ULVAC

YO17-0938-DI-001-06

Dry Vacuum Pump

Original Instructions

Instruction Manual

Model
LS-Series
LS120 (-C/-L), LS300 (-C/-L), LS600 (-C/-L), LS1200 (-C/-L)

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

Components Division, ULVAC, Inc.

www.ulvac.co.jp

ULVAC SOLUTIONS

Before Using This Pump

Thank you for purchasing the dry pump LS series (hereafter, "this pump") made by ULVAC (hereinafter, "we"). To ensure safety, upon receiving the pump, confirm that it matches the details of your order and has not been damaged in transit or for another reason.

This instruction manual (hereinafter, "this document") describes appropriate handling and maintenance procedures to safely use this pump and to maximize its performance. Read this document in advance to properly use this pump.

Install and operate this pump according to the safety-related laws and regulations (such as fire prevention laws and electrical wiring regulations) in your country or region. To this end, you must first attend a publicly recognized general safety training (including on electrical and loading safety topics) in your country or region. Never handle this pump without first undergoing safety training. The operator must attend such training. The operator must have expertise, skills, and certifications related to electricity, machinery, loading, vacuum usage, and other fields.

This pump has been designed to conform to the rules in place when this document was created. Conformity is not guaranteed because the applicable standards may change in the future.

Performance and safety may not be ensured if equipment connected to this pump does not conform to the same rules or if the pump is altered. In such cases, we cannot guarantee (take responsibility for) performance or safety. Product alterations made by the customer are not covered by the warranty, and we cannot take responsibility for them.

Before installing or removing this pump, separate all energy sources (including power and cooling water) from the product.
None of this pump's parts may continue to be used permanently while maintaining the performance upon delivery. Performance inevitably degrades after a certain amount of time elapses, thus increasing the likelihood of product problems even in assumed common usage scenarios. We ask that our customers perform preventive maintenance to avoid problems in accordance with their usage scenarios.
By performing preventive maintenance measures, you can lower the probability of problems with this pump due to parts failures caused by parts becoming worn out as well as the probability of other risks, such as downtime caused by pump problems, fire, or effects on other processes.
From the viewpoint of preventive maintenance, we also ask our customers to prepare maintenance and inspection plans and to replace parts and perform overhauls according to such plans.

If you have any questions about handling or other matters, please contact our nearest sales office or dealer.

Safety Indications

Signal words and symbol marks are used in the warning indications contained in this document and on the product so that the user can understand the matters to be observed. Their meanings are as follows.

▶ Meanings of signal words

Terms that indicate a safe warning level are called signal words.

Danger	Indicates an imminent possibility that incorrect handling may lead to the user's death or serious injury.
Warning	Indicates a possibility that incorrect handling may lead to the user's death or serious injury.
Caution	Indicates a possibility that incorrect handling may lead to the user suffering a medium-level injury.
Notice	Indicates important information not related to human injury.

▶ Meanings of symbol marks

	Indicates potential risks related to human injury.
	Indicates potential risks related to electrical shock.
	Indicates potential risks related to high temperature.
	Indicates what you must not do.
	Indicates what you must do.
	Indicates that the operator must wear protective gloves.
	Indicates that the operator must wear protective goggles
	Indicates that the operator must read the instruction manual.

Warning Label Types and Display Positions

Attach warning labels to the warning locations on this pump. Before operating this pump, be sure to confirm the warning contents.

▶ Warning Label Types and Descriptions

	Parts with this warning label have a risk of electrical shock. Turn off the primary power supply before starting wiring or maintenance.
	Because it becomes very hot, do not touch any section during operation or for sometimes after operation is stopped. Touching it may cause burns.
	Do not operate this pump while equipment is attached that prevents gas from moving to the exhaust port (e.g., that blocks the exhaust port). The pump's internal pressure may rise, causing the casing or level gauge to rupture, oil leakage, or motor overload. Explosive or flammable gas, gas that increases the susceptibility of substances to fire, or other gas may ignite inside the pump, thus increasing the pump's internal pressure. Do not exhaust gas that has these characteristics.
	Before use, read through the instruction manual and fully understand its contents.

▶ Warning label display positions

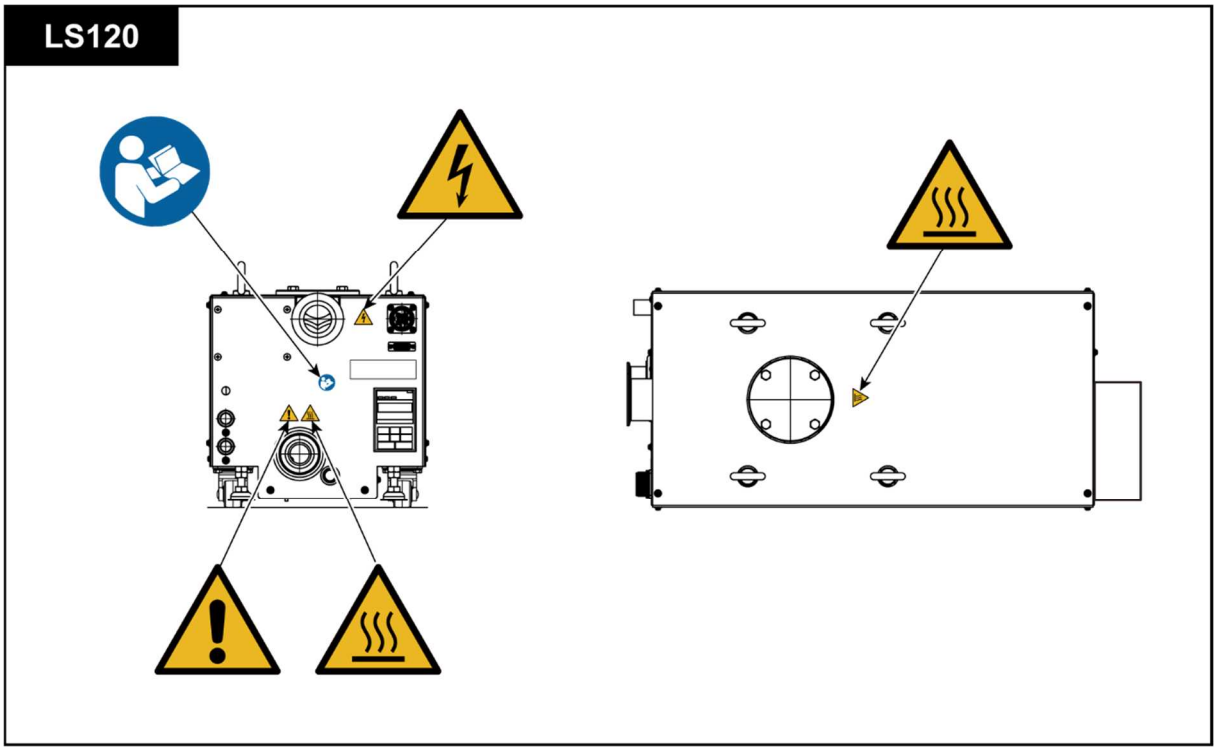


Fig. 1 Warning label attachment position (LS120)

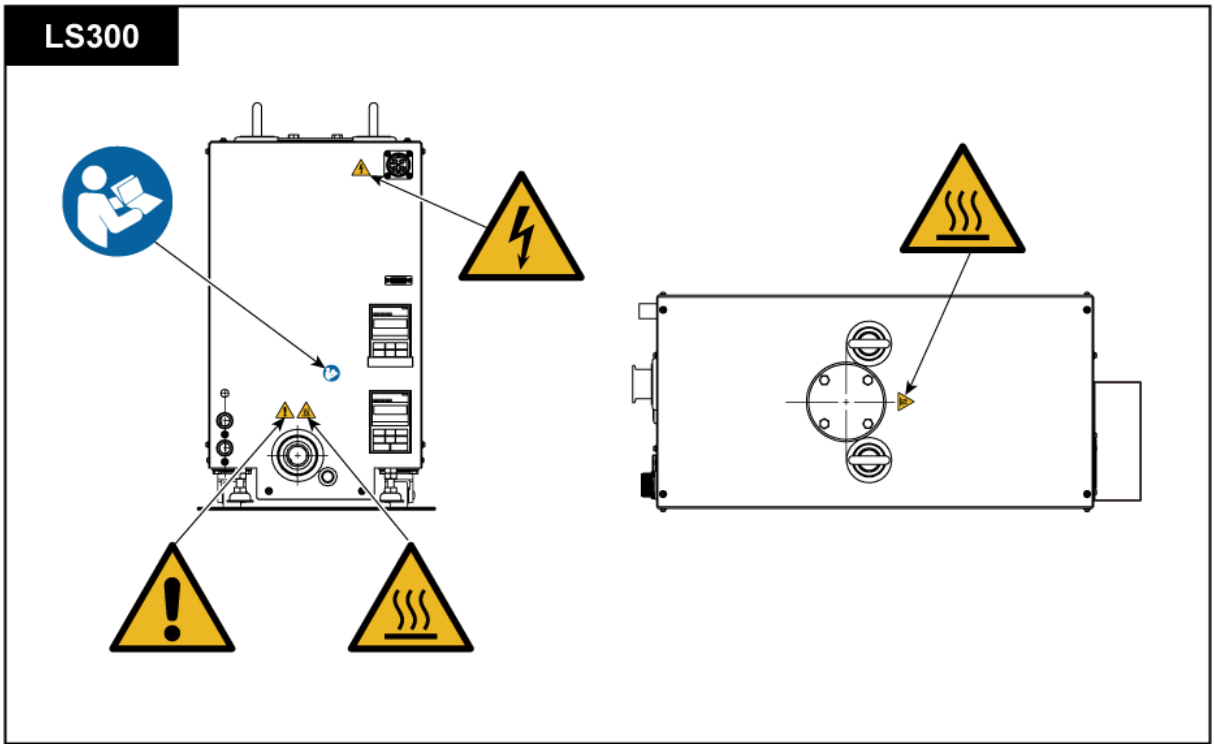


Fig. 2 Warning label attachment position (LS300)

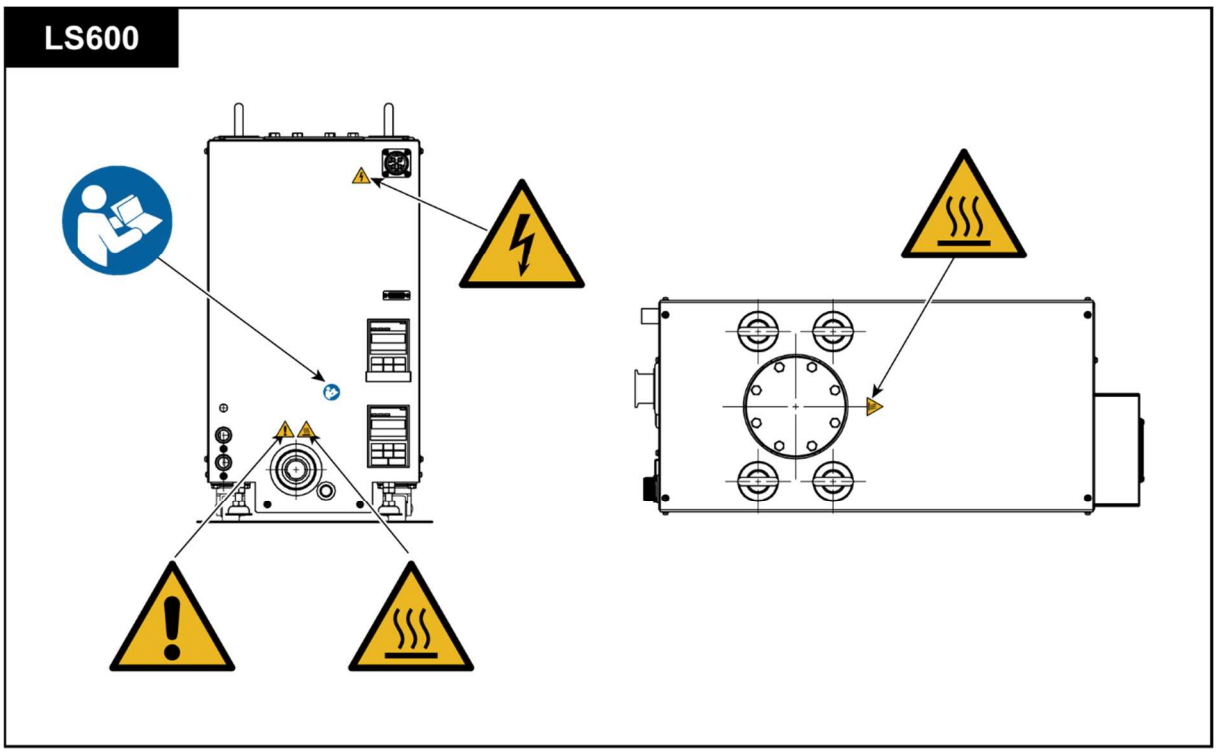


Fig. 3 Warning label attachment position (LS600)

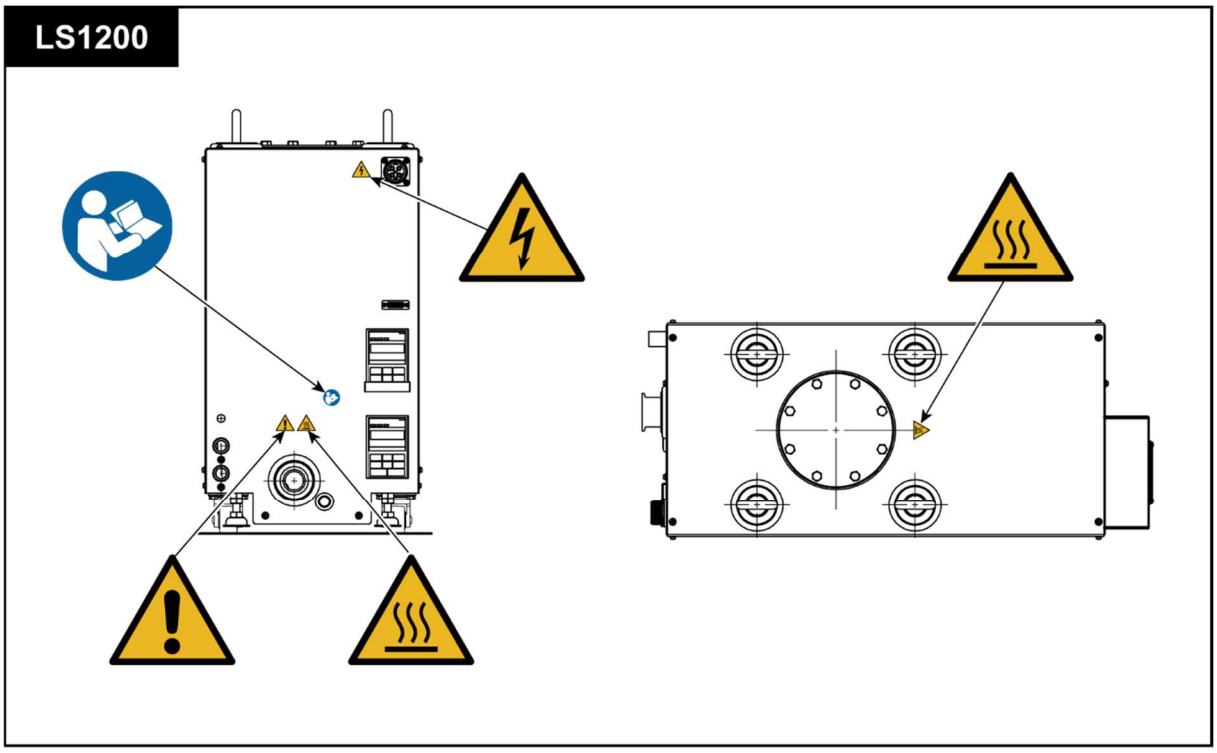


Fig. 4 Warning label attachment position (LS1200)

Warranty Terms

Although this pump undergoes our stringent internal inspection before shipment, if there are any failures attributable to us such as a manufacturing defect or accident during shipping, contact our nearest sales office or dealer. We will repair or replace it free of charge.

▶ Warranty target

(a) Dry pump LS-Series (LS120/LS300/LS600/LS1200)

▶ Warranty period

(a) Transactions in Japan: One year from the shipment date
(b) Direct export transactions: One year from the B/L date

▶ Warranty scope

The warranty applies only to this pump. If a failure or accident occurs during air or nitrogen exhaust due to our design or a manufacturing defect, we will repair the pump free of charge if within one year of delivery.

▶ Disclaimer

The warranty does not cover the product failures listed below or those due to one of the following causes; we will charge for such repairs even during the warranty period.

- Failures or defects caused by exhaust of gas or a substance other than air or nitrogen
- Failures or defects caused by consumables
- When the power voltage or frequency of the power supply used differs from what was specified at the time of order
- Failures or defects caused by natural disasters such as fires, floods, earthquakes, or lightning, or force majeure such as war
- Failures or defects caused by handling errors or incorrect usage
- When the product has been altered, disassembled, or repaired without our permission
- Failures or defects caused by use in an abnormal environment (including strong electromagnetic fields, radioactive environments, high temperatures, high humidity, flammable gas atmospheres, corrosive gas atmospheres, and dust)
- Failures or defects due to noise
- Secondary damage incurred by the customer caused by product defects or claims from third parties that we have infringed on patents
- When our engineer determines that the failure or defect occurred because the pump's usage requirements were not satisfied
- Products for which the warranty period has elapsed

▶ Response

(a) Transactions in Japan:

We will send a substitute product, or repair the product returned to us or our nearest ULVAC TECHNO office.
If on-site action is required, contact our nearest sales office or dealer separately.

(b) Direct export transactions:

We will send a substitute product, or repair the product returned to us or our nearest service center.
The customer must bear the cost of shipping the returned product.

▶ Miscellaneous (warranty terms)

(a) If there are any individual contracts, memoranda on the specifications, or other agreements in addition to this document, handling will conform to their contents.

(b) Before exporting this pump from Japan, contact us and perform the necessary procedures according to the provisions of export-related laws such as the Foreign Exchange and Foreign Trade Law.

(c) If you have any questions about this pump or want to consult with us regarding it, confirm the model and manufacturing number and then contact our nearest sales office or dealer.
https://www.ulvac.co.jp/support_info/

(d) Note that this document's contents are subject to change without notice.

