolt screw parts.
- (4) Tighten the four bolts by hand to fix the gasket.
- (5) Fully tighten the remaining bolts.
- (6) Additionally tighten all tightening bolts in order in in a crisscross and symmetrical pattern using a torque wrench to an even torque.  
Apply the torque according to the process below.  
1st: Tightening torque of 5N·m  
2nd: Tightening torque of 10N·m  
3rd: Tightening torque of 12N·m  
4th: Tightening torque of 12N·m
- (7) If the leakage does not stop even after they are tightened to a torque of 12N·m, additionally tighten them to 15 N·m.  
If the leakage does not stop yet, remove the flange and check the sealing part.  
A gasket once tightened is not allowed to reuse. When the flange is removed, replace the gasket with new one.  
The major causes of incomplete sealing are listed as follows:
  - 1) There are flaws on the sealing surface.
  - 2) Cracks on the gasket or contamination

**Oil filling (See Fig. 9)**

- (1) Remove the cap nut ⑤.
- (2) Remove the packing retainer ⑥ and the metal packing ⑦.
- (3) As shown in (D), set a clean funnel at the oil filler port.
- (4) Pour a specified amount of oil.
- (5) After the completion of oil filling, attach the cap nut ⑤, packing retainer ⑥, and metal packing ⑦.

Be sure to replace the metal packing ⑦ with new one.

Tighten the cap nut to a tightening torque of 120 N·m.

- (6) If the given ultimate pressure is not obtained even after the oil is replaced, sediments including sludge has accumulated in the pump case in some cases.

In such a case, an overhaul is necessary.

Please contact the nearest service center described at the end of this document.

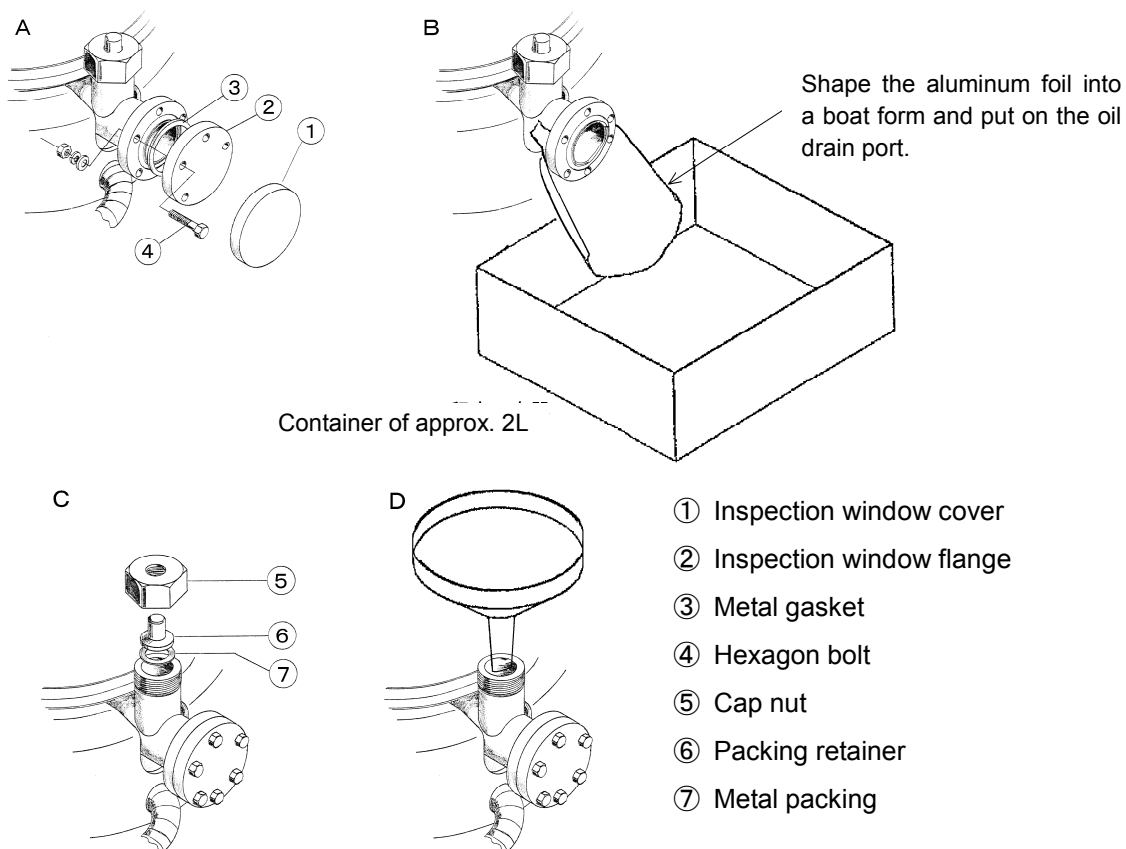


Figure 9: Oil replacement instruction diagram



**Oil leak check**

In the event of oil leakage from the oil filler or drain ports etc., the gasket needs to be replaced and re-tightened.

The seals used for this unit are available at the nearest service center described at the end of this document. Please contact the center.



- (1) **Never scratch the sealing surface with extreme care.**
- (2) **Carefully wipe the sealing surfaces of the flange and the gasket before assembling clean and dry with alcohol.**  
**Wear clean nylon gloves to avoid touching by bare hands.**
- (3) **After putting the companion flange on, do not move the flange.**
- (4) **A gasket once tightened is not allowed to reuse.**  
**When the flange is removed, replace the gasket with new one.**
- (5) **Be sure to apply molybdenum disulfide before tightening the bolts.**  
**Otherwise the bolts seize up and become unable to be removed.**
- (6) **Do not tighten the tightening bolts to higher than 15 N·m.**



### 6.2.4 Disassembling of pump

If a large amount of tar substance adheres to the nozzle surface or the inside surface of the pump case, it is necessary to disassemble and clean the pump.