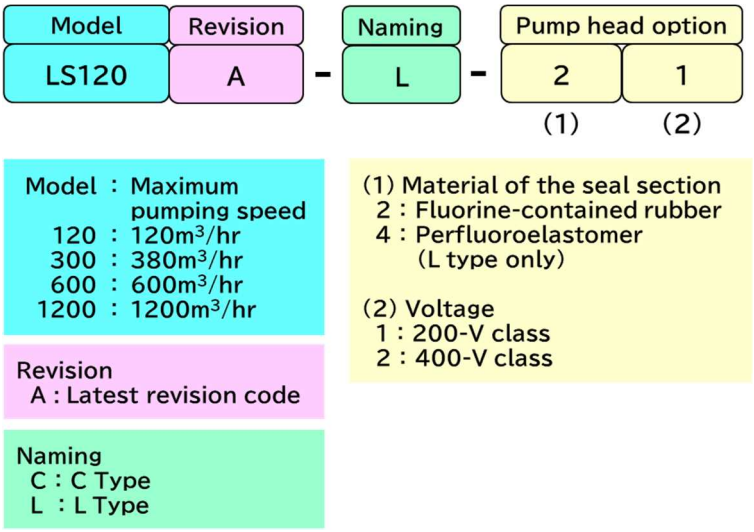
About This Document

- To ensure this pump remains usable for a long time, before installing, operating, inspecting, or maintaining it, be sure to read this document and fully understand the safety notes as well as the pump's specifications and operating procedures.
- Note that the specifications, prices, and other contents in this document are subject to change without notice for improvement or other reasons. Changes are released as a revision that updates the document number listed on the top-right corner of the instruction manual's cover.
- Be sure to give this document to the end user who uses the product.
- Copying this instruction manual in whole or in part for third parties without our permission is strictly prohibited.
- This document is intended for users whose native language is Japanese. If users whose native language is not Japanese perform work related to this pump, thoroughly provide safety training and handling instructions under your own responsibility.

Target Models

This document applies to LS120 (-C/-L), LS300 (-C/-L), LS600 (-C/-L), and LS1200 (-C/-L).
Symbols and numbers used for models have the following meanings.

Table 1 Model list



C Type" and "L Type" are used in this document when necessary to distinguish between product namings that include "C" and "L."
If "C Type" and "L Type" are not referred to specifically, the same applies to both "C" and "L" product namings.

Applicable Standards

ULVAC

CE **EU/EC DECLARATION OF CONFORMITY** CE

We hereby declare that the following our products conform the essential health and safety requirement of the following directives and standards.

Product	Dry Vacuum Pump	
Model	LS120A(-C/-L),LS300A(-C/-L),LS600A(-C/-L),LS1200A(-C/-L)	
Manufacturer	ULVAC, Inc. 2500 HAGISONO, CHIGASAKI, KANAGAWA, 253-8543, JAPAN	
Test standard	Machinery directive	2006/42/EC EN1012-2:1996+A1:2009
	Low voltage directive	2014/35/EU EN61010-1:2010
	EMC directive	2014/30/EU EN61000-6-4:2007+A1:2011 EN61000-6-2:2005 EN61000-4-2:2009 EN61000-4-3:2006+A1:2008+A2:2010 EN61000-4-4:2012 EN61000-4-5:2014 EN61000-4-6:2014 EN61000-4-8:2010
Test lab.	ULVAC, Inc TUV Rheinland Japan Ltd. Kyushu EMC Laboratory	

Note: This declaration becomes invalid if technical or operational modifications are introduced without the manufacture's consent.

European contact address: ULVAC GmbH Head Office
Parking11, 85748, Garching, Germany

Signature : Kiyokazu Yanagisawa

Date : May. 07. '18

Address : ULVAC, Inc.
2500 Hagisono, Chigasaki, kanagawa, 253-8543, Japan

Name : KIYOKAZU YANAGISAWA

Title : General Manager of Components Division

Form:A003S1287-01

Contents

1. To Ensure Safe Use

This chapter describes how to reduce risks as well as which dangerous behaviors must be avoided for each work item

1.1 Handling of This Pump

If you need an overhaul or repair or if you have a problem, contact our nearest service center.

	This manual assumes that this pump's interlock system or control system has been integrated into the host equipment. Connect the pump's power line to the host equipment's EMO system.
	This pump can exhaust inert gas (air, nitrogen, or argon). If the pump exhausts other gas (toxic, combustible, corrosive, or explosive gas, or gas that increases the susceptibility of substances), such gas may leak from the pump's main unit or ignite or explode inside the pump. Therefore, do not use this pump to exhaust such gases.
	Install this pump in a ventilated room indoors. If nitrogen or argon leaks, the lack of oxygen may cause suffocation.
	Before installing or removing this pump, separate all energy sources (including power and cooling water) from it.
	If this pump sucks in toxic gas, both the pump's main unit and the lubricant will become toxic. Keep this in mind during maintenance.
	Install an appropriate filter, separator, and trap so that this pump does not suck in liquid or solid particles.

- This pump has been designed to conform to the rules in place when this document was created. Conformity is not guaranteed because the applicable standards may change in the future.
- Performance and safety may not be ensured if equipment connected to this pump does not conform to the same rules or if the pump is altered. In such cases, we cannot guarantee (take responsibility for) performance or safety.
- Do not handle this pump if you have not undergone publicly recognized general safety training (including on electrical and loading safety) in your country. The operator must attend such training.
- Install and operate this pump according to the safety-related laws and regulations (such as fire prevention laws and electrical wiring regulations) in your country

- If you do not inform us of the details of hazardous substances you have used or that the pump exhausted a substance that is difficult to detoxify, we may refuse to maintain or otherwise handle the pump. When requesting overhaul, maintenance, repair, or other work, fill out the Declaration of Contamination attached to this document and submit it to the service center.
- Before exporting this pump from Japan, it must undergo screening according to the Foreign Exchange and Foreign Trade Law as well as government ordinances, ministerial ordinances, notices, and other orders based on said law. Contact our nearest sales office or dealer.

  [List of sales offices]
  https://www.ulvac.co.jp/support_info/sales_office/

1.2 Acceptance, Transport, and Storage

1.2.1 Acceptance

	**Never get under this pump.** The pump may fall or topple if a forcible operation is performed or if the equipment is not sufficiently maintained. Never get under this pump.
	**Ask a specialist company to perform disassembly.** This pump comes packaged in a wooden crate, cardboard box, or other material. Ask a specialist company to perform disassembly. Workers may cut their hands on nails or wooden chips during work. Instruct those who disassemble the pump to wear leather gloves and to use an appropriate bar or other disassembly tool.
	**Use a crane or other cargo-handling equipment.** When taking this pump out of the package or lifting it, instruct workers to lift it while holding the eyebolts on the upper part using a crane or other cargo-handling equipment and to transport it. Before using the eyebolts, confirm that there are no abnormalities.
	**Certified persons must perform loading work and operate the cargo-handling machine.** Never perform loading work or operate the cargo-handling machine if you do not have the appropriate certifications.
	**After unpacking, check for any missing items or damage.** Check for any missing items, damage, part abnormalities, or other problems after unpacking. It you find any defects, do not install the pump.

1.2.2 Transport

	**Do not use the casters as a transportation device or a means of equipment support.** Although this pump is equipped with casters, do not use them as a transportation device or a means of equipment support.

Warning	**For transport, use cargo-handling equipment or a pallet truck.** To transport this pump, a load higher than the safety standards is required. Therefore, manually transporting it may cause lower back pain or injury. For transport, hang this pump with cargo-handling equipment (such as a mobile crane) or fix it on a pallet and then transport it by pallet truck.

1.2.3 Storage

Notice	**Respect the environment requirements.** This pump is a machine with a precise clearance. Confirm that the storage location satisfies the requirements listed in "3.1.2 Storage environment requirements."

1.3 Installation and Operation

Warning	**Do not remove the face panel.** Never remove the face panel. Failure to observe this instruction may lead to burns or electrical shock.
Warning	**Do not remove the casters.** Do not remove the casters, and do not install this pump directly on the ground.
Notice	**Do not apply shock to this pump or put in at an incline, position it sideways, or stand it up or reverse it.** Do not apply shock to this pump or put in at an incline, position it sideways, or stand it up or reverse it. Doing so will degrade the pump's operation. Install this pump so that it is level.
Notice	**Operate the pump after the main unit's temperature reaches the operable ambient temperature.** When this pump has been stored outside the operable ambient temperature range, operate it after the main unit's temperature has returned to the operable ambient temperature.
Notice	**Install this pump's main unit so that it is level.** After moving this pump to the installation location, adjust the four adjusters within the range of 0 to 10 mm, and install this pump's main unit so that it is level. If you operate this pump on the casters, vibrations will travel to the floor. Alternately, this pump may travel by itself and collide with the surrounding equipment.
Notice	**Respect the environment requirements.** This pump is a machine with a precise clearance. Confirm that the installation location satisfies the requirements in "3.1.3 Environment requirements for installation and operation."

1.4 Disposal

Ask a waste disposal specialist to dispose of this pump if you have used it to exhaust harmful gas that may endanger human health.

Ask a waste disposal specialist to dispose of this pump if you have used it to exhaust harmful gas that may endanger human health.

Dispose of this pump according to the laws and ordinances issued by your local government.
Particularly if you have used this pump to exhaust harmful gas, ask a waste disposal specialist to dispose of this pump.
The customer must incur any disposal-related costs.

1.5 Protective device

Be sure to install an earth leakage circuit breaker.

If no earth leakage circuit breaker is installed, then equipment burnout, fire, or electrical shock may occur.

This pump is not equipped with a power interrupter and leak detector.
When selecting a ground-fault interrupter, refer to "3.6 Wiring."

1.6 Risks and Safety Measures Specific to This Pump

1.6.1 Vacuum pumping and exhaust of hazardous gases or substances

Do not use this pump to exhaust toxic, combustible, corrosive, or explosive gas, or gas that increases the susceptibility of substances.

It is very dangerous to exhaust toxic, combustible, corrosive or explosive gas, or gas that increases the susceptibility of substances. It is very dangerous if this pump sucks in such gas because ignition or an explosion may occur due to residue gas or product; this may occur during operation or even after operation stops. Do not exhaust gas that has these characteristics.

Wear protective equipment.

During work such as inspections, wear protective equipment suitable for handling the toxic substance to be used.

Ask a waste disposal specialist to dispose of this pump.

To dispose of this pump, ask a waste disposal specialist authorized by the government.

To detoxify this pump, ask a specialist.

To detoxify this pump before overhaul or disposal, ask a waste disposal specialist.

1.6.2 Transport of heavy objects

	**Never get under this pump.** The pump may fall or topple if a forcible operation is performed or if the equipment is not sufficiently maintained. Never get under this pump.
	**Never perform loading work or operate the cargo-handling machine if you do not have the appropriate certifications.** Never perform loading work or operate the cargo-handling machine if you do not have the appropriate certifications. Failure to observe this instruction may lead to accident or injury.

1.6.3 Electrical shock

	**Before connecting the power, turn off the primary power supply.** Be sure to turn off the primary power supply before connecting the power.
	**Before inspection or relocation, turn off the primary power supply.** Be sure to turn off the primary power supply before inspection or relocation.
	**Be sure to connect the ground terminal.** A certified electrical worker must embed grounding or connect the ground line. Incomplete grounding incurs the risk of electrical shock.

1.6.4 High temperature

	**Do not remove the face panel.** Never remove the face panel. This pump becomes very hot during operation and remains hot for a while after operation stops. Touching it may lead to burns.
	**Do not touch the pump's main unit, motor, or piping during operation.** Do not touch the pump's main unit, motor, or piping during operation because they are very hot. Failure to observe this instruction may lead to burns.
	**Wait until the pump temperature drops.** The pump is hot immediately after operation stops. Wait a while until the pump temperature drops and then perform inspection. Failure to observe this instruction may lead to burns.

1.6.5 Ruptures

	**Do not increase the pressure on the pump's exhaust side to 0.03 MPaG or higher.** Measure the pressure on the pump's exhaust side. If the pressure is 0.03 MPaG (0.3kg/cm^{2}G) (gauge pressure) or higher, remove any objects that prevent gas on the exhaust port side from passing. If the pump's internal pressure exceeds 0.03 MPaG, the pump may rupture.

1.6.6 Leakage of hot cooling water

Warning 	**If you inadvertently operate this pump without flowing water, stop the pump immediately and keep away from it.** If you inadvertently operate this pump without flowing water, stop the pump immediately and keep away from it. Hot steam may blast out of the pump's cooling water port.
Warning 	**Install an interlock on the cooling water pathway.** Install a flowmeter on the cooling water pathway, and install an interlock so that this pump stops if supply of cooling water stops. If you operate this pump without flowing cooling water, hot steam may blast out of the pump's cooling water port.
Warning 	**Wait until the pump temperature drops.** After stopping this pump and confirming that the pump temperature has dropped, remove and inspect the pump.

1.7 Safety Data Sheet

Warning 	**Carefully read the safety data sheet.** Obtain and carefully read the safety data sheet (SDS) before using this pump. If lubricant adheres to the skin or enters the eyes, follow the first aid procedure described on the safety data sheet.
Notice 	**Use the specified lubricant.** Use of a non-specified lubricant will affect the pump's performance and service life as well as void the pump's warranty coverage.

Do not use a chemical substance (lubricant) not specified in this document.

Lubricant	BARRIERTA J100FLUID, J100FLUID E (NOK KLUBER)
Bearing grease	NOXLUB, KF1920 (NOK KLUBER)

The SDS describes the chemical substances that may be used or touched to operate this pump. To understand the characteristics of hazards, carefully read the SDS. Obtain the latest version of the SDS from our nearest sales office or dealer.
The SDS provides reference information to ensure safe handling of dangerous or hazardous chemical substances.
Anyone handling lubricant must always obtain the latest SDS and understand that measures suitable for the actual handling and other situations in question must be taken under their own responsibility by referring to the SDS before using the lubricant. The SDS itself does not guarantee safety.

2. Product Overview

The LS series is designed for vacuum pumping of general equipment; it assumes that the interlock system and control system have been integrated into the host equipment.
The LS series is mainly used in the following processes:

- Evacuate the process chamber of equipment that only uses inert gas (nitrogen or argon) typified by sputtering and deposition
- Evacuate the load or unload lock chamber (for the air)
- Other general vacuum pumping (Gas with a low risk level: Gas that is not toxic, flammable, corrosive, or explosive)

2.1 Features

High pumping speed

- High pumping speed at near atmospheric pressure, and pumping down time can be drastically reduced

Low power consumption

- ECO-SHOCK technology realizes low power consumption (C Type)
- Power consumption at the ultimate pressure is the industry-leading 0.6kW or less(LS120A-C)

Low noise

- Built-in silencer achieves the noise level 61dB(A) or less

Low running-cost

- No shaft sealing gas
  * Purge gas is available with L Type.

2.2 Applications

⚠Warning 	**Do not use this pump for applications that have not been listed in this document.** Using this pump for applications not listed in this document may cause unexpected accidents or failures.

- Vacuum pumping systems in various equipment
  - Sputtering systems
  - Deposition equipment
  - Gluing systems
  - Heat treating furnaces and other equipment
- Vacuum pumping systems in the light process that do not generate side reaction products
- Backing pumps in high vacuum pumping systems
- Other vacuum pumping applications in general

2.3 Naming

The pump has two types for specific applications.

■ C type ： Clean process

- Feature ： Low power consumption model (with built-in ECO-SHOCK)
- Applications ： For clean process such as air and nitrogen

  Sputtering / Vapor deposition / Lamination / Load lock room / TMP backing pump etc.

■ L Type ： Light process

- Features ： Light process model (with surface treatment and purge function)
- Applications ： For light process such as steam and volatile liquid medicine

  Vacuum drying / Freeze drying / Ashing / General industrial use etc.

2.4 Performance Curves

2.4.1 Pumping speed

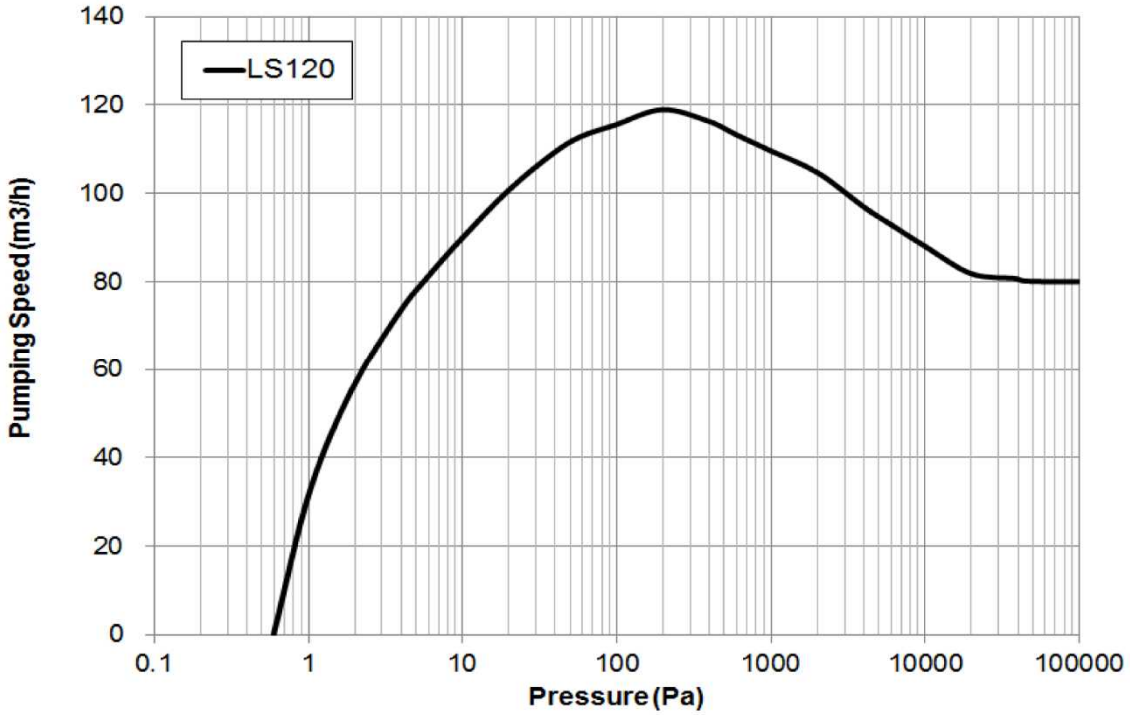


Fig. 5 Pumping speed curve (LS120)

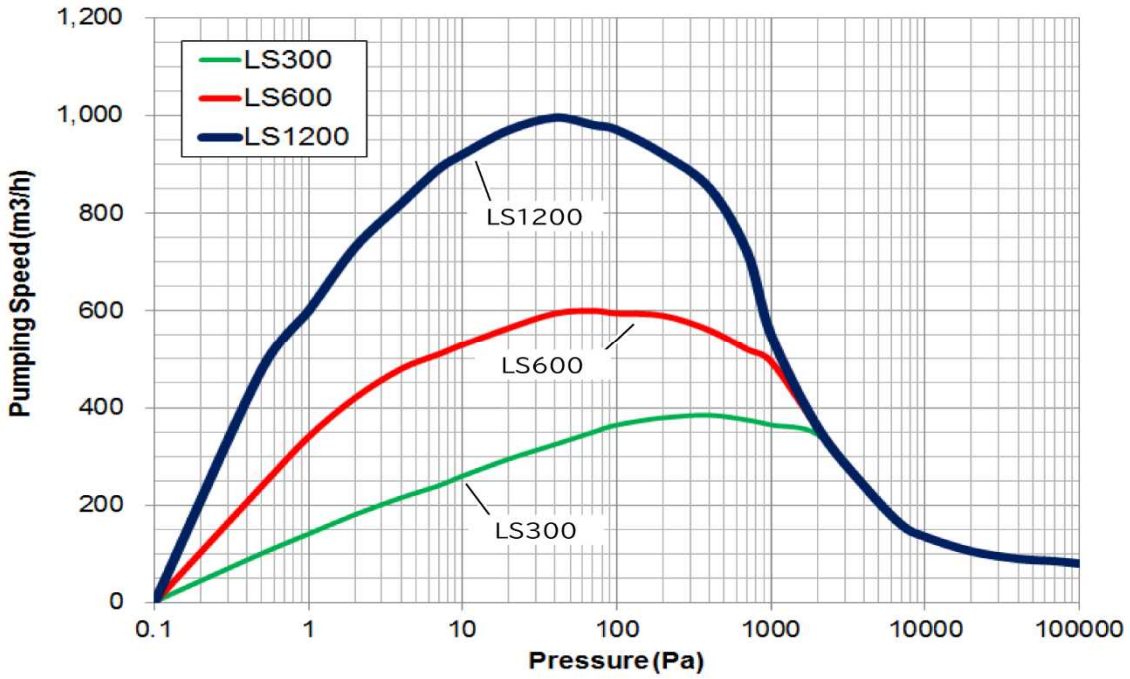


Fig. 6 Pumping speed curve (LS300, LS600, LS1200)

2.4.2 Power requirements

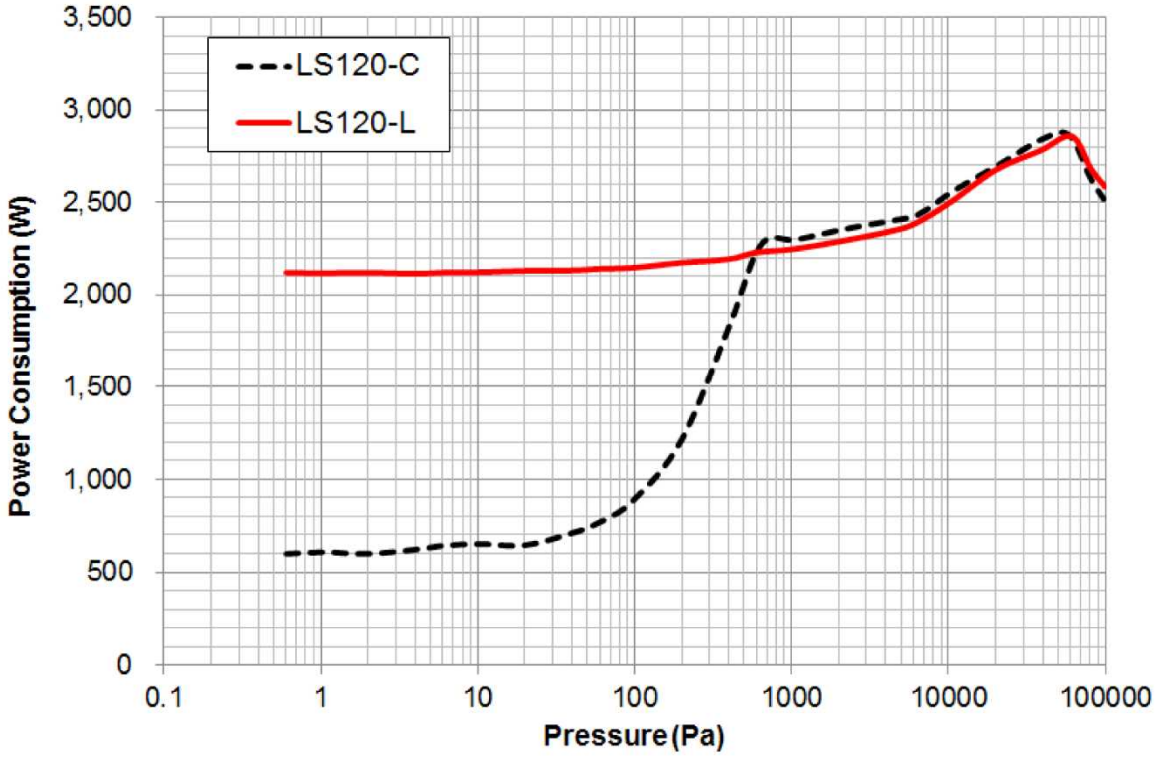


Fig. 7 Power curve (LS120)

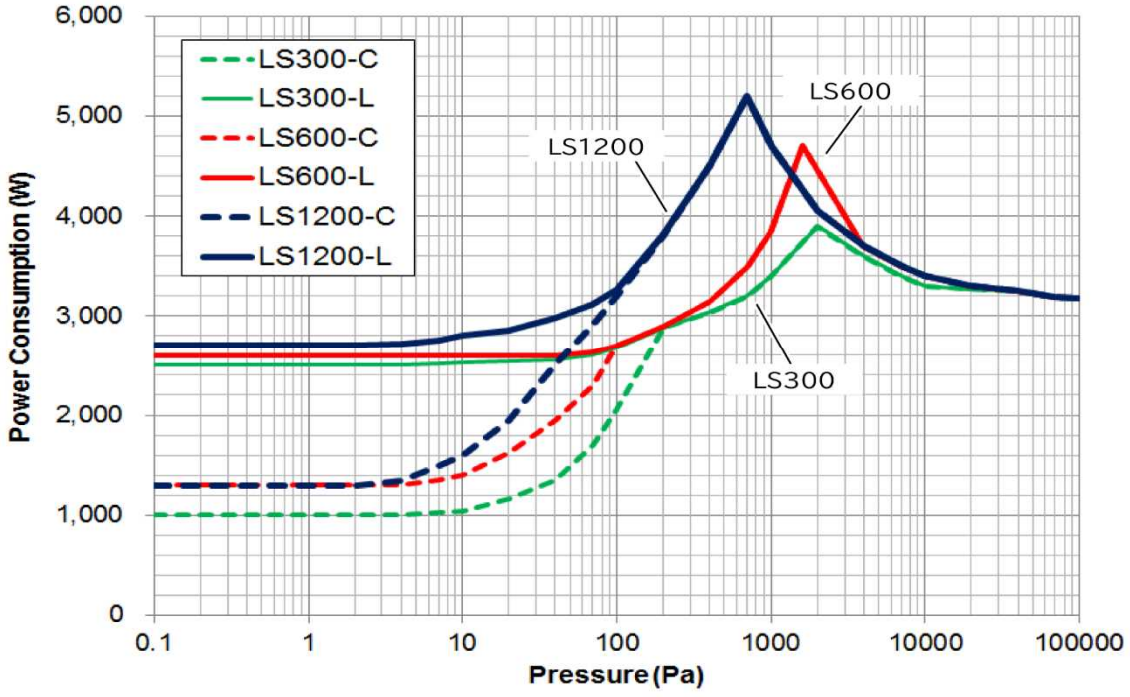


Fig. 8 Power curve (LS300, LS600, LS1200)

2.5 Part Names and Functions

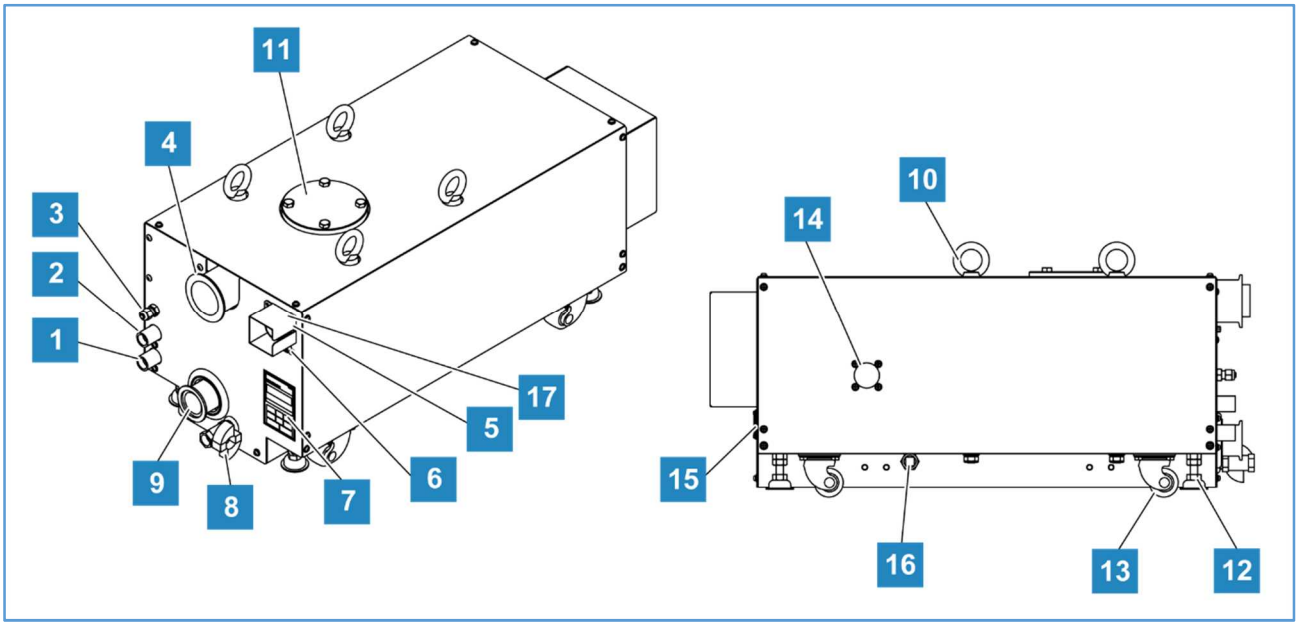


Fig. 9 Part names (LS120)

Table 2 Part names (LS120)

Name		Function	Reference
1	Cooling water outlet	Connects the piping that exhausts cooling water. (Rc3/8)	3.5.2
2	Cooling water inlet	Connects the piping that supplies cooling water. (Rc3/8)	3.5.2
3	Purge gas inlet (L types only)	Connects the piping that supplies purge gas.	3.5.3
4	Pump inlet port (horizontal): KF50	Connects the container or piping for which pump pumping is performed.	3.5.1
5	Power connector	Connects the power cable.	3.6.1
6	Signal connector	Connects the signal line.	3.6.2
7	Controller	Displays the pump's status (e.g., operating, stopped, or alarm).	2.6
8	Drain valve (L types only)	The valve used for drain exhaust. (Rc3/8)	3.5.4
9	Exhaust outlet port: KF40	Connects the piping that discharges exhausted gas.	3.5.1
10	Eyebolt	Used to hoist the pump using a crane or other equipment.	3.3.1
11	Pump inlet port (vertical): VG50	Connects the container or piping for which vacuum exhaust is performed.	3.5.1
12	Adjuster	Adjusts the pump height.	3.4.1
13	Caster	A wheel that swivels.	3.3
14	Lubricant inspection window (L types only)	Used to check the amount of lubricant.	5.1
15	Ventilation inlet	The inlet port for ventilation air.	4.1
16	Drain port (L types only)	An exhaust outlet for water or other liquid that has accumulated inside the pump. (Rc3/8)	3.5.4
17	Power connector guard	Used to guard the power connector. * Because this product has been approved to serve as permanently connected equipment, you must install the guard after connecting the power wiring.	3.6.1

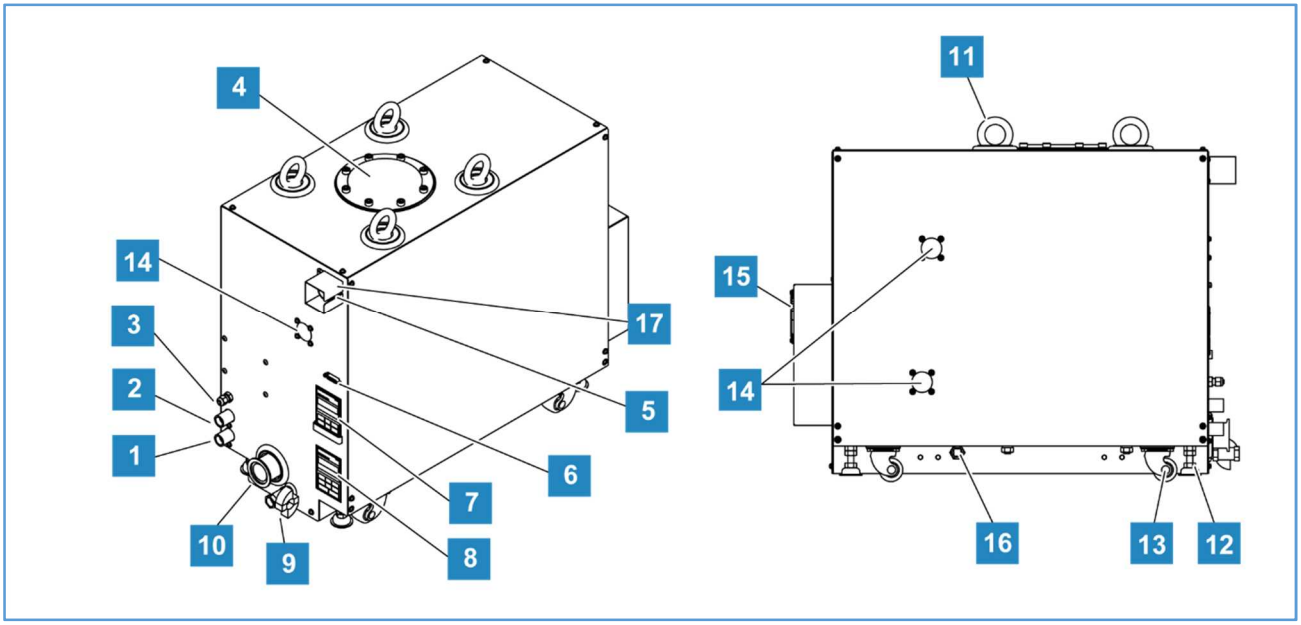


Fig. 10 Part names (LS300, LS600, LS1200)

Table 3 Part names (LS300, LS600, LS1200)

Name		Function	Reference
1	Cooling water outlet	Connects the piping that exhausts cooling water. (Rc3/8)	3.5.2
2	Cooling water inlet	Connects the piping that supplies cooling water. (Rc3/8)	3.5.2
3	Purge gas inlet (L types only)	Connects the piping that supplies purge gas.	3.5.3
4	Pump inlet port	Connects the container or piping for which pump exhaust is performed.	3.5.1
5	Power connector	Connects the power cable.	3.6.1
6	Signal connector	Connects the signal line.	3.6.2
7	Controller for MBP	Displays the status (e.g., MBP alarm).	2.6
8	Controller for DRP	Displays the pump status (e.g., operating, stopped, or DRP alarm).	2.6
9	Drain valve (L types only)	The valve used for drain exhaust. (Rc3/8)	3.5.4
10	Exhaust outlet port: KF40	Connects the piping that discharges exhausted gas.	3.5.1
11	Eyebolt	Used to hoist the pump using a crane or other equipment.	3.3.1
12	Adjuster	Adjusts the pump height.	3.4.1
13	Caster	A wheel that swivels.	3.3
14	Lubricant inspection window (L types only)	Used to check the amount of lubricant.	5.1
15	Ventilation inlet	The inlet port for ventilation air.	4.1
16	Drain port (L types only)	An exhaust outlet for water or other liquid that has accumulated inside the pump. (Rc3/8)	3.5.4
17	Power connector guard	Used to guard the power connector. * Because this product has been approved to serve as permanently connected equipment, you must install the guard after connecting the power wiring.	3.6.1

2.6 Description of the Controller

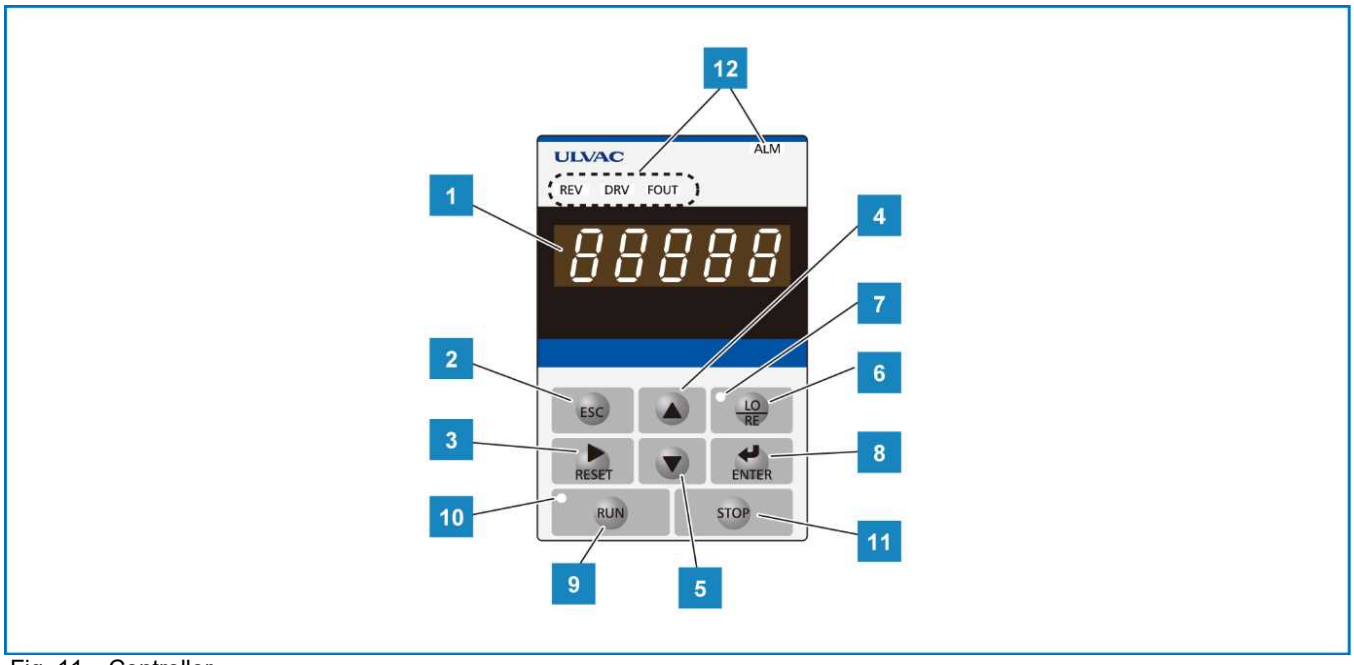


Fig. 11 Controller

Table 4 Description of the controller

Name		Function
1	Data display section	Displays information such as the number of revolutions and current status.
2	ESC key	Returns to the status that is active before pressing the ENTER key.
3	RESET key	During controller operation, this key moves between digits. If an alarm has occurred, this key resets the alarm.
4	Up key	Selects the status to be monitored. You can also press this key to go to the next item or data.
5	Down key	Selects the status to be monitored. You can also press this key to return to the original item or data.
6	LO/RE selection key	Press this key to switch between controller operation (LOCAL) and operation with wiring for remote operation (REMOTE).
7	LO/RE lamp	Lights up when the controller (LOCAL) is selected. Refer to "Table 6 LO/RE lamp, RUN lamp."
8	ENTER key	Press this key to display or determine the status to be monitored. Use this key to move from one screen to the next.
9	RUN key	Operates the pump when LOCAL is selected.
10	RUN lamp	Lights up while the pump is operating. Refer to "Table 6 LO/RE lamp, RUN lamp."
11	STOP key	Stops the pump.
12	LED lamps	Refer to "Table 5 LED lamp display."