#### For ULK-04A, ULK-06A

Removal of pump from line

- (1) Remove the electric wires from the terminal box.
- (2) Remove the thin flex tubes for cooling water.
- (3) Remove the tightening bolts for the inlet and outlet port flanges embedded in the system.
- (4) Place the removed pump on a flat surface.

#### Removal and disassembling of nozzle (See Fig. 10.)

- (1) Pull up the air inlet gasket.
- (2) Remove the screw ① attached to the latch of the cold cap ⑤.  
Pull out the expansion ring retainer ③ and the expansion ring ②.
- (3) Take up the nozzle ring ④.  
Also remove the cold cap ⑤, bearing case ⑥, bearing ⑦, and shaft ⑧.
- (4) Hold the 1st steam tower ⑬ just under the hot cap ⑫ and pull up the nozzle ⑨.
- (5) Remove the fractionating plate ⑩ and the nozzle fixing ring ⑪.  
In ULK-04A, the nozzle fixing ring ⑪ and the fractionating plate ⑩ are integrated.
- (6) For the nozzle system, pinch the 1st steam tower ⑬ with your fingers and turn counterclockwise. Then the upper and lower parts split.  
See Figure 11.
- (7) The upper part can be removed by turning the hot cap ⑫ counterclockwise.
- (8) The steam tower can be disassembled into pieces by removing the hexagon nut ⑬.
- (9) When the hexagon nut ⑮ is loosened, the 2nd steam tower ⑳, the 3rd steam tower ㉑, the 4th steam tower ㉒, and the 5th steam tower ㉔ are removed.

No.	Name
1	Cross-recessed panhead machine screw M4 × 5
2	Expansion ring
3	Expansion ring retainer
4	Nozzle ring
5	Cold cap
6	Bearing case
7	Bearing ※1
8	Shaft ※1
9	Nozzle
10	Fractionating plate ※2
11	Nozzle fixing ring ※2

\*1: The bearings and the shaft are swaged.

\*2: In ULK-04A, the nozzle fixing ring and the fractionating plate are integrated.

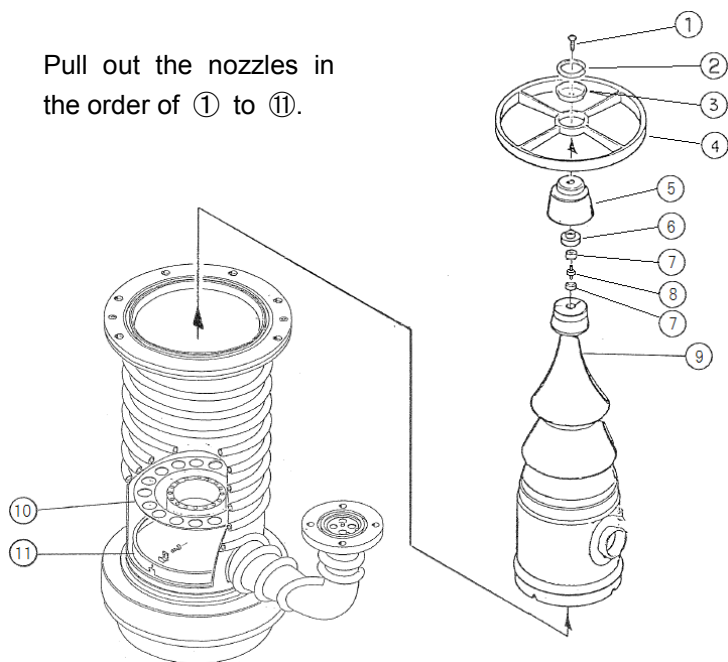
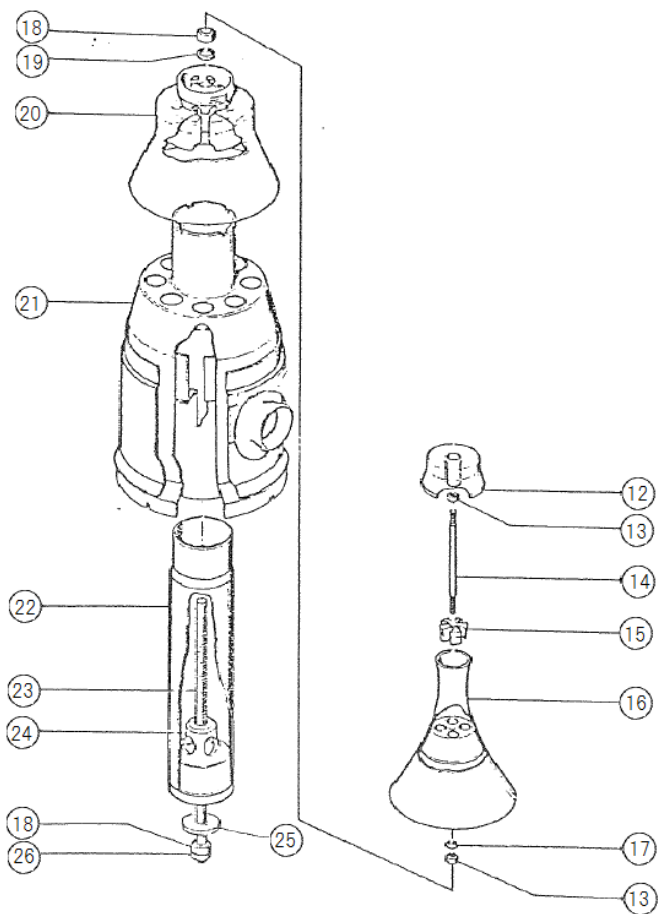


Figure 10: Nozzle pull-out instruction diagram for ULK-04A, ULK-06A



No.	Name
12	Hot cap
13	Hexagon nut M5
14	Screw
15	Fixing ring (A) ※3
16	1st steam tower
17	Spring washer M5
18	Hexagon nut M8
19	Spring washer M8
20	2nd steam tower
21	3rd steam tower
22	4th steam tower
23	Long bolt
24	5th steam tower
25	Washer ※4
26	Hexagon nut M8: 3 types

\*3: Shims for clearance adjustment are inserted in some cases.

\*4: Dedicated washers.

Figure 11: Exploded diagram of nozzle for ULK-04A, ULK-06A

**For ULK-10A,ULK-14A**

Removal of pump from line

- (1) Remove the electric wires from the terminal box.
- (2) Remove the thin flex tubes for cooling water.
- (3) Remove the tightening bolts for the inlet and outlet port flanges embedded in the system.
- (4) Place the removed pump on a flat surface.

**Removal and disassembling of nozzle (See Fig. 11.)**

- (1) Remove the hexagon socket head bolt ②, hexagon nut ③, and plain washer ①.
- (2) Remove the hexagon nut ④ (hexagon socket head bolt for ULK-10A), plain washer ⑤, cold cap support (C) ⑥, and cold cap support beam (B) ⑦.
- (3) Remove the hexagon socket head bolt ⑨, and then remove the plain washer ⑩, spacer ⑪, cold cap ⑫, and spacer ⑬ in order from top.
- (4) Turn the lower part of the 1st steam cylinder ⑭ and remove it.
- (5) Remove the shim (1) ⑮, 2nd steam cylinder ⑯, and shim (2) ⑰.
- (6) Pull up the back-flow check link ⑱.
- (7) Loosen the cross-recessed round machine screw ⑲ and displace the ejector protection ring in the direction of the 3rd steam cylinder ⑳.
- (8) Pull up the 3rd steam cylinder ㉑.
- (9) Pull up the 4th steam cylinder ㉒.
- (10) Remove the hexagon nut (23), plain washer ㉔.
- (11) Pull up the 5th steam cylinder (25).
- (12) Remove the long bolt (26), hexagon nut (27).
- (13) If the 1st steam cylinder needs to be disassembled into smaller pieces, see Fig. 12.