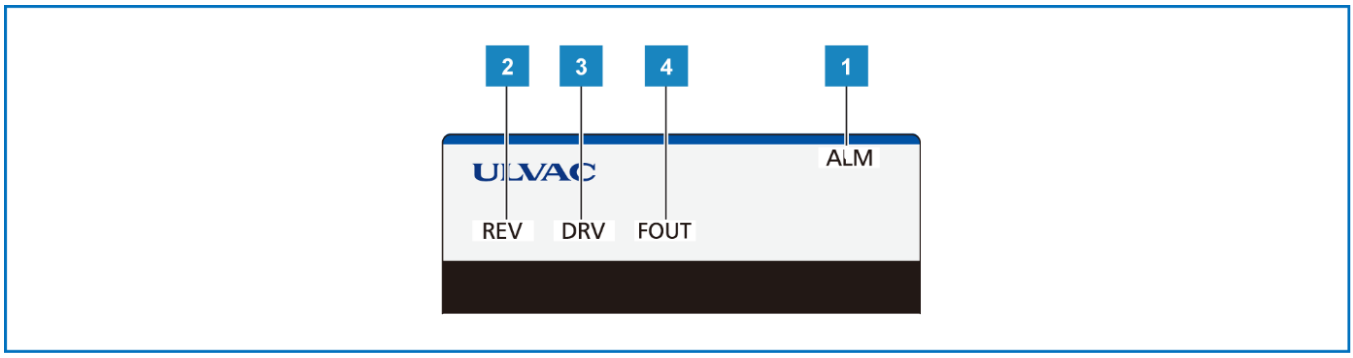


Fig. 12 LED lamps

Table 5 LED lamp display

Name		On	Blinking	Off
1	ALM LED lamp	Alarm detected.	Warning detected.	Normal status.
2	REV LED lamp*	The reverse rotation command has been entered.	–	The forward rotation command has been entered.
3	DRV LED lamp	In drive mode	–	–
4	FOUT LED lamp	Displays the number of revolutions (rpm).	–	–

* The REV LED lamp is on for MBP.

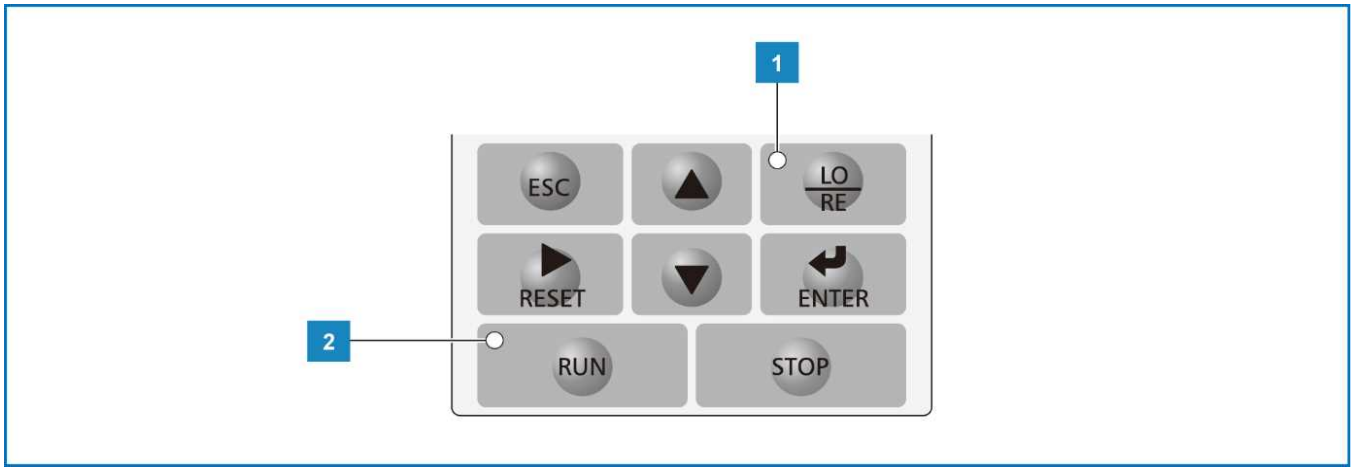


Fig. 13 LO/RE lump

Table 6 LO/RE lamp, RUN lamp

Name		On	Blinking	off
1	LO/RE lamp	The operation command from the controller is selected (LOCAL).	–	The operation command from outside the controller is selected (REMOTE).
2	RUN lamp	Operating	Decelerating to stop	Stopped

Data display transition

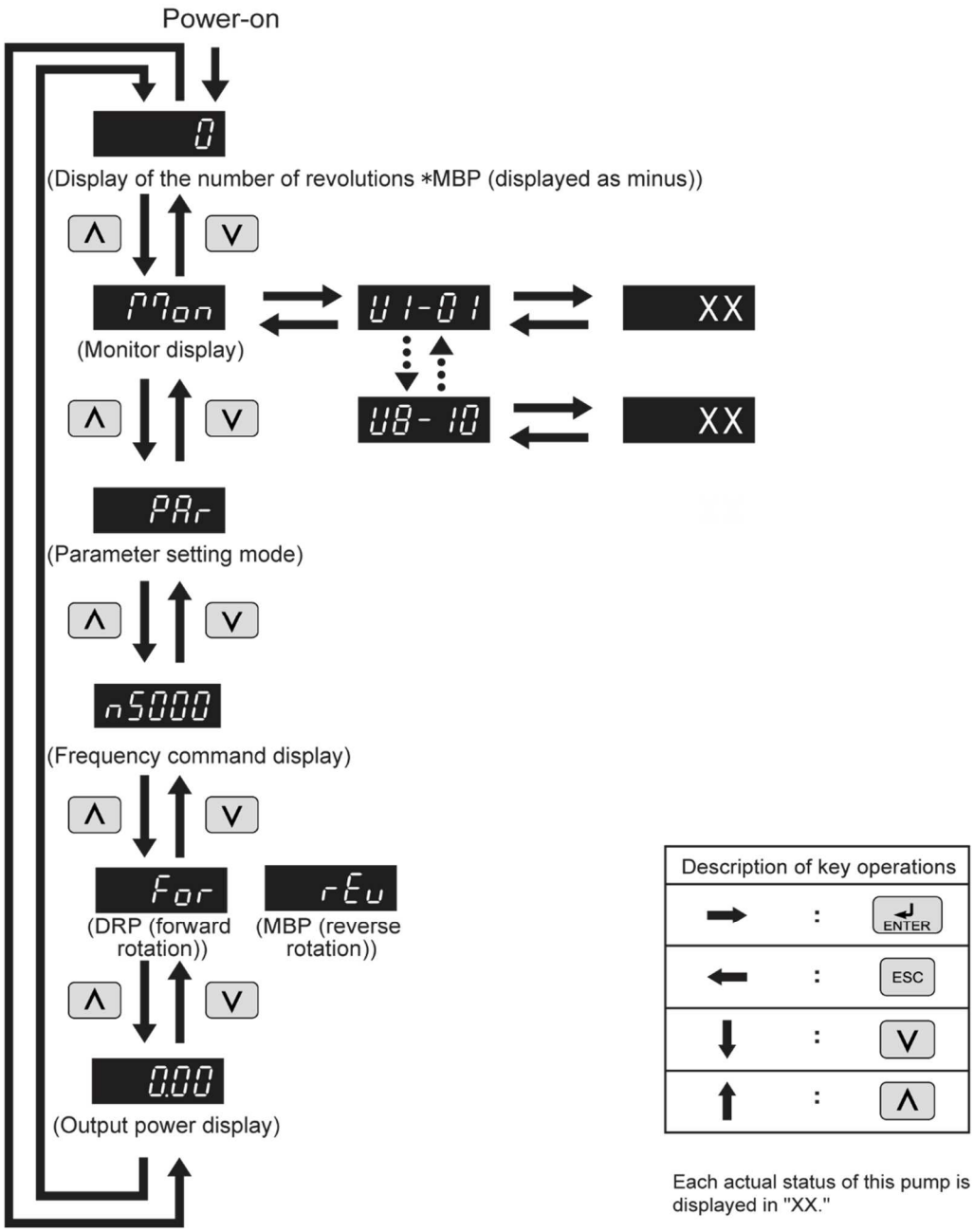


Fig. 14 Data display Transition diagram

2.7 System Configuration

The customer must take responsibility for the area enclosed by the dashed line in the figure below.
The customer should prepare and manage the piping, wiring, and facilities in this area under their own responsibility

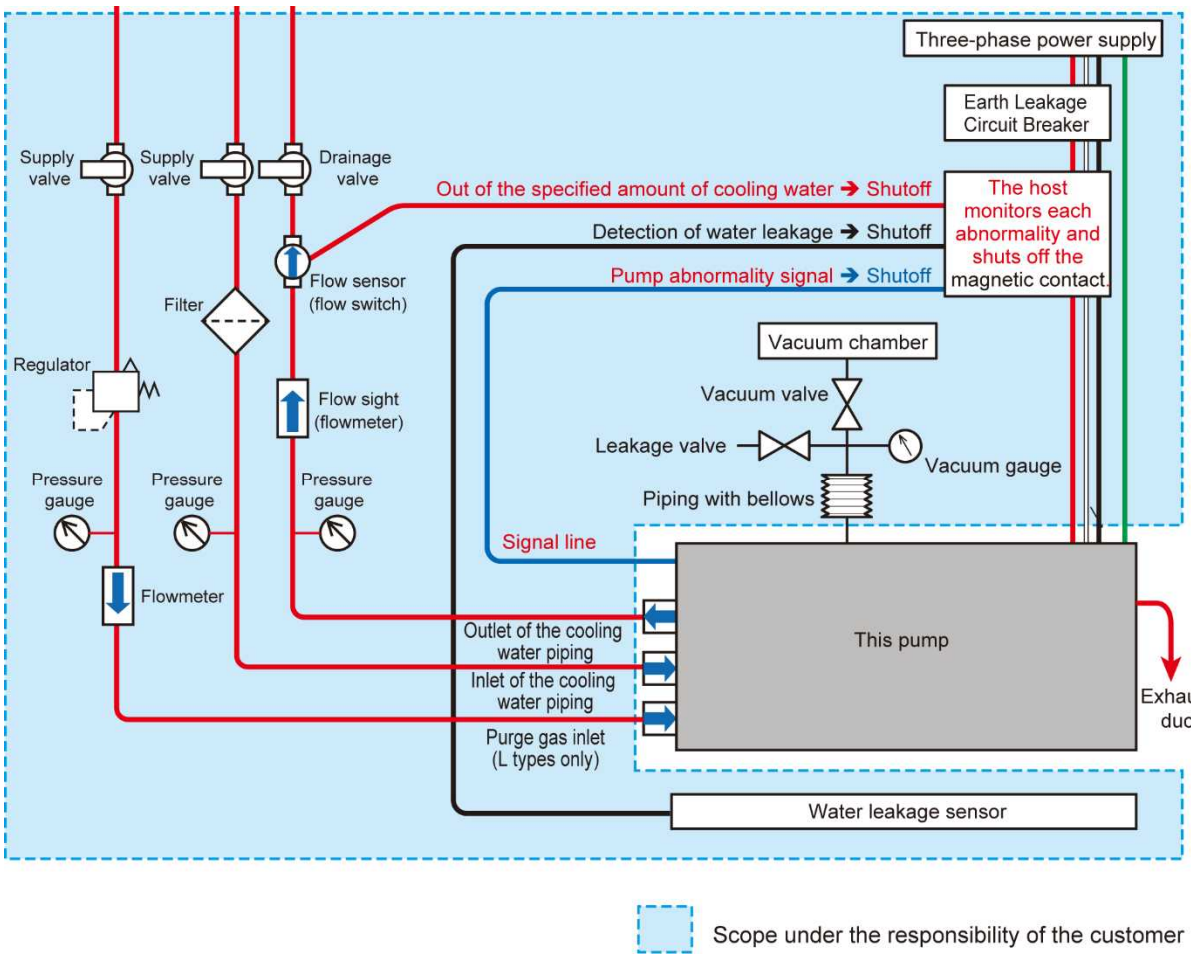


Fig. 15 System connection diagram

Notice	The warranty applies only to this pump. (Refer to Warranty scope.) Note that failures or damage caused by piping, wiring, or facilities in the above scope indicating the customer's responsibility are not covered by the warranty.

3. Installation

3.1 Before Installation

3.1.1 Division of roles from shipment to startup

This pump is provided on the assumption that we are in charge of the stages from packing through shipment (transport), while the customer is in charge of the stages from cargo reception through startup. However, the customer may fully or partly transport, unpack, or install this pump depending on the pump's terms and conditions.

Packing	- ULVAC
Transport	- ULVAC entrusts this task to a specified carrier.
Cargo reception and unpacking	- Customer
Inspection	- Customer
Transfer to the installation location	- Customer
Installation and assembly	- Customer
Piping and wiring	- Customer
Startup check	- Customer

Notice	The above work from shipment to startup may not apply in your case. Check the pump's specifications document. If you have any questions, please contact us.

3.1.2 Storage environment requirements

When storing this pump (prior to installation) in a warehouse or lobby, or when you will not be using it for a long time, store it so that the following requirements are satisfied.

Ambient temperature	**-20°C to 60°C (no freezing)**
Ambient humidity	95% RH or less (no condensation)
Altitude	Altitude of 1,000 m or lower
Vibration resistance	Vibration acceleration of 0.5 G (114 dB) or lower
Other requirements	No dust.
	The room must be ventilated.
	Do not stack these pumps, position this pump sideways, or stand it up.
	Do not apply shock to this pump.
	Do not expose this pump to direct sunlight.
	Keep this pump away from heat sources.
	Be sure to release the water in the cooling water piping before storage. In low temperatures (0°C or less), parts may be damaged by frozen water.
	Do not incline this pump by 10° or more.

3.1.3 Environment requirements for installation and operation

This pump is a machine with a precise clearance.
Confirm that the following requirements are satisfied during installation and operation.

Ambient temperature	**5 to 40°C**
Ambient humidity	95% RH or less (no condensation)
Altitude	Altitude of 1,000 m or lower
Power Supply	Overvoltage category II (IEC 61010-1)
Other requirements	Pollution degree 2 (IEC 61010-1)
	There is no corrosive or explosive gas.
	No dust.
	The room must be ventilated.
	Do not stack these pumps, position this pump sideways, or stand it up.
	Do not apply shock to this pump.
	Do not expose this pump to direct sunlight.
	Keep this pump away from heat sources.
	After moving this pump to the installation location, adjust the four adjusters within the range of 0 to 10 mm, and install the pump so that it is level.
	Securely fix this pump in place in case an earthquake occurs.
	Do not incline this pump by 10° or more.

3.2 Unpacking

This pump is protected with stretch film, a buffer, or other materials and is packaged in a wooden crate or cardboard box upon shipment.
If this pump has been packaged in a wooden crate, ask a specialist to disassemble the crate.
Provide the following notes and instructions to the company you ask to perform unpacking.

3.2.1 Notes on unpacking

	**Never get under this pump.** The pump may fall or topple if a forcible operation is performed or if the equipment is not sufficiently maintained.
	**Never perform loading work or operate the cargo-handling machine if you do not have the appropriate certifications.** Never perform loading work or operate the cargo-handling machine if you do not have the appropriate certifications.
	**Use cargo-handling equipment to lift this pump.** When taking this pump out of the package or lifting it, instruct workers to lift it while holding the eyebolts on the upper part using a crane or other cargo-handling equipment and to transport it.
	**Do not incline this pump by 10 or more.** Doing so may cause this pump to topple or otherwise move, causing injury or damage.
	**If this pump has been packaged in a wooden crate, wear leather gloves and use an appropriate disassembly tool.** Workers may cut their hands on nails or wooden chips during work. Instruct those who disassemble the pump to wear leather gloves and to use an appropriate bar or other disassembly tool.

3.2.2 Confirmation after unpacking

After unpacking, confirm that this product matches your order and has not been damaged in transit or for another reason.
If you notify us of a packing problem after starting use, we may charge for a repair.
Although we ship with the greatest care, after unpacking, confirm the following to ensure safety.

- The details of your order match the actual product.
- Accessories (instruction manual and optional parts) have been included.
- No parts were damaged in transit.
- No screws, nuts, or other parts have come loose in transit. No parts have been removed.

If you find a problem, contact our sales department or specified agent.

Table 7 List of standard accessories

Product name	Specifications	Qty.	Remarks
Power connector	CE connector (DDK) /JL04V connector (JAE)	1	CE05-6A22-22SD-D-BSS / JL04V-6A22-22SE-EB-R
Waterproof cable clamp	CE connector (DDK) / JL04V connector (JAE)	1	CE3057-12A-1-D / JL04-2022CK(14)-R
Signal connector	D-sub 15pin male	1	With a clamp hood
Quick Manual	Japanese and English	1	–
Power connector guard	–	1	–
Nuts (L types only)	1/4	1	VUW-6.35N
Front rings (L types only)	1/4	1	VUW-6.35S
Back rings (L types only)	1/4	1	VUW-6.35R

3.3 Transport

	**Do not use the casters as a transportation device or a means of equipment support.** Although this pump is equipped with casters, do not use them as a transportation device or a means of equipment support.
	**Do not incline this pump by 10 or more.** Otherwise, this pump may topple, causing injury or damage.
	**For transport, use cargo-handling equipment (e.g., a mobile crane) or a pallet truck.** The pump's weight is as follows. LS120: 142 kg, LS300: 220 kg, LS600: 242 kg, LS1200: 266 kg To transport this pump, a load higher than the safety standards is required. Therefore, manually transporting it may cause lower back pain or injury.
	**Wear safety shoes** Be sure to wear safety shoes before transferring this pump.

3.3.1 How to hoist this pump using a crane

Danger	**Never get under this pump.** When hoisting this pump, it may fall or topple if a forcible operation is performed or if the equipment is not sufficiently maintained. Never get under this pump.
Warning	**Use a crane or other cargo-handling equipment.** When taking this pump out of the package or lifting it, instruct workers to lift it while holding the eyebolts on the upper part using a crane or other cargo-handling equipment and to transport it. Before using the eyebolts, confirm that there are no abnormalities.

1. Prepare an appropriate hoisting attachment and check that the eyebolts are in normal condition (e.g., not loosened or damaged).
2. Hang the hoisting attachment on the pump's eyebolts and the crane hook.