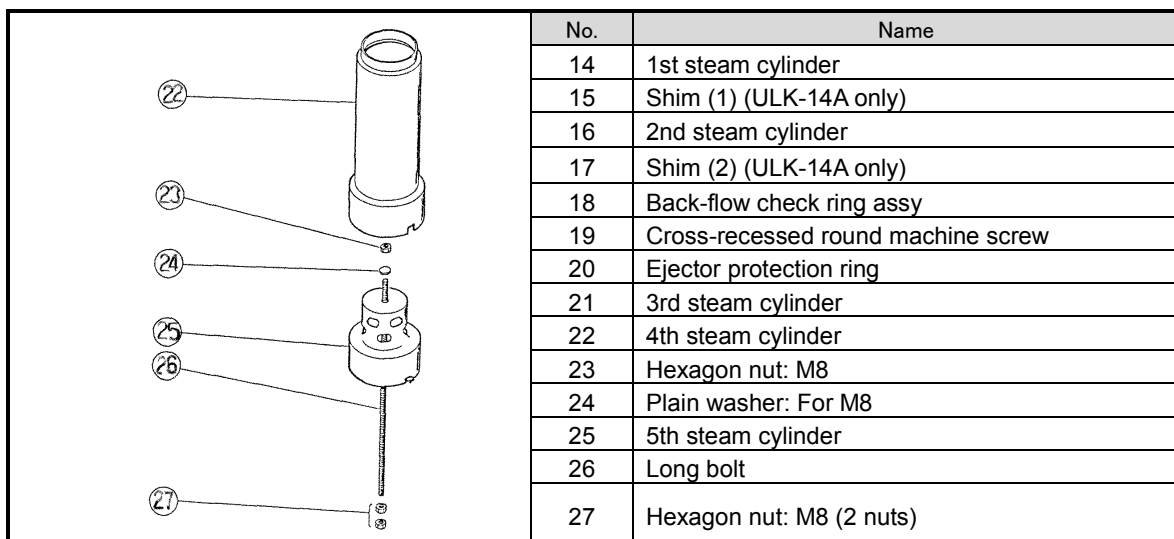
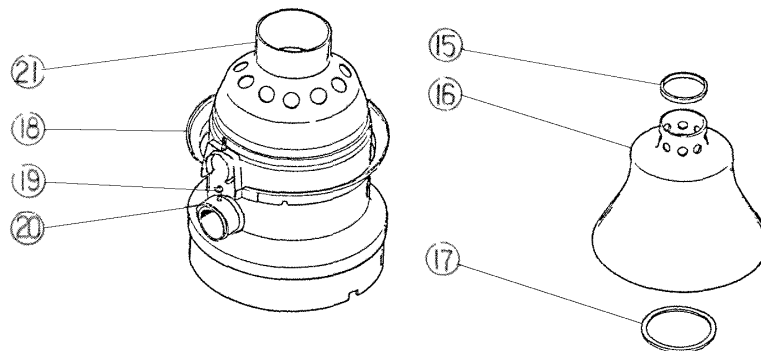
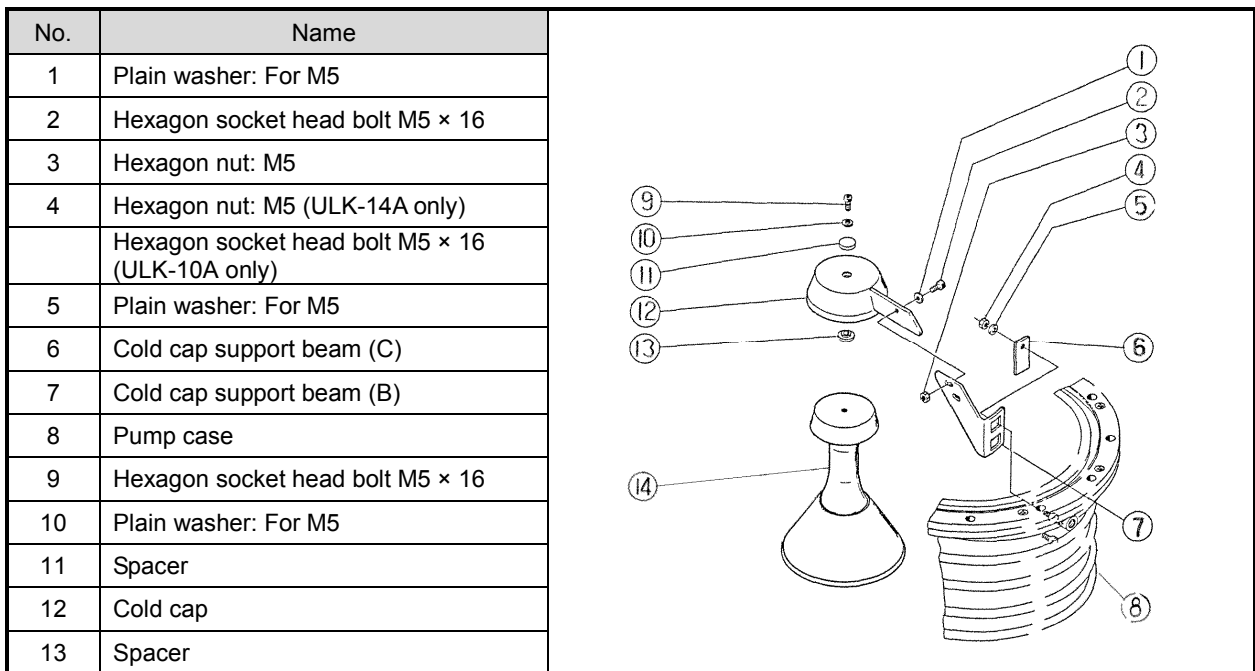


Figure 12: Exploded diagram of nozzle for ULK-10A, ULK-14A

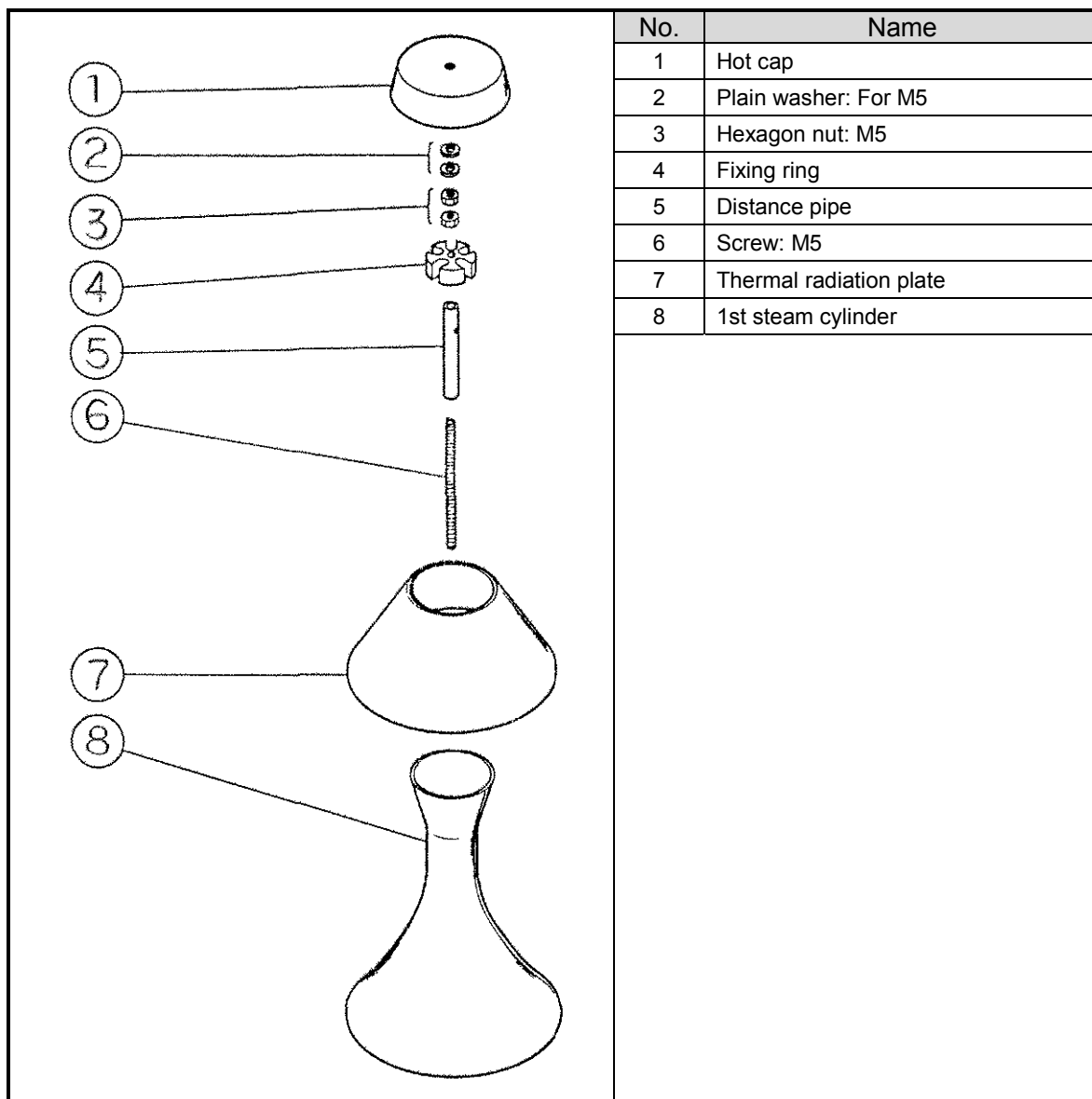


Figure 13: Exploded diagram of 1st steam cylinder for ULK-10A, ULK-14A

### 6.2.5 Cleaning of pump

For the pump case / disassembled nozzles and gaskets, clean them with alcohol.

**CAUTION**

- (1) Wear clean nylon gloves to avoid touching by bare hands.
- (2) Be sure to be in a well-ventilated place when cleaning the nozzle.
- (3) If the vacuum piping with the pump removed is dirty, clean it too.

### 6.2.6 Assembling of nozzle

Assemble the nozzles in reference to Figs. 10 to 13 in the reverse order of disassembling of the nozzles. However, pay attention to the following:

#### For ULK-04A,ULK-06A

When inserting the nozzles into the pump case,

set them so that the four set screws on the fixing ring are inserted into the outermost notches on the nozzles.

At this point, set them so that the ejector nozzle is positioned on the air outlet side.

#### For ULK-10A,ULK-14A

- (1) Set the notches at the lower part of the 5th steam cylinder (25), 4th steam cylinder (22), and 3rd steam cylinder (21) to be perpendicular to the air outlet port of the pump case (8).
- (2) Do not excessively tighten the hexagon nut (23).  
If it is excessively tightened, the 5th steam cylinder may deform.
- (3) When screwing the 1st steam cylinder (14) into the long bolt (26), hold the lower part of the 1st steam cylinder (14) and slightly turn it clockwise.  
Also for the same reason above, do not excessively tighten this. If it is excessively tightened, the 2nd steam cylinder (16) may deform.
- (4) Tighten the hexagon socket head bolt (9) just slightly by hand.

**CAUTION**



Be sure to wear clean nylon gloves before assembling the nozzles.

**6.2.7 Attachment of pump in the line**

- (1) Pour the specified amount of oil from the air inlet or outlet.
- (2) Attach the air inlet flange and the air outlet flange in the line.
- (3) Attach the thin flex tubes for cooling water.
- (4) Connect the electric wires to the terminal box. (See Fig. 4.)





**6.2.8 Removal of heater**



The heater replacement should follow the heater replacement instructions.

It is basically recommended to request a service center to replace the heater.






- (1) The pump is stopped.
- (2) The temperatures of the pump and the heater is close to the ambient temperature.
- (3) The primary power cable is disconnected.

Check these and then replace the heater.

The heater replacement should follow the heater replacement instructions.

It is basically recommended to request a service center to replace the heater.



**For ULK-04A,ULK-06A**

See Figs. 14

For replacement of the heater, it is necessary to provide a work area with enough volume for that work. For the volume below the pump, see the external dimensions (Figs. 2, 3).

- (1) Shut off the power to the heater. After the pump is sufficiently cooled down, remove the electric wiring between the main and auxiliary terminals.
- (2) Remove all connecting terminals for wire connections to the heater in the terminal box.
- (3) Remove the nuts attached to the center of the bottom of the boiler and remove the heater cover.
- (4) Removal of the nut in 4-2 allows you to remove the reflector ⑤, whereas removal of the other nut in 4-1 allows you to remove the heater ②.
- (5) Remove the thermo cement adhering to the bottom of the pump case.