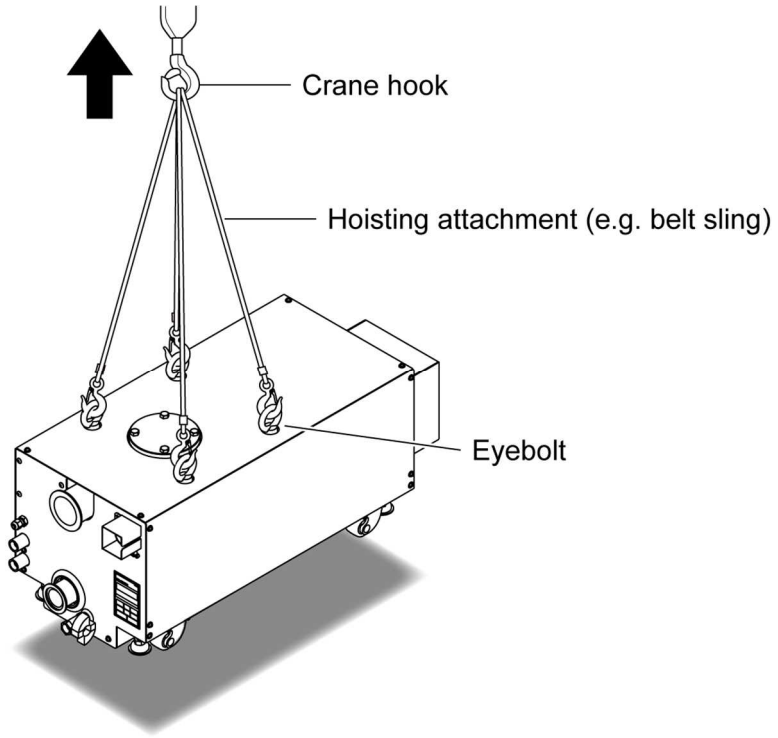


Fig. 16 Hoisting by crane

3. Slowly operate the crane and hoist the pump up to the point immediately before it leaves the ground.
4. Operate the crane again and hoist the pump until it leaves the ground.
5. After starting to hoist the pump, confirm that the belt sling and hoisting tool are in normal condition. Confirm that the load is not inclined.
6. When unloading the pump, slowly lower the crane so as not to apply shock to or damage the pump.

3.3.2 How to transport this pump via pallet truck

Warning

Do not carry this pump with the adjusters raised.

When transporting this pump via pallet truck, lower the four adjusters. If you carry this pump without the adjusters attached to the pallet, the pump may topple, causing injury or damage.

Warning

Always use a pallet when transporting via a pallet truck.

Do not transport this pump by pallet truck without placing it on a pallet. Otherwise, this pump may topple, causing injury or damage.

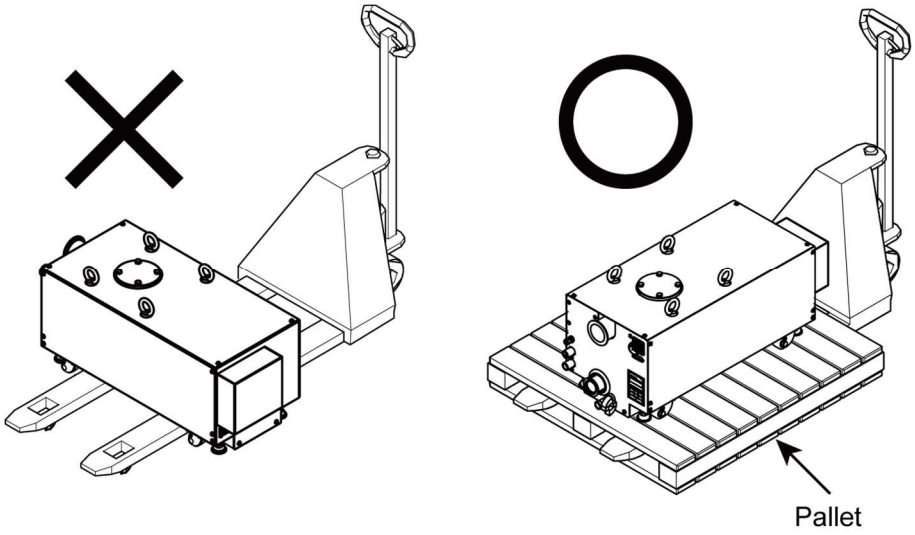


Fig. 17 Using a pallet

1. When placing this pump on a pallet, lower the four adjusters.

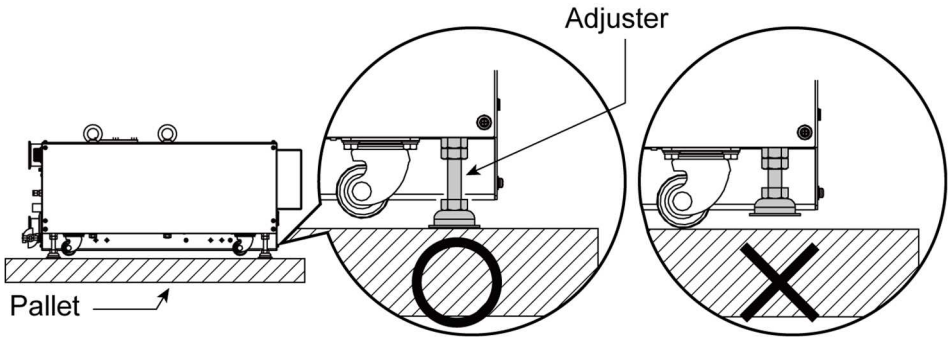


Fig. 18 Adjusters during transport

2. Put the pallet truck's fork through the pallet and slowly lift the pallet.
3. Transport this pump after confirming that there are no obstacles in the direction of travel.

3.4 Installation

3.4.1 Leveling

Notice	**Install this pump so that it is level.** If you install this pump on an inclined floor or other such surface, or if adjuster-based adjustment is out of balance, noise or failure may occur.

After moving this pump to the installation location, use the adjusters to adjust the pump's inclination and install it so that it is as horizontal as possible. (The adjustment range is within +10 mm.)
Use the adjusters to perform adjustment while checking the inclination with a level as necessary.

3.4.2 Earthquake countermeasures

As an earthquake countermeasure, fixing brackets are available as an option.

Notice	**Fix this pump in place in case an earthquake occurs.** In case an earthquake occurs, securely fix this pump in place as in Fig. 20 Earthquake resistant fixing brackets. If the pump is not sufficiently fixed in place, it may topple or move, damaging the surrounding equipment.
Notice	**The piping and wiring must be structured to absorb shaking.** Ensure that the vacuum piping, cooling water piping, purge gas piping, and power wiring have a structure that absorbs shaking so that the piping does not break or become disconnected if shaking occurs.

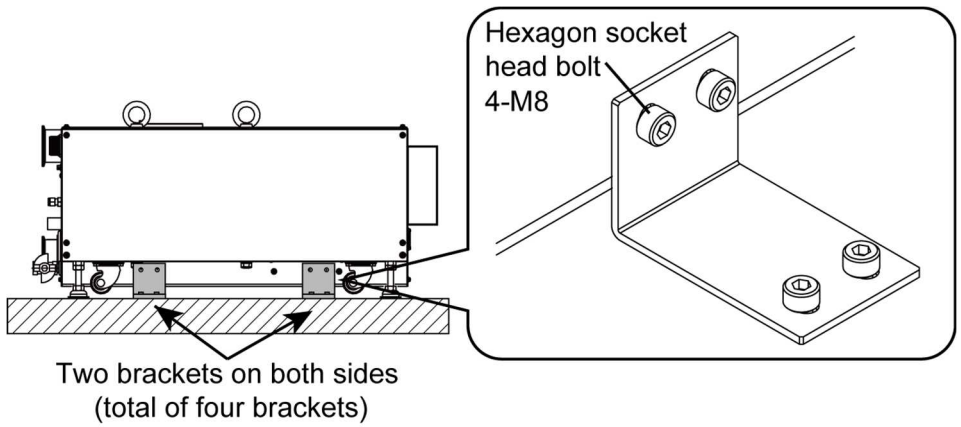


Fig. 19 Earthquake-resistant fixing brackets

Earthquake resistance has been checked based on the requirements of the 1997 edition of the USA's Uniform Building Code (UBC).

For the overturning moment, horizontal load, and position of the center of gravity, refer to Table 8 Earthquake resistance evaluation.

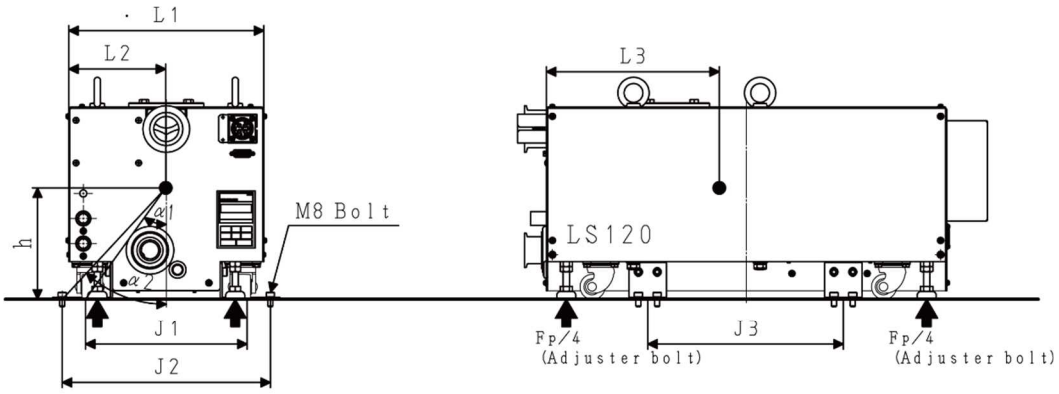
Table 8 Earthquake resistance evaluation

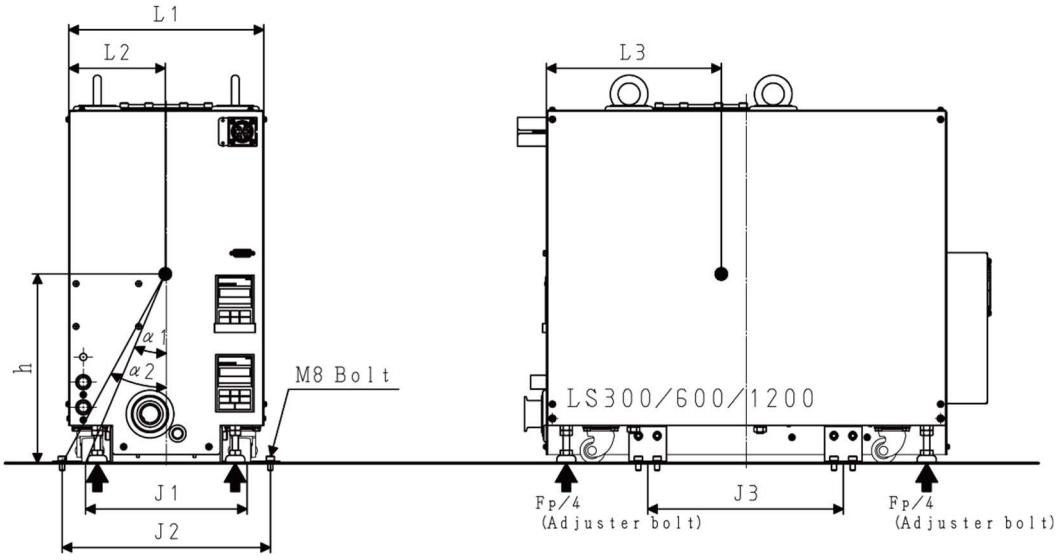
ULVAC, Inc. Components Div.

Earthquake resistance evaluation

Date : March , 2018

		unit	LS120	LS300	LS600	LS1200
Whole width of the surface of projection that falls easily	L1	mm	311	311	311	311
Short distance from the fulcrum on the surface of projection that falls easily to the position of the center of gravity	L2	mm	128	127	126	127
Distance from the rear panel to the position of the center of gravity	L3	mm	276	232	260	279
Height from the floor to the position of the center of gravity	h	mm	178	270	288	301
Weight of equipment	Wp	kg	142	220	242	266
Horizontal moment (adjuster bolt) Fp=0.94×Wp	Fp/4	kg	33.4	51.7	56.9	62.5
There is overturning moment R when 0.94*h>0.85*L2.			OK	OK	OK	OK
Overturning moment R=(Wp*(0.94h-0.85L2))/(2*L1)	R	kg	13.4	51.6	63.7	74.8
Shear stress of anchor bolt (M8 × 2)	τ	N	2038	2038	2038	2038
Fp<τ			OK	OK	OK	OK
Tensile stress of anchor bolt (M8 × 2)	σ	N	3531	3531	3531	3531
R<σ			OK	OK	OK	OK
Interval between adjuster bolts	J1	mm	220	220	220	220
Interval between earthquake-resistant brackets	J3	mm	312	312	312	312
Tipping angle	α1	deg	31.7	22.2	20.9	20.1
Interval between earthquake-resistant brackets	J2	mm	332	332	332	332
Tipping angle	α2	deg	43.0	31.6	30.0	28.9
α>15deg			OK	OK	OK	OK





3.5 Piping and Wiring

Warning	**Shut off hazardous energy sources.** Before working on piping or wiring, check that all hazardous energy sources have been shut off by referring to "1. To Ensure Safe Use."
Notice	**The piping and wiring must be structured to absorb shaking.** Ensure that the vacuum piping, cooling water piping, purge gas piping, and power wiring have a structure that absorbs shaking so that the piping does not break or become disconnected if shaking occurs.

3.5.1 Piping for the pump inlet and exhaust outlet ports

Warning	**Do not increase the pressure on the pump's exhaust side to 0.03 MPaG or higher.** Measure the pressure on the pump's exhaust side. If the pressure is 0.03 MPaG (0.3kg/cm2G) (gauge pressure) or higher, remove any objects that prevent gas on the exhaust port side from passing. If the pump's internal pressure exceeds 0.03 MPaG, the pump may rupture.

- **Before connecting piping, remove the flange for storage.**

  In the LS series, the flange for storage, inlet port mesh, and desiccant are attached to the pump inlet port flange upon shipment from the factory. Before connecting piping, remove the flange and desiccant for storage.

- **Be sure to attach the flange to the unused pump inlet port.**

  The LS120 has both a horizontal and a vertical pump inlet port. Be sure to attach the flange to the unused pump inlet port.
  * For the LS120, use of the horizontal pump inlet port is assumed. When using the vertical pump inlet port, attach a blank flange to the horizontal pump inlet port. (The blank flange for the horizontal pump inlet port is not provided as standard equipment.)

- **Do not put foreign objects into the pump inlet or exhaust outlet ports.**

  When connecting piping, do not allow foreign objects (e.g., bolts) to fall into the pump inlet port or exhaust outlet ports. If a foreign object falls into a port, the pump must be disassembled to remove the object. In such a case, contact our nearest service center.

- **Do not directly put a load on the pump inlet port or exhaust outlet ports.**

  Ensure that the loads of connected piping and other parts are not directly put on the pump inlet port or exhaust outlet ports.

- **Be careful not to damage the gasket's sheet surface.**

  Be careful not to damage the gasket's sheet surface (pump inlet or exhaust outlet ports). After assembling the piping, perform a leak test for the entire system.

- **The pump is not leakless in the C specifications.**

  The ECO-SHOCK section on the exhaust side of the pump is not leakless in the C types.

- **Use piping that can sufficiently withstand pressure.**

  If the exhaust piping is thin metal piping, bellows, or the like, it may resonate due to exhaust pulse, causing noise that exceeds the standard value for the work environment. Use piping that can sufficiently withstand pressure.

3.5.2 Cooling water piping

Notice 	**Use an appropriate joint.** This pump's cooling water port is Rc3/8. Connect the cooling water piping to it using an appropriate joint. Do not confuse the cooling water inlet with the cooling water outlet.
Notice 	**Points to observe when using cooling water piping** Observe the following items related to cooling water and piping.

- **Be sure to flow the necessary amount of cooling water.**

  If the amount of water drops below the specified value, especially during a high inlet pressure operation, the pump's temperature rises, causing a pump abnormality. We recommend installing a flowmeter in the cooling water system and installing an interlock so that the pump will be stopped if the amount of water drops below the specified value.

- **When stopping operation of the pump in winter, release any water inside the pump.**

  Otherwise, when stopping operation in winter, the pump may be damaged by water that freezes in the cooling water piping. When stopping operation, release the water inside the pump by, for example, blowing compressed air into the cooling water port.

- **We recommend using water that contains few impurities (e.g., industrial water; refer to the table below).**

  We recommend using water that contains few impurities as cooling water for this pump (e.g., refer to Table 9 [Reference] Standard Quality of Industrial Water in Japan).
  Depending on water quality, water stains from calcium carbonate or other substance may accumulate inside the pump's cooling water system, reducing the amount of cooling water. In addition, chlorine ions may corrode the inner wall, causing cooling water to leak.
  If using pure water, metal may elute, causing cooling water to leak. Note in advance that in such cases, we may charge for repair.

Table 9 [Reference] Standard Quality of Industrial Water in Japan

Turbidity	pH	Alkalinity	Hardness	Evaporation residue	Chlorine ions	Iron	Manganese
20 mg/L or less	6.5 to 8.0	75 mg/L or less	120 mg/L or less	250 mg/L or less	80 mg/L or less	0.3 mg/L or less	0.2 mg/L or less

Established by the Japan Industrial Water Association (Industrial Water Quality Standards Establishment Committee).

- **Do not install electrical equipment or wiring underneath this pump or on the floor around it.**

  This pump is designed not to leak water under the specified conditions. It has undergone a water leakage test. However, if this pump is used under abnormal conditions that deviate from the specifications (e.g., an abnormal rise in water pressure), water may leak. In such a case, water will continue to leak until water supply from the equipment is stopped. Do not install electrical equipment or wiring underneath this pump or on the floor around it.
  We recommend placing a water leakage sensor below this pump or on the floor around it so that the power will be shut off if the water leakage sensor activates.

- **Install a flowmeter (e.g., flow sight) on the cooling water supply source.**

  To check the flow, install a flowmeter that can be used to visually recognize that cooling water is flowing (e.g., flow sight) on the cooling water supply source of the equipment or other device.

- **When using multiple pumps, connect their cooling water piping in parallel.**

  When using multiple pumps, connect their cooling water piping in parallel. If such piping is connected in series, cooling capacity will be insufficient, causing a failure.

- **Use a filter or other tool to filter water that has many impurities.**

  When using that has with many impurities, including water stains or iron, use a filter or other tool to filter it during the stage prior to use.

- **Ensure a sufficient flow rate.**

  If you continue to operate the pump with a cooling water flow rate below the specified value, a failure may occur.

  Ensure the specified flow rate.

  If the supply source and drainage port are far away from each other or if the piping has a difference in height (the drainage port is raised above the pump), it may not be possible to ensure a sufficient flow rate. In this case, ensure the flow rate by changing the piping layout, replacing the piping with larger piping, or increasing the supply pressure within the specification range.

- **Use piping that has appropriate water pressure resistance and heat resistance.**

  In the cooling water system, use joints and piping that have a water pressure resistance of at least 0.9 MPa and heat resistance of at least 70°C.

- **In the cooling water system (including facilities), do not use metal piping other than SUS piping.**

  In the cooling water system (including facilities), do not use metal piping other than SUS piping. For example, when using metal piping that contains copper, zinc, or other substances, ions may melt in water. Melted ions may separate out and adhere to the piping's inner wall, reducing the cooling water flow rate.