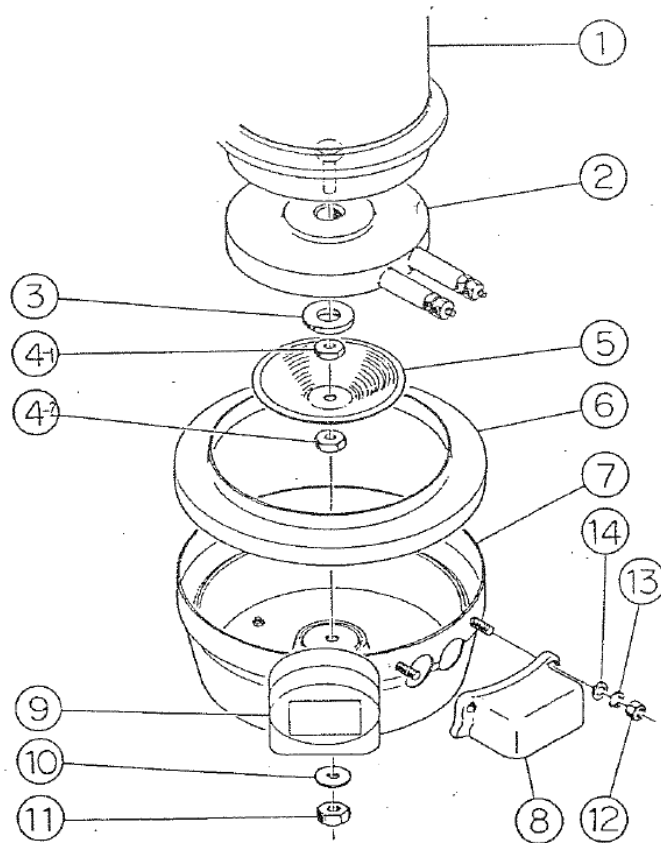


Figure 14: Diagram on removal of heater of ULK-04A, ULK-06A

**For ULK-10A, ULK-14A**

See Figs. 15, 16.

For replacement of the heater, it is necessary to provide a work area with enough volume for that work. For the volume below the pump, see the external dimensions (Figs. 4, 5).

(1) Figure 16

Remove all connecting terminals for wire connections in the terminal box.

(2) Figure 15

Remove the screws at the top of and before and after the boiler cover, and then remove the heater cover.

(3) Figure 15

Removal work can be done in the reverse numerical order. Assembling work can be done in the numerical order.

Also for the removal process of the heater, see the nut numbers shown in Figure 16.

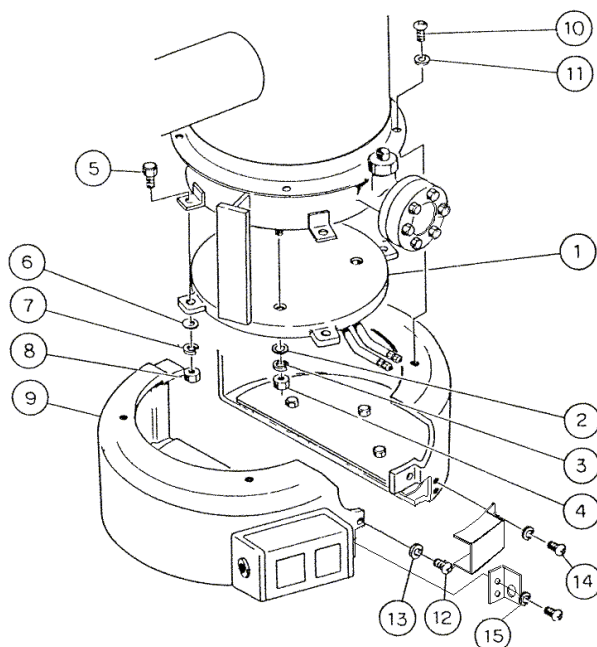


Figure 15: Removal of heater of ULK-10A, ULK-14A

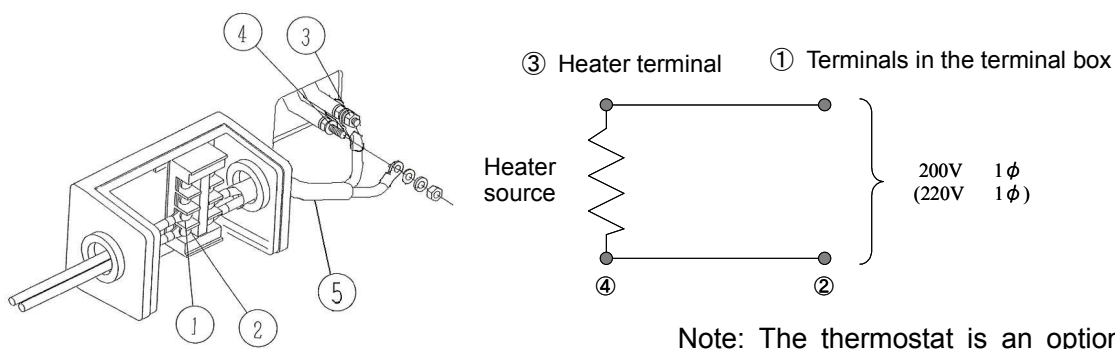


Figure 16: Wiring work instructions in terminal box for ULK-04A, ULK-06A

## 6.2.9 Attachment of new heater

### For ULK-04A,ULK-06A

See Figs. 14

- (1) On the side where the heater pump is attached, spread evenly thermo cement of 1 to 2mm in thickness across the front surface.
- (2) Set the heater ② to the mounting position and securely tighten the nut 4-1.
- (3) Remove the thermo cement coming out of the joint surface between the heater and the pump.
- (4) Attach the reflector ⑤ and securely tighten nut 4-2.
- (5) Attach the heater cover in an oblique direction so that the heater terminals are put in the holes of the heater cover.  
Use molybdenum disulfide to prevent it from being seized up in attachment of the hexagon nuts 4-1, 4-2 (11).
- (6) Carry out the wiring in the terminal box. After that, connect the wires from the switch board.  
Note that if heated under the condition where the thermo cement is not dried enough, the cement spout, resulting in an improper condition.

**For ULK-10A,ULK-14A**

See Figs. 15, 16.

(1) Figure 15

Attach the parts ① to ⑮ in the numerical order.

At this point, spread evenly thermo cement of 1 to 2 mm in thickness across the side where the heater pump is attached.

Remove the thermo cement coming out of the joint surface between the heater and the pump.