  This pump uses SUS piping and the PTFE as cooling water piping. Note in advance that we will charge for repair of problems caused by piping blockage or decreased cooling efficiency due to separation or accumulation of impurities (water stains, microorganisms, metal powder, or metal ions).

■ Specifications of the junction area

Connection port Rc3/8 female

■ Compatible piping

Joints and piping that have water pressure resistance of at least 0.9 MPa
The heat resistance must be at least 70°C.

Table 10 Piping specifications

Cooling water	Supply pressure (MPa)	0.1 to 0.3	
	Differential pressure at ports (MPa)	0.1	
	Flow rate (L/min)	LS120：＞2.0	LS300／LS600／LS1200：＞4.0
	Supply water temperature (°C)	10 to 30 (no condensation)	

3.5.3 Purge gas

The pump with the L types has a purge gas introduction mechanism.
If the gas you handle contains condensable gas or water, liquid may accumulate at the pump's final stage.
Introduce CDA (dew point: -60°C) or nitrogen at the pump's final stage using purge gas to suppress liquid from accumulating at the pump's final stage. Be sure to adjust a flow rate of purge gas after running at the ultimate pressure.

Warning	**Use the provided nuts and ferrules.** Use the provided nuts and ferrules for piping. Use of other parts may cause a failure or accident.
Notice	**When stopping this pump, perform a warm-up operation before processing and the degassing operation.** When stopping this pump, be sure to perform a warm-up operation for 1 hour before processing and the degassing operation (when operating in the open air). If you perform processing before the temperature has sufficiently risen in the pump's main unit during the initial stage of startup or if there is residue gas when the pump stops, condensable gas will condense inside the pump, reducing the pump's service life.
Notice	**Use a configuration that prevents condensed gas from directly returning to the pump.** Bend the exhaust side piping using an L-shaped pipe or other tool so that condensed gas does not directly return to the pump. We recommend installing a mechanism that releases accumulated liquid.
Notice	**Exhaust water vapor at up to 1.5 kg/hr.** If this pump exhausts more water vapor than its processing capacity, even purge gas may condense inside the pump, reducing the pump's service life. We recommend operating the pump continuously, avoiding intermittent or similar manners of operation.

Connect the purge gas piping based on the following specifications.

■ Specifications of the junction area

Tube fitting for 6.35 mm-diameter pipe

■ Compatible piping

Use SUS pipe having an outside diameter of 6.35 mm and pressure-proof joints of at least 0.9 MPa.
The heat resistance performance should be at least 100°C.
Supply gas pressure: 0.09 to 0.11 MPaG Flow rate: 48 to 55 SLM

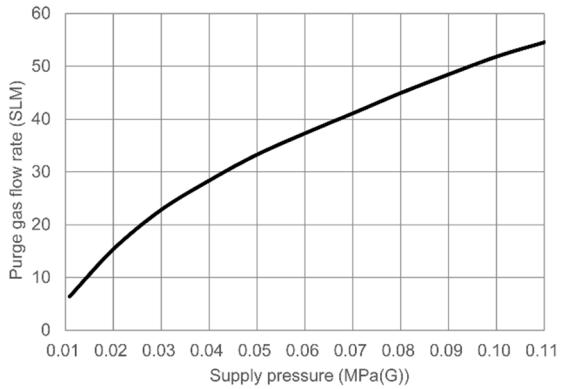


Fig. 20 Supply pressure and flow rate for regulator

3.5.4 Drain

The L types provide a front drain valve and side drain port in order to prevent liquid condensed on the exhaust port side from accumulating inside the pump.

When discharging a condensable gas, connect the drain pipe to the drain valve and drain port, and then actively discharge the liquid.

Periodically drain the pump manually or by using a pump or other tool while the pump is stopped.

When draining the pump while it is operating, use a structure that prevents backflow because there is a risk of backflow if the pump interior is in a vacuum state when it stops.

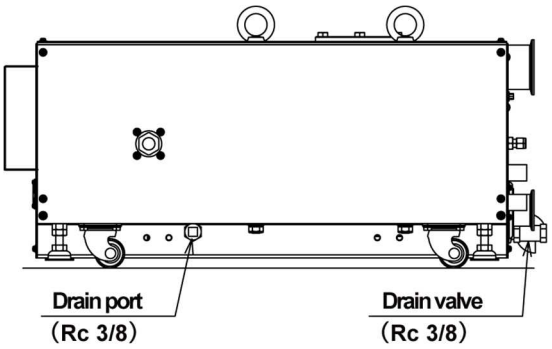


Fig. 21 Drain

3.6 Wiring

3.6.1 Power wiring

	**Wiring work must be performed by certified workers.** Electrical wiring work must be performed by certified workers.
	**Before performing wiring work, turn off the primary side power supply.** When performing wiring work, before starting, be sure to turn off the primary side power supply. Never perform wiring work while applying voltage.
	**Be sure to connect the ground terminal.** Incomplete grounding may cause electrical shock.
	**Use the supplied connectors.** Use only the supplied connectors. If other connectors are used, the first ground contact may fail, incurring the possibility of electrical shocks.
	**Use only with the rated voltage.** Use this pump only with the rated voltage. Otherwise, the earth leakage circuit breaker will not operate normally, which may cause burnout or a fire.
	**Conform to all laws and regulations.** Install and operate this pump according to the safety-related laws and regulations (such as fire prevention laws and electrical wiring regulations) in your country or region.
	**Fix the cable in place or provide it with a cover.** Fix the cable in place so that it does not directly contact the pump, or provide it with a cover (cable rack).
	**Provide an earth leakage circuit breaker.** An earth leakage breaker protects equipment and wiring in the event of a short circuit and provides overload protection. In addition, it also prevents electrical shocks and protects against ground faults, which can trigger electrical leakage fires. If an earth leakage breaker is not attached, or if the attached earth leakage breaker is not appropriate for the motor capacity, then equipment burnout, fire, or electrical shock may result.

- Use wire compatible with your local safety codes (e.g. UL, TUV compatible).
- Wire the cable according to the regulations in NEC Article 400.
- Prepare a power supply with a capacity appropriate for the pump's power specifications by referring to “Table 13 Power supply capacity and recommended earth leakage circuit breaker ratings list”.
- In addition, high-frequency leakage currents occur because an inverter is used inside the pump. When using a leakage breaker that does not implement the specified high-frequency countermeasures, use an earth leakage circuit breaker with a residual operating current value of 200 mA or more.

Table 11 Power supply capacity and recommended earth leakage circuit breaker ratings list

Ratings list	200V				400V			
	LS120	LS300	LS600	LS1200	LS120	LS300	LS600	LS1200
Recommended type	NV-32SV(F)-(Mitsubishi Electric)							
Rated current (A)	20	30	30	30	10	15	15	15
Rated residual operating current (mA)	30	30	30	30	30	30	30	30
Power supply capacity (kVA)	7.5	9	11	12	7.5	9	11	12

■ Power supply pin assignment

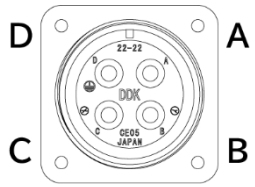


Fig. 22 Pin assignment

Pin assignment	
Pin No.	Specifications
A	L1/R phase
B	L2/S phase
C	L3/T phase
D	PE/GND

Table 12 Receptacle connector specifications

Receptacle connector maker	Dai-Ichi Electronic Inc. Ltd. / Japan Aviation Electronics Industry,Ltd.
Receptacle part No.	CE05-2A22-22PD-D / JL04HV-2E22-22PE-B-R
Compatible plug (direct type)	CE05-6A22-22SD-D-BSS / JL04V-6A22-22SE-EB-R
Compatible wire size	Max. 10AWG/4 conductors Outside diameter of insulation coating φ4.5 mm
Rated current (50/60 Hz)	46A

- Attach the guard after connecting the power connector.

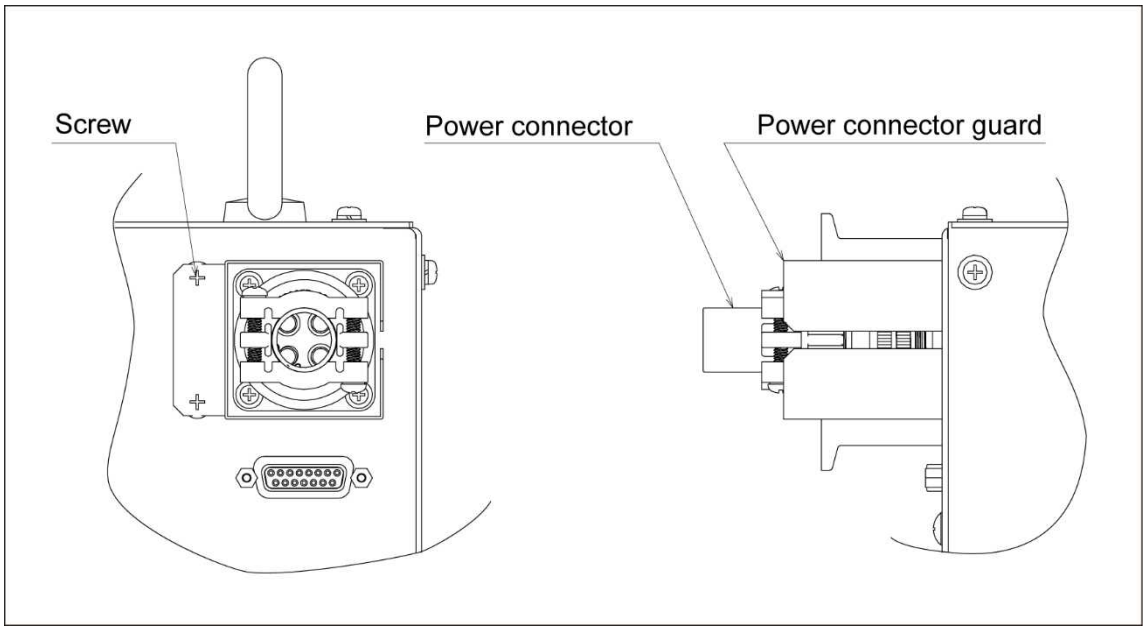


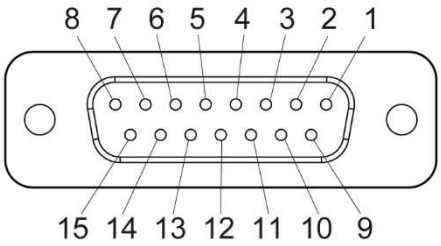
Fig. 23 Power connector guard attachment drawing

3.6.2 Wiring for remote control

	**Power supply wiring work must be performed by certified workers.** Electrical wiring work must be performed by certified workers.
	**Before performing wiring work, turn off the primary side power supply.** Before performing wiring work, turn off the primary side switch. Never perform wiring work while applying voltage.

- A voltage of 24 VDC and a current of 8 mA are applied to the input system on the pump side. Prepare a no-voltage contact.
- The pump side of the output is a no-voltage contact (photocoupler output). For the signal voltage, use a voltage of 48 VDC and a current of 2 to 50 mA.
- When starting or stopping this pump from a remote location, connect the signal line to the remote connector plug. This pump can be started or stopped by contact signals.
- Signal connector pins 13 and 14 are short-circuited by default upon shipment from the factory. When it is not necessary to start or stop the pump remotely, use it with the signal connector plug attached.
- If not using the external interlock function (used when activating an interlock with equipment other than a system in which the pump is installed), connect 13 and 14 by jumper wire. If this wiring is not connected between these pins, the pump will recognize it as an external interlock command and will not start. ("Hbb" will be displayed on the controller.)
- "Start check" is output when the DRP revolution speed is 4000 or higher.
- While the "Pump start" signal is input, the "Alarm reset" signal is ignored. Be sure to turn the "Pump start" signal OFF before executing "Alarm reset."
- The inverter can be started and stopped by turning the power supply side electromagnetic contactor (MC) ON or OFF, respectively. However, doing this frequently will cause the inverter to fail. In view of the life of the relay contact or electrolytic capacitor inside the inverter, limit the frequency of starting and stopping to once in 30 minutes.
- To conform to the EMC standards, noise contacted from the cable must be suppressed. Use a shielded cable for wiring. The conduction noise changes depending on factors such as the relationships between other electrical equipment that has been incorporated, wiring conditions, and the arrangement details. Check the conformity of the entire pump and system at your facilities.
- "External abnormality" can be used to stop the pump by contact signal of other equipment (eg flowmeter).

■ Pin assignment for remote control wiring



Pin assignment				
No.	I / O	Item	Specifications	
1	IN	Pump start	CLOSE: Run	OPEN: Stop
2	IN	Alarm reset	CLOSE: Reset	
3	IN	External abnormality	CLOSE: Abnormal	OPEN: Normal
4	IN	Spare	Unavailable	
5		N.C		
6	OUT	Startup check	CLOSE: Running	OPEN: Stopped
7		N.C		
8	OUT	Alarm	CLOSE: Normal	OPEN: Alarm
9	IN	IN COM		
10		N.C		
11		N.C		
12		N.C		
13	IN	External interlock	CLOSE: Normal	OPEN: Interlock
14	IN	External interlock common		
15	OUT	OUT COM		

Fig. 24 Pin assignment for remote control wiring

Table 13 Connector specifications

Pump side connector	D-sub 15pin female
Compatible connector	D-sub 15pin male
Compatible wire size	AWG #22

* Size of connector screws are M2.6.

4. Operation

4.1 Precautions for operation

	**Only suction for inert gases.** This pump is designed to exhaust only inert gases (air, nitrogen, or argon). It cannot be used to exhaust other gases (toxic, combustible, corrosive, or explosive gas, or gas that increases the susceptibility of substances) because such gas may leak from the pump's main unit or ignite or explode inside the pump.
	**Do not suction toxic gases with this pump.** If this pump sucks in toxic gas, both the pump's main unit and the lubricant will become toxic. Keep this in mind during maintenance.
	**Do not use this pump in areas where a hazardous atmosphere may form.** Do not use this pump in areas where a hazardous atmosphere may be formed by an explosive gas. Otherwise, injury or fire may occur.
	**Do not block the exhaust outlet port.** Do not operate this pump with equipment attached to the exhaust outlet port side that blocks the exhaust outlet port or disturbs the flow of gases. Such operation may cause the pump's internal pressure to rise, causing the casing or level gauge to rupture, oil leakage, or motor overload. This pump does not have a pressure-resistant structure. The pump's guaranteed withstand pressure is 0.03 MPaG (0.3 kg/cm2G) (gauge reading).
	**Ensure a space of at least 0.5 m in front of the outlet port.** If there is a wall or obstacle within 0.5 m of the outlet port, abnormal heating may cause burn injuries or fire.
	**During operation, do not touch the pump's main body or piping.** During operation, do not touch the pump's main body or piping during operation because they reach extremely high temperatures. Touching it may lead to burns.
	**Confirm that the valves are open.** If the piping located behind the exhaust outlet port has valves, confirm that such valves are open.
	**Be sure to feed cooling water to this pump during operation.** Be sure to feed cooling water to this pump during operation. The necessary amount of cooling water is as follows. - Cooling water amount: at least 2.0 L/min. (LS120) or 4.0 L/min. (LS300/LS600/LS1200) - Cooling water in/out pressure difference: 0.1 to 0.3 MPaG (gauge reading) - Cooling water temperature: 10 to 30 ˚C

Notice

For cooling water, use water containing few impurities.

We recommend using water that contains few impurities (e.g., industrial water; refer to the table below). Depending on water quality, water stains from calcium carbonate or other substance may accumulate inside the pump's cooling water system, reducing the amount of cooling water.
In addition, chlorine ions may corrode the inner wall, causing cooling water to leak. If using pure water, metal may elute, causing cooling water to leak.
Note in advance that in such cases, we may charge for repair.

[Reference] Standard Quality of Industrial Water in Japan

Turbidity	pH	Alkalinity	Hardness	Evaporation residue	Chlorine ions	Iron	Manganese
20 mg/L or less	6.5 to 8.0	75 mg/L or less	120 mg/L or less	250 mg/L or less	80 mg/L or less	0.3 mg/L or less	0.2 mg/L or less

Established by the Japan Industrial Water Association
(Industrial Water Quality Standards Establishment Committee).

Notice

Pay attention to decreases in the amount of cooling water.

When the amount of cooling water decreases, failures occur, such as rapid wear and burnout of pump components. The risk of such failures increases particularly when the inlet pressure is high. Keep alert for decreases.

Notice

Use the pump with the external panel attached.

If the pump is operated with the external panel removed, performance may deteriorate. Be sure to use the pump with the panel attached. Vacuum pumping performance may not be fully exerted immediately after starting the pump or if the panel is removed.

Notice

Perform warming-up operation for approximately 30 minutes (recommended) after starting.

We recommend performing warming-up operation for approximately 30 minutes after starting so that the pump can fully exert its vacuum pumping performance.

Notice

Upon pump startup, avoid operations that apply a large load.

When it takes a long time for the pump to reach the stationary rotational frequency after startup, the inverter protection circuit activates, stopping the pump with an alarm. Apply a load after the pump reaches the stationary rotational frequency.

Notice

Do not suction acids or other chemicals.

If the pump suctions acids or other chemicals, it may become out of order.

4.2 Preparations for Operation

4.2.1 Pre-operation check

Before starting operation of this pump, reconfirm the following.

1. Confirm that connection of the cooling water piping, and power connector, and signal connector has been completed.
2. Open the cooling water valve and confirm that no cooling water leaks.
3. When feeding a purge gas in a pump with the L types, feed the purge gas after connect the purge gas piping. Confirm that the purge gas does not leak.
4. Supply the primary side power.

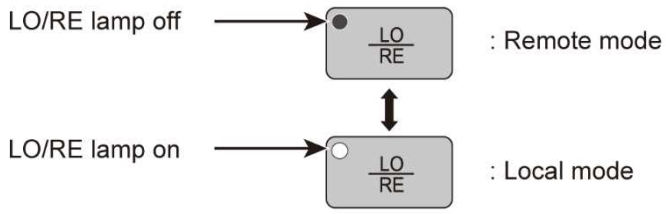
4.2.2 How to switch between LOCAL (manual) / REMOTE modes

Inputting operation commands on the controller is called LOCAL operation.
Inputting operation commands through sequence control from an upstream system via the remote control wiring is called a REMOTE operation.

1. **Turn on the power supply.**
   The initial screen appears.
2. **Press** 

only if using the DRP controller.

   This toggles LOCAL and REMOTE mode.
   The LO/RE lamp turns off when "REMOTE" mode is selected; it turns on when "LOCAL" mode is selected.



* Do not be selected "LOCAL" mode on MBP controller. MBP cannot start rotating, if "Start check" is output when the DRP revolution speed is 4000 or higher.

4.3 How to Start and Stop the Pump

4.3.1 LOCAL operation

Use the pump with the supplied signal connector plug attached.

How to start the pump

- **Press** RUN **on the DRP controller.**

  The pump starts and the RUN lamp on the controller turns on.
  * MBP starts rotating automatically when the DRP revolution speed exceeds 4000 rpm.

How to stop the pump

- **Press** STOP **on the DRP controller.**

  The pump stops and the RUN lamp on the controller turns off.
  * MBP starts decelerating automatically when the DRP revolution speed drops below 4000 rpm.

4.3.2 REMOTE operation

Use the machine to which the supplied signal connector plug has been attached with a signal line wired to each pin.

How to start the pump

- **Input the start signal from the host side.**
  The pump starts.
  * MBP starts rotating automatically when the DRP revolution speed exceeds 4000 rpm.

How to stop the pump

- **Cut off the start signal from the host side.**
  The pump stops.
  * MBP starts decelerating automatically when the DRP revolution speed drops below 4000 rpm.

4.4 Monitor Display

4.4.1 Monitor display method

To check each pump state, select "Monitor Display" on the controller and follow the procedures below.

1. **Turn on the power supply.**
   The initial screen appears.

2. **Press** [∧] **or** [∨] **until**  **(monitor display) appears on the controller, and then press** [ENTER] **.**
   The controller changes to "Monitor Display" mode.

3. **Press** [∧] **or** [∨] **, and then select the parameter that you wish to display.**

4. **Press** [ENTER] **, and check each pump status.**

5. **When you are finished checking, press** [ESC] **to return to the initial screen.**

4.5 List of Parameters

4.5.1 U1：Status monitor

To display the operation status, use the U1 parameter.

Table 14 List of status monitor parameters

No.	Name	Function
U1-03	Output current	Displays the output current.

4.5.2 U3：Alarm history

To display the alarm history, use the U3 parameter.

Table 15 List of alarm history parameters

No.	Name	Function
U3-01	First prior alarm content	Displays the content of the first prior alarm.
U3-02	Second prior alarm content	Displays the content of the second prior alarm.
U3-03	Third prior alarm content	Displays the content of the third prior alarm.
U3-04	Fourth prior alarm content	Displays the content of the fourth prior alarm.
U3-05	Fifth prior alarm content	Displays the content of the fifth prior alarm.
U3-06	Sixth prior alarm content	Displays the content of the sixth prior alarm.
U3-07	Seventh prior alarm content	Displays the content of the seventh prior alarm.
U3-08	Eighth prior alarm content	Displays the content of the eighth prior alarm.
U3-09	Ninth prior alarm content	Displays the content of the ninth prior alarm.
U3-10	Tenth prior alarm content	Displays the content of the tenth prior alarm.
U3-11	Cumulative No. of operating hours upon the first prior alarm	Displays the cumulative number of operating hours upon the occurrence of the first prior alarm.
U3-12	Cumulative No. of operating hours upon the second prior alarm	Displays the cumulative number of operating hours upon the occurrence of the second prior alarm.
U3-13	Cumulative No. of operating hours upon the third prior alarm	Displays the cumulative number of operating hours upon the occurrence of the third prior alarm.
U3-14	Cumulative No. of operating hours upon the fourth prior alarm	Displays the cumulative number of operating hours upon the occurrence of the fourth prior alarm.
U3-15	Cumulative No. of operating hours upon the fifth prior alarm	Displays the cumulative number of operating hours upon the occurrence of the fifth prior alarm.
U3-16	Cumulative No. of operating hours upon the sixth prior alarm	Displays the cumulative number of operating hours upon the occurrence of the sixth prior alarm.
U3-17	Cumulative No. of operating hours upon the seventh prior alarm	Displays the cumulative number of operating hours upon the occurrence of the seventh prior alarm.
U3-18	Cumulative No. of operating hours upon the eighth prior alarm	Displays the cumulative number of operating hours upon the occurrence of the eighth prior alarm.
U3-19	Cumulative No. of operating hours upon the ninth prior alarm	Displays the cumulative number of operating hours upon the occurrence of the ninth prior alarm.
U3-20	Cumulative No. of operating hours upon the tenth prior alarm	Displays the cumulative number of operating hours upon the occurrence of the tenth prior alarm.

4.5.3 U4：Operation monitor

To display the pump’s operation information, use the U4 parameter.

Table 16 List of operation monitor parameters.

No.	Name	Function
U4-01	Cumulative No. of operating hours	Displays the pump's cumulative No. of operating hours.
U4-08	Inverter temperature	Displays the inverter temperature.

5. Maintenance and Inspections

To use the pump safely while maintaining its original performance, you must perform daily and periodic inspections as well as maintenance.

5.1 Daily Inspections

To prevent pump failures and extend the pump's service life, inspect the following items.

Item	What to check	Abnormality response
Lubricating oil color (L types)	Check the lubricating oil color from the lubricant oil view port.	If the color has changed, contact the ULVAC service center.
Cooling water	The cooling water flows at the specified flow rate.	Check the hydraulic pressure and piping.
Water leakage	The floor is not wet.	Check the hydraulic pressure and piping.
Purge gas (When using a purge gas)	The purge gas flows at the specified flow rate.	Check the supply pressure and piping.
Abnormal sounds or vibrations	There are no abnormal sounds or vibrations.	Check whether the pump and piping, etc. are fixed in place.
Power value	No overload is being applied to the pump.	Check the inlet-side pressure. Check the exhaust-side piping.

5.2 Inspection after Long-term Storage

If this pump is stored for a long period of time without being operated (at least six months), trouble may occur when the pump is operated due to rusting.

If the pump has not been used for a long period of time, before using the pump again, request an inspection from your local ULVAC service center.

5.3 Overhaul

We recommend performing an overhaul periodically. Overhauls are necessary to maintain performance (including safety) as well as to ensure the planned level of productivity.

⚠Caution 	**Perform an overhaul once a year.** Overhaul the pump once a year. When usage conditions make the contamination or performance degradation significant, we recommend performing an overhaul even when less than a year has passed since the previous overhaul. Upon performing an overhaul, the components listed in the "Appendix Major Replacement Parts" must be replaced at a minimum.

When an overhaul is required, contact your local ULVAC service center. When requesting overhaul, maintenance, repair, or other work, fill out the Declaration of Contamination attached to this document and submit it to the service center.

If you do not inform us of the details of hazardous substances you have used or that the pump exhausted a substance that is difficult to detoxify, we may refuse to maintain or otherwise handle the pump.

5.4 Notes on Transportation

This product is precision equipment. Do not give any strong impact or continuous vibration in transportation, otherwise the product could be damaged. In transportation, please use a means of transportation which have vibration-proof function (an air suspension truck, for example).

Especially when passing by rough road, we recommend that the product is transported keeping the packing condition when it ships from ULVAC.

When the product is put on the high temperature / humidity environment for a long time, it causes the breakdown of the product due to corrosion of mechanical parts or performance loss of electrical parts. Please transport or store the product under an appropriate environment.

6. Troubleshooting

6.1 Major Problems

Table 17 Major Problems

Problem	Cause	Corrective action	Reference
The pump does not turn on.	No power is supplied.	Supply power.	4.2.1
	The connector is incorrectly wired.	Perform wiring correctly.	3.6.1
	There is a leak inside the pump.	Contact the ULVAC service center.	Last page of this manual
The controller display is blank	No power is supplied.	Supply power.	4.2.1
	An instrumentation failure has occurred.	Contact the ULVAC service center.	Last page of this manual
The controller cannot activate the pump.	LOCAL mode is not selected.	Press the REMOTE/LOCAL switch.	4.2.2
	The wiring for external interlock is not connected ("Hbb" turns on).	Short circuit pins 13 and 14 for remote control.	3.6.2
	An instrumentation failure has occurred.	Contact the ULVAC service center.	Last page of this manual
The pump does not start by remote operation.	The remote control wiring is not connected correctly.	Correctly connect the remote control wiring.	3.6.2
	The wiring for external interlock is not connected ("Hbb" turns on).	Short circuit pins 13 and 14 for remote control.	3.6.2
	An instrumentation failure has occurred.	Contact the ULVAC service center.	Last page of this manual
The pump makes an unusual sound.	The panel makes a vibrating sound.	Contact the ULVAC service center.	Last page of this manual
	An exhaust sound is heard.	Even if the pump is operating normally, the sound may become loud due to resonance in the piping. Use a pipe with a thicker wall to suppress the sound.	
	A pump failure has occurred.	Contact the ULVAC service center.	Last page of this manual
	The exhaust side pressure has risen.	Check the exhaust piping.	3.5.1
	The inlet piping is leaking.	Check the inlet piping and stop the leak.	3.5.1
The pressure does not decrease.	The inlet port mesh is clogged.	Check the inlet piping.	3.5.1
	The suction piping is clogged.	Check the exhaust piping.	3.5.1
	The pump operation temperature has not reached the target value.	Perform a warm-up operation for approximately 30 minutes after startup. The ultimate pressure in the specification table is the value directly above the pump.	7.1

6.2 Alarm Statuses and Corrective Actions

Display	Alarm name	Status
CoF (CoF)	Current offset fault	Operation has started while the motor is free-running

Cause	Corrective action	Reference
The pump was restarted before pump rotation had come to a complete stop.	Restart the pump after pump rotation has stopped completely.	4.3
	If this alarm still occurs after restarting the pump, contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
STo (STo)	Step-out detection	Motor step-out has been detected.

Cause	Corrective action	Reference
Power interruption	Check the electrical wiring.	3.6.1
No cooling water flow	After cooling down the pump, let cooling water flow.	3.5.2
Pump overload	Contact the ULVAC service center.	Last page of this manual
Ventilation fan failure	Contact the ULVAC service center.	Last page of this manual
Ambient temperature outside the specified range	Operate the pump at an appropriate ambient temperature.	3.1.3
Rotation disabled by foreign material	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
LF (LF)	Output phase-loss	A phase loss occurred on the inverter output side.

Cause	Corrective action	Reference
Electrical wiring disconnected	Check whether the power supply wiring has become disconnected or is miswired. → Perform wiring correctly.	3.6.1
Motor failure	Contact the ULVAC service center.	Last page of this manual
Inverter failure	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
LF2 (LF2)	Output current imbalance	The output current's three-phase balance has been lost.

Cause	Corrective action	Reference
Motor failure	Contact the ULVAC service center.	Last page of this manual
Inverter failure	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
oC (oC)	Overcurrent	An overcurrent was applied to the motor.

Cause	Corrective action	Reference
Motor failure	Contact the ULVAC service center.	Last page of this manual
Pump overload	A foreign object has disabled rotation. ➞ Contact the ULVAC service center.	Last page of this manual
	The exhaust port pressure has risen. ➞ Clean and wash the pump's exhaust piping.	3.5.1
	A bearing has been damaged. ➞ Contact the ULVAC service center.	Last page of this manual
	The inlet pressure is high. ➞ Check the inlet piping (for leaks, etc.)	3.5.1
Inverter failure	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
oL1 (oL1)	Motor overload	Motor overload protection has been activated.

Cause	Corrective action	Reference
Pump overload	A foreign object has disabled rotation. ➞ Contact the ULVAC service center.	Last page of this manual
	The exhaust port pressure has risen. ➞ Clean and wash the pump's exhaust piping.	3.5.1
	The inlet pressure is high. ➞ Check the inlet piping (for leaks, etc.)	3.5.1
Motor failure	Contact the ULVAC service center.	Last page of this manual
Hunting of the power supply is occurring due to a phase loss of the power supply wiring.	Check the power supply wiring.	3.6.1

Display	Alarm name	Status
oL2 (oL2)	Inverter overload	Inverter overload protection has been activated.

Cause	Corrective action	Reference
Pump overload	A foreign object has disabled rotation. ➞ Contact the ULVAC service center.	Last page of this manual
	The exhaust port pressure has risen. ➞ Clean and wash the pump's exhaust piping.	3.5.1
	A bearing has been damaged. ➞ Contact the ULVAC service center.	Last page of this manual
	The inlet pressure is high. ➞ Check the inlet piping (for leaks, etc.)	3.5.1
Clogging of exhaust piping	Clean and wash the pump's exhaust piping.	3.5.1
The stationary rotation frequency cannot be reached.	The inlet pressure is high. ➞ When starting the pump, apply a load after the pump reaches the stationary rotation frequency.	4.1
Hunting of the power supply is occurring due to a phase loss of the power supply wiring.	Check the power supply wiring.	3.6.1
Insufficient the warm-up operation.	The load was applied without carrying out the warmup operation. ➞ Perform warming-up operation for approximately 30 minutes after starting.	

Display	Alarm name	Status
oL5 (oL5)	Detection of exhaust piping clogging 1	The exhaust piping is clogged.

Cause	Corrective action	Reference
Clogging of exhaust piping	Clean and wash the pump's exhaust piping.	3.5.1

Display	Alarm name	Status
oPr (oPr)	Operator connection failure	The cable between the inverter and controller has been disconnected.

Cause	Corrective action	Reference
Wiring disconnect between the inverter and controller	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
ou (ov)	Main circuit overvoltage	Overvoltage has been detected.

Cause	Corrective action	Reference
Power interruption	Check the power supply wiring.	3.6.1
The motor has a ground fault.	Contact the ULVAC service center.	Last page of this manual
Excessive power supply voltage	Check the supplied voltage. ➞ Reduce the voltage down to that of the pump's power supply specification.	7.1
Inverter failure	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
oH (oH)、 oHI(oH1)	Inverter overheating	Inverter overheating has been detected.

Cause	Corrective action	Reference
Excessive ambient temperature	Reduce the ambient temperature.	3.1.3
Ventilation fan failure	Contact the ULVAC service center.	Last page of this manual
Insufficient cooling water flow rate	Check the cooling water and increase the supplied amount.	3.5.2
	The cooling water in/out pressure difference is insufficient. ➞ Increase the supply pressure.	3.5.2
	The cooling water piping has become clogged, or impurities have been mixed in the cooling water. ➞ Clean the piping.	3.5.2
	The cooling water piping has a leak. ➞ If the leak is inside the pump, contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
TNEr (TmEr)	Thermistor disconnection detected	・The thermistor input circuit has become disconnected. ・Thermistor failure

Cause	Corrective action	Reference
Thermistor input circuit disconnection	Contact the ULVAC service center.	Last page of this manual
Thermistor failure	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
PF (PF)	Main circuit voltage abnormality	The main circuit DC voltage fluctuates abnormally at a time other than regeneration.

Cause	Corrective action	Reference
Phase loss of input power supply	Check whether the input power supply wiring has become disconnected or is miswired. ➞ Correctly wire the power supply.	3.6.1
Excessive voltage fluctuation of input power supply	Check the power supply voltage. ➞ Implement power supply stabilization measures.	3.6.1
Unbalanced interphase voltage		
Inverter failure	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
Hbb (Hbb)	External interlock signal being input	An external interlock signal has been input in the remote control wiring.

Cause	Corrective action	Reference
External interlock being input	Check the external interlock status. ➞ Cancel the external interlock.	3.6.2
External interlock disconnected or not wired	Check whether the remote control wiring has become disconnected or is miswired. If the pump is operating in LOCAL mode, check whether pins 13 have been 14 are short-circuited. ➞ Correctly wire the remote control wiring.	3.6.2
Alarm in MBP	Remove the cause of the MBP alarm, and then reset the alarm.	6.1

Display	Alarm name	Status
$mAin (MAIn)	Maintenance timing exceeded	It has been exceeded time for replacing the inverter.

Cause	Corrective action	Reference
It had been exceeded time for replacing the inverter, then operating hours has been exceeded 30,000.	We recommend performing an overhaul, including replacement of the inverter. ➞ Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
CPF01 (CPF01)	Controller communication abnormality	A communication abnormality lasting at least two seconds has occurred.

Cause	Corrective action	Reference
Noise from the remote control wiring	Use a shielded cable for the remote control wiring. ➞ Be sure to ground the wiring.	
Bad controller wiring	Contact the ULVAC service center.	Last page of this manual

Display	Alarm name	Status
EF3 (EF3)	External abnormality signal being input	An external abnormality signal has been input in the remote control wiring.

Cause	Corrective action	Reference
External abnormality being input	Check the other equipment status. ➞ Cancel the contact of other equipment.	3.6.2

6.3 How to Restart the Pump After an Alarm

Resetting an alarm

If the controller displays an alarm, restart the pump after eliminating the cause of the alarm. Upon restarting the pump, reset the alarm using any of the following methods.

Procedure after an alarm occurs	How to reset the alarm
After eliminating the cause of the alarm, reset the alarm and then restart the pump.	Press the controller's RESET key while the alarm content is displayed on the controller.*
After eliminating the cause of the alarm, turn on the alarm reset signal from the signal connector.	Short circuit the alarm reset signal pin of the remote control wiring.
Turn the power on again.	Turn the primary side power off. Turn it on again after the controller display turns off.

* In the case of the LS300, 600, and 1200, press the RESET keys of the controllers for both DRP and MBP in sequence.