(2) Figure 16

Connect the lead wires of the heater (the two lead wires from the terminal box) to the heater terminal.

(3) Figure 16

Cover the glass wool tube ⑤ on the lead wires of the heater.

Draw the lead wires of the heater into the terminal box and carry out wiring according to Fig. 17.

(4) Connect the wires on the primary side.

Note that if heated under the condition where the thermo cement is not dried enough, the cement spout, resulting in an improper condition.

### 6.3 Inspection after storage for long period of time

If the vacuum pump is stored for a long period of time without operation, it may not work properly due to occurrence of rust etc. If it has not been used for a long period of time, make a request of your nearest service center to perform inspections.

### 6.4 Overhaul

The inspection items are as mentioned above. However we recommend periodical overhauls under the condition where the pump is polluted or its performance deteriorates excessively depending on the service conditions.

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

For overhauls, contact your nearest service center described at the end of this document.

Note that you are requested to complete and submit the pollution certificate attached to the end of this document.



**Carry out an overhaul once a year.**

**In addition, if the pump is polluted or its performance deteriorates excessively under your service conditions, carry out an overhaul even if it is within one year.**

**In an overhaul, at least the parts described in "9. Main replacement parts" need to be replaced.**

## 6.5 Trouble check list

Table 3: Trouble check list

Problem	Cause	Measure	Ref.
Pressure does not decrease.  Pressure varies	(1) Improper wire connections	(1) Check the wire connections.	0.6 3.6
	(2) Improper setup of safety circuits for electromagnetic switches etc.	(2) Set the safety circuits to the heater specifications.	0.6 3.6
	(3) A break in a wire of the heater	(3) Replace the heater.	6.2.8~ 6.2.9
	(4) No oil or low oil level	(4) Supply oil. (Disassemble and inspect in the case of heating without water.)	3.2 6.2.1~ 6.2.7
	(5) Contamination of oil	(5) Replace oil. Overhaul if sludges or moisture exists	3.2 6.2.1~ 6.2.7
	(6) Oil seized up	(6) Disassembling, cleaning Overhaul	3.2 6.2.1~ 6.2.7
	(7) Excessive temperature rise or insufficient heating	(7) Recheck for the surrounding environment and the utilities	0.5.3 2.2 3
	(8) Wrong oil	(8) Overhaul	3.2 6.2.1~ 6.2.7
	(9) Leaking	(9) Check the flange connection and each part of the piping using a leak detector for leakage. Repair the point of leak.	3.4~ 3.5
	(10) Gas feed more than the exhaust capacity of this system	(10) Review of exhaust system	

Problem	Cause	Measure	Ref.
Pressure does not decrease.  Pressure varies	(11) The pipe diameter in the section to the ancillary pump.	(11) Use pipes with a sufficient conductance.	3.4~ 3.5
	(12) The valves on the high vacuum and ancillary pump sides are closed.	(12) Open the valves.	3.4~ 3.5
	(13) The exhaust capacity of the ancillary pump is low.	(13) Review of exhaust system	2.2
	(14) A condensable gas, such as vapor and solvents, has been sucked.	(14) Replace oil. Overhaul	3.2 6.2.1~ 6.2.7
	(15) Is it left for 15 or more minutes after the power to the heater is turned on?	(15) Wait until the pump becomes hot.	
	(16) The heater cement has deteriorated.	(16) Replace the heater cement.	6.2.8~ 6.2.9
	(17) The pressure measurement method is wrong.	(17) Measure the pressure properly.	
	(18) The exhaust performance of the ancillary pump is decreased.	(18) Measurement of the ultimate pressure etc. of the ancillary pump Overhaul of ancillary pump	
	(19) The vacuum gauge is not appropriate.	(19) Make measurements in the proper pressure zone using a properly calibrated vacuum gauge.	
	(20) The pipes connected to the air inlet are thin or the distance is long.	(20) Make connections with pipes of the diameter similar to the air inlet to shorten the distance to the vacuum chamber.	3.4~ 3.5
(21) Oil, grease, or dirt adheres to the inside of the pipes on the high vacuum side, flanges, etc.	(21) Cleaning of pipes etc.		

Problem	Cause	Measure	Ref.
Cooling water does not flow at the specified quantity.	(1) The connectors in use are small in inner diameter.	(1) Connector	3.3
	(2) Cooling water pipes are thin.	(2) Replace the cooling water pipe with a thick one.	3.3
	(3) Cooling water pipes are long.	(3) Shorten as much as possible.	
	(4) The water pressure is low.	(4) Use a compressor.	3.3
	(5) A pipe for the pump body is clogged because calcium etc. sediments inside.	(5) Clean the inside of the pipe.	
	(6) Cooling water contains impurities.	(6) Install a filter. A pipe in the pump body is clogged, clean the inside of the pipe.	
	(7) Connected in series with other cooling water pipes.	(7) Take cooling water from the very source as much as possible.	
	(8) A pipe in the pump body is crushed.	(8) Repair	
	(9) A cooling water pipe is broken.	(9) Replace the cooling water pipe.	
Water leakage	(1) Loosened or yet-to-be-tightened cooling water joints	(1) Service and repair of joints	
	(2) A pipe in the pump body is crushed.	(2) Repair	

Problem	Cause	Measure	Ref.
The thermostat reacts.  Note 1 The thermostat is an option.  Note 2 The thermostat cannot be used to detect cooling water shortage.	(1) Low oil level No oil Being heated without water	(1) Supply oil. Disassemble and inspect in the case of heating without water. Overhaul	3.2 6.2.1~ 6.2.7
	(2) High surrounding environment temperature	(2) Recheck for the surrounding environment and the utilities	0.5.3 2.2 3
	(3) The are around the pump is covered.	(3) Provide better ventilation.	
	(4) Low cooling water level	(4) Feed the specified amount of cooling water.	3.3
	(5) High cooling water temperature	(5) Use a chiller etc.	3.3
	(6) Heater cement has deteriorated.	(6) Apply heater cement again.	6.2.8~ 6.2.9

## 7. Disposal

When disposing of the vacuum pump, follow the laws and the regulations of local government. Especially after the exhaust of toxic gas, please ask a professional company to dispose of the pump. Note that the disposal cost shall be borne by the customer.



- (1) Especially after the exhaust of hazardous gas on a human body, please ask a professional company to dispose of the pump. Not only the pump body but also the pump oil become toxic.
- (2) Dispose of the pump oil following the "DISPOSAL CONSIDERATIONS" section in the "1.2 material safety data sheet."



## 8 Warranty Clauses

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

### 8.1 Warrantable Items

- (1) Oil Diffusion Pump: ULK-04A / ULK-06A / ULK-10A / ULK-14A

### 8.2 Duration of guarantee

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

### 8.3 Warrantee scope

- (1) Domestic business in Japan:
  - Product, which has damage, caused by a failure on delivery.
  - Products not satisfying the standard specifications although the product is used under the service conditions described in this document such as temperature range and power etc.
- (2) Direct export transaction:
  - Product, which has damage, caused by a failure on delivery.
  - The warrantee scope shall confirm to INCOTERMS2000.
  - Products not satisfying the standard specifications although the product is used under the service conditions described in this document such as temperature range and power etc.

## 8.4 Response procedure

(1) Domestic business in Japan:

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

(2) Direct export transaction:

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

## 8.5 Disclaimer

(1) Failure occurred after expiration of warranty period

(2) Failure caused by force majeure, such as fire, storm and flood damage, earthquake, lightning strike, war etc.

(3) Failure occurred due to carelessness handling or faulty usage.

(4) Products remodeled, disassembled or repaired without ULVAC's acceptance

(5) Failure occurred under abnormal environment, such as intense electromagnetic field, radiation, high-temperature, high-humidity, flammable gases, corrosive gases, dust etc.

(6) Failure occurred by noise.

(7) Product deficiency or secondary indemnification occurred to Buyer.

(8) Product deficiency or secondary indemnification occurred to Buyer, from law suit to ULVAC by third party for patent infringement.

(9) The reason of the failure deemed below the specified usage condition by ULVAC technical staff.

The normal service conditions are as follows:

(a) Operating atmospheric temperature: 10 to 40°C

(b) Type and temperature of exhaust gas: Dry air or dry nitrogen; 0 to 40°C

(c) Operation in compliance with instructions manual

(10) Consumable parts.

## 9 Main Replacement Parts

Table 4: List of main replacement parts

		Material	Shape/Dimensions	Remarks
Air inlet gasket	ULK-04A	Nitrile rubber or fluorine-contained rubber	4 × 4 × I.D120	
	ULK-06A		4 × 4 × I.D175	
	ULK-10A		8 × 8 × I.D275	
	ULK-14A		8 × 8 × I.D380	
Air outlet gasket	ULK-04A	Nitrile rubber or fluorine-contained rubber	W4 × I.D39.5	V40
	ULK-06A		W4 × I.D54.5	V55
	ULK-10A,ULK-14A		W4 × I.D99	V100
Oil ULVOIL D-11		Hydrocarbon-based		
Oil ULVOIL D-31		Silicone-based		
Heater				The wattage of the heater depends on the oil type.
Thermo cement				
Thermostat				Option

\* The standard gasket material is nitrile rubber; fluorine-contained rubber is an option.

## ULVAC Component Pollution Certificate

This is the certificate to make requests for repairs/inspections of ULVAC's components. Before sending back your own equipment to us, complete this certificate and submit it to our departments in charge of your requests or individual sales offices.

**Note that for components using toxic gases or to which reactant products adhering to, contact our departments in charge of your requests or individual sales offices in advance.**

Trade name : \_\_\_\_\_  
 Model : \_\_\_\_\_  
 S/N : \_\_\_\_\_  
 Application purpose : \_\_\_\_\_

Details on request: \_\_\_\_\_

Fault condition: \_\_\_\_\_

Other special notes: \_\_\_\_\_

Pollutant (: Check all that apply)

- Ensure that the products above are not polluted.
- The products above are polluted with the following harmful substances.

	Pollutant name (molecular formula)	Characteristics
1		
2		
3		
4		
5		

### To ULVAC, Inc.

Name of contact person \_\_\_\_\_

Date: / /

Customer/Company name: \_\_\_\_\_  
 Department: \_\_\_\_\_  
 Person in charge: \_\_\_\_\_ Sign  
 TEL \_\_\_\_\_  
 FAX \_\_\_\_\_  
 E-mail \_\_\_\_\_

\* You are responsible for any accidents attributed to pollutants produced on the way to us. Therefore take special care in packing the components.  
 In addition, **depending on the pollutants and the polluted conditions, we refuse to do repairs etc. and return the components to you.**

<b>Column for ULVAC, Inc.</b>	Sign for receipt	
SDS request: Yes/No		
Order number		



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

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

Name of parts	Hazardous substances or elements					
	Pb	Hg	Cd	Cr <sup>6+</sup>	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.