7. Specifications

7.1 Performance Specifications

Model C : C Type L : L Type			LS120		LS300		LS600		LS1200	
			C	L	C	L	C	L	C	L
Pumping speed	Max.	m^3 / hr	120		380		600		1000	
	Atmospheric pressure		80							
Ultimate pressure		Pa	≤0.6				≤0.1			
Power Supply (selection)		VAC	3phase 200-240 Vac±10% or 380-480 Vac±10% 50/60 Hz							
Approx. Power consumption*	At ultimate pressure	kW	0.6	2.0	1.0	2.5	1.3	2.6	1.3	2.7
	At max. load		2.9		3.9		4.7		5.2	
Cooing water flow rate		L / min	>2.0				>4.0			
Purge gas flow rate		SLM	—	0 to 50	—	0 to 50	—	0 to 50	—	0 to 50
Max. water vapor tolerance		kg / h	—	1.5	—	1.5	—	1.5	—	1.5
Noise		dB(A)	61		61		62		64	
Inlet port			KF50、VG50		ISO-F-50		ISO-F-80		ISO-F-100	
Outlet port			KF40							
Lubricant			BARRIERTA J100FLUID, J100FLUID E (NOK KLUBER)							
DRP		mL	240		240		240		240	
MBP			—		240		300		300	
dimensions	Width	mm	311							
	Length		639							
	Height		307		537		563		563	
Weight		kg	142		220		242		266	
Overseas safety standards			CE、 cTUVus							

* The ECO-SHOCK section on the exhaust side of the pump is not leakless in the C Type

7.2 Dimentional Drawings

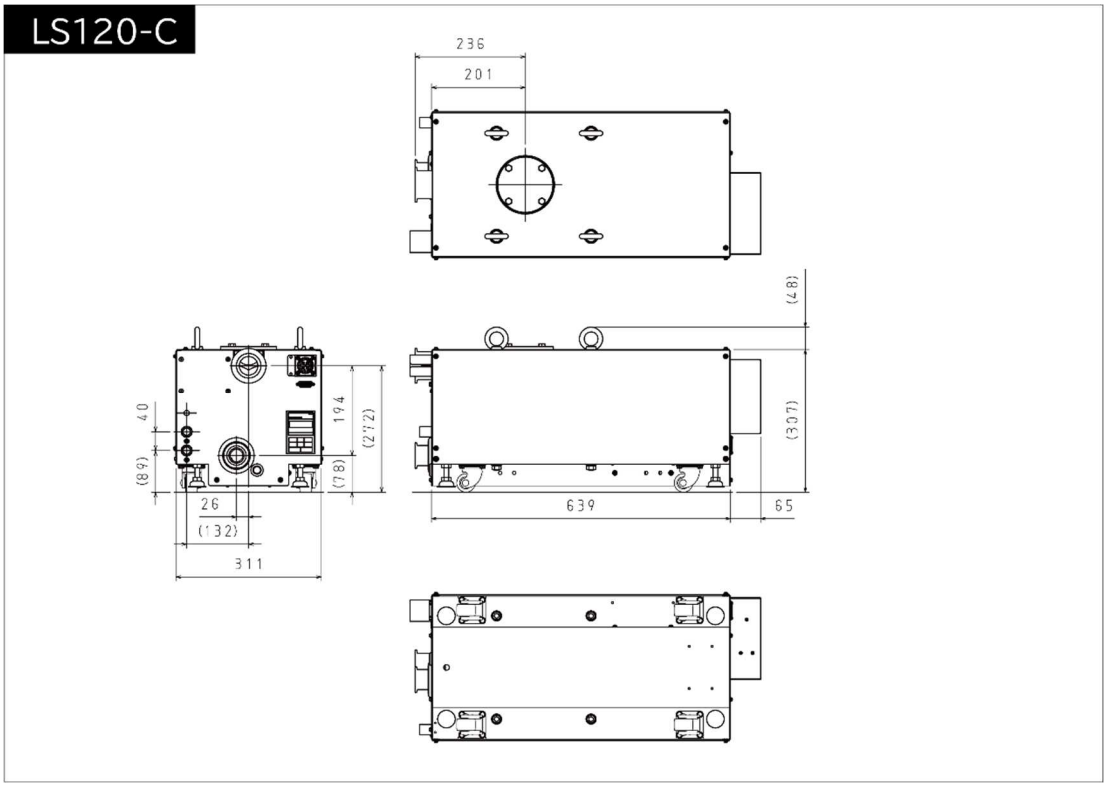


Fig. 25 LS120-C dimentional drawing

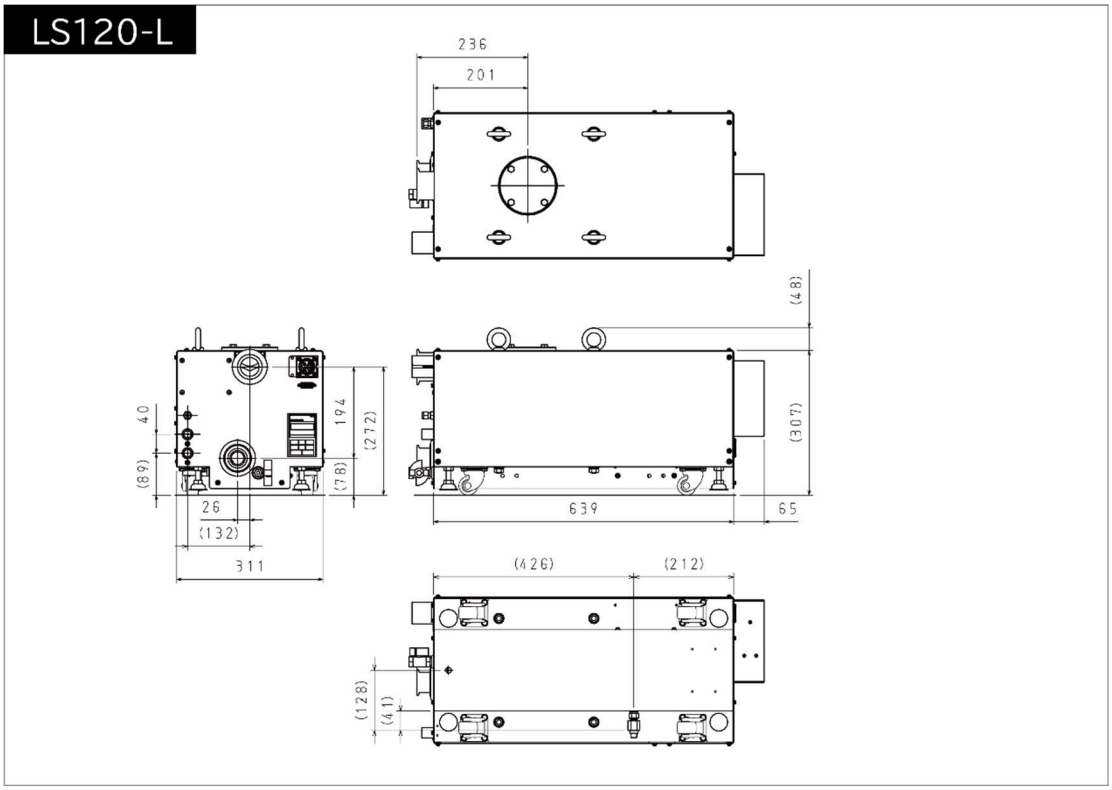


Fig. 26 LS120-L dimentional drawing

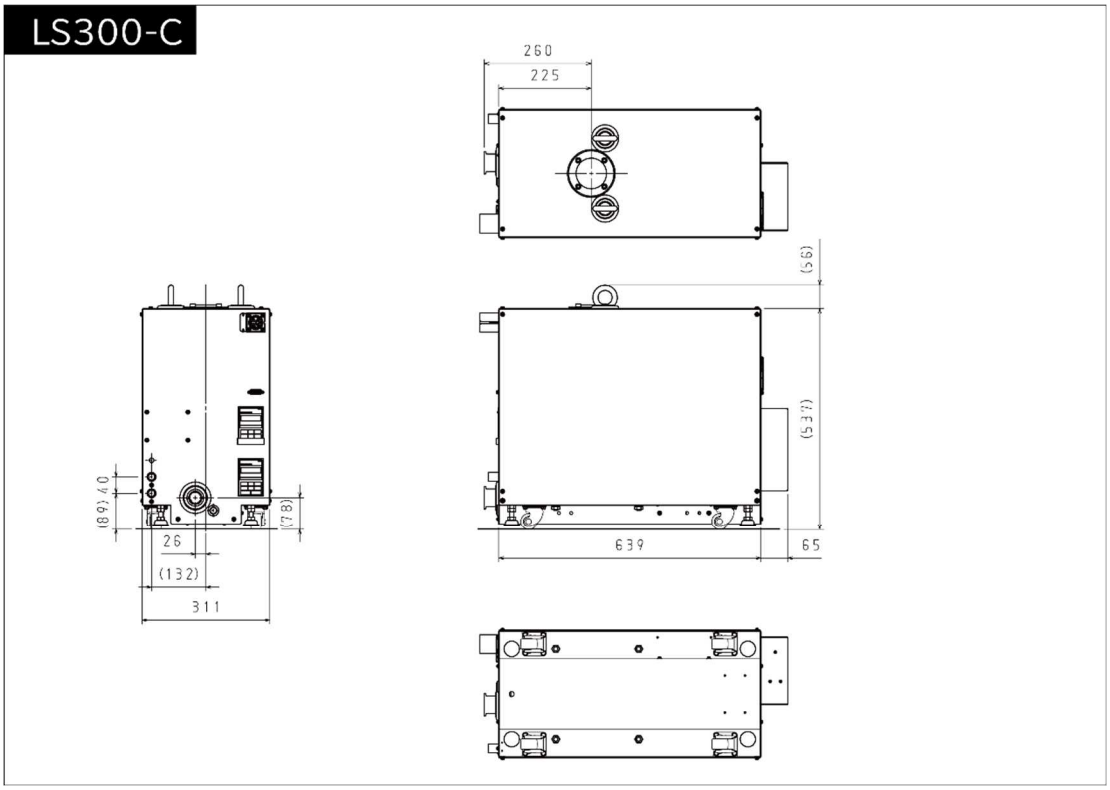


Fig. 27 LS300-C dimentional drawing

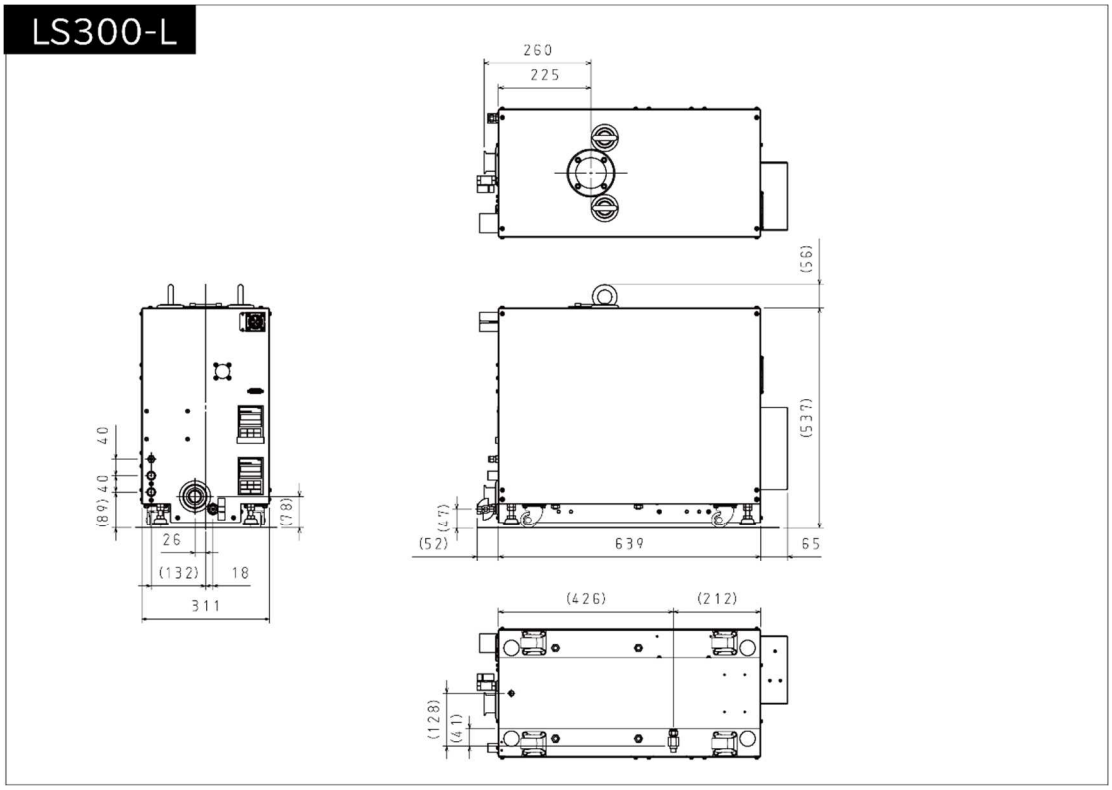


Fig. 28 LS300-L dimentional drawing

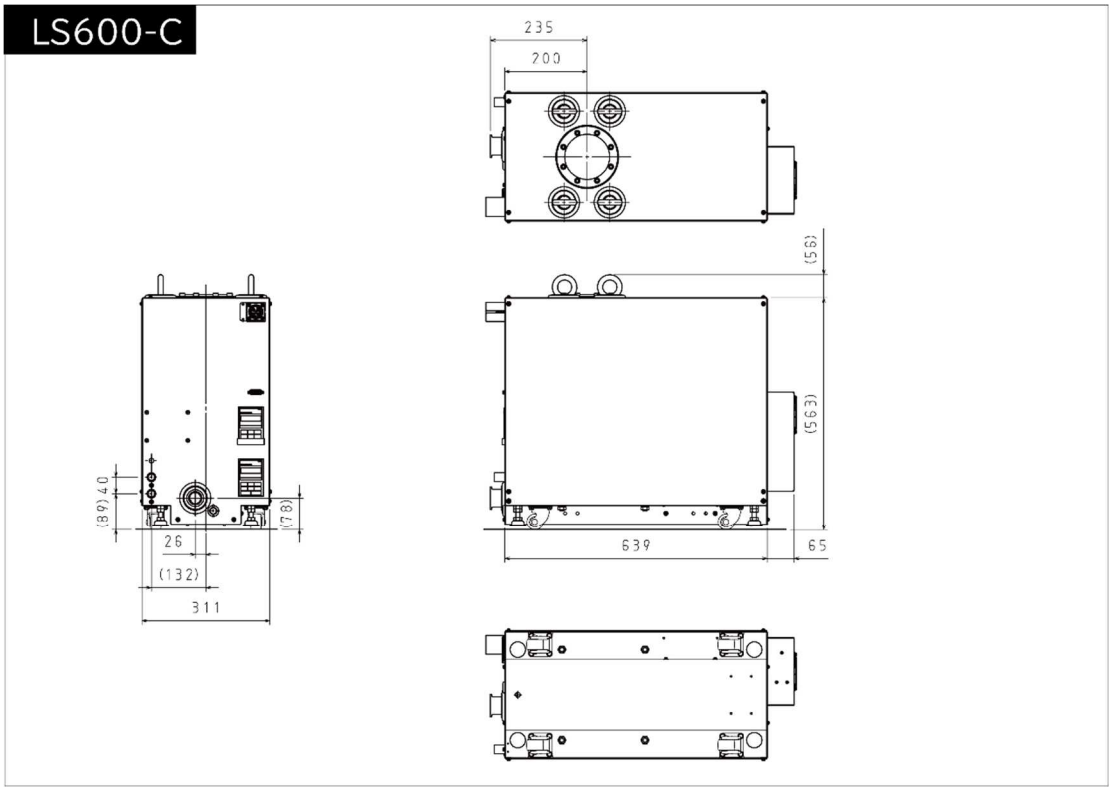


Fig. 29 LS600-C dimentional drawing

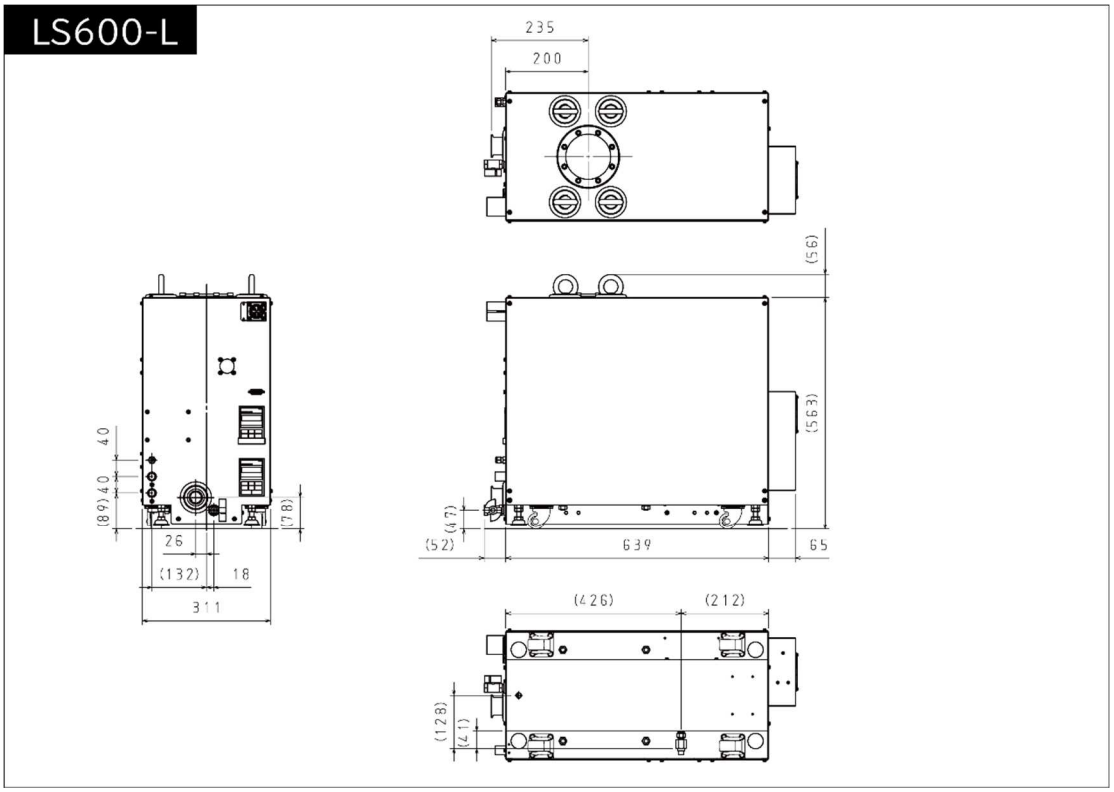


Fig. 30 LS600-L dimentional drawing

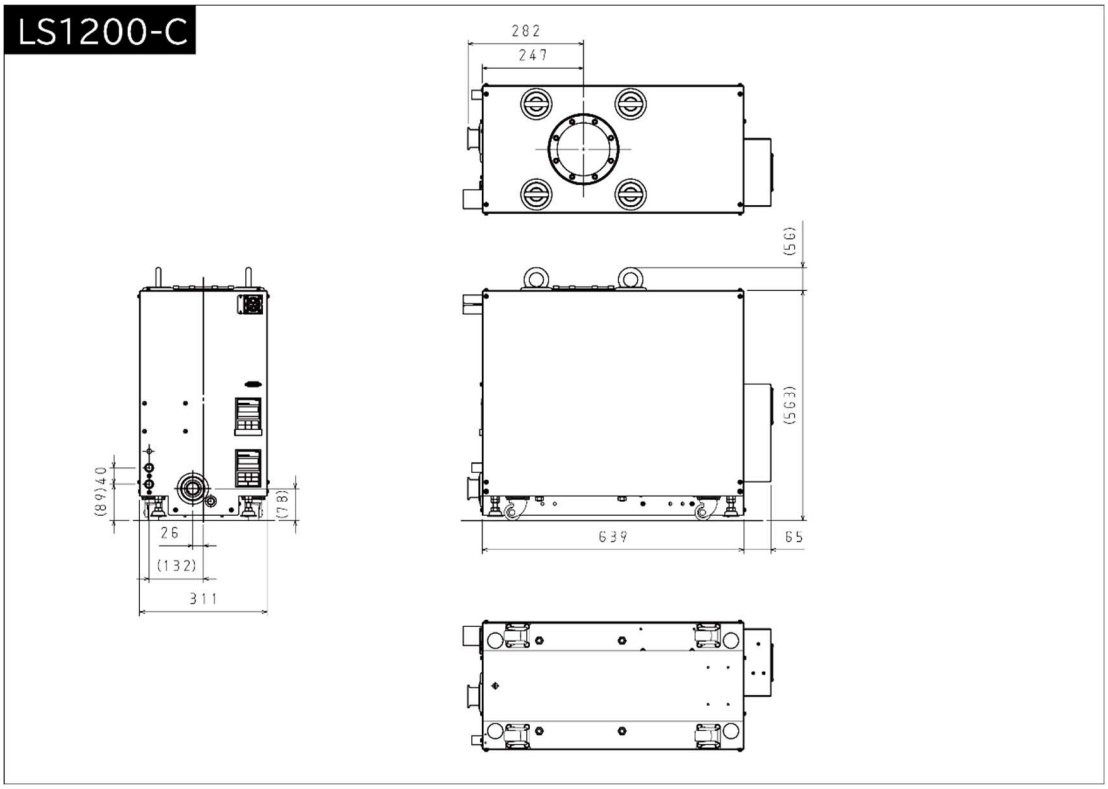


Fig. 31 LS1200-C dimentional drawing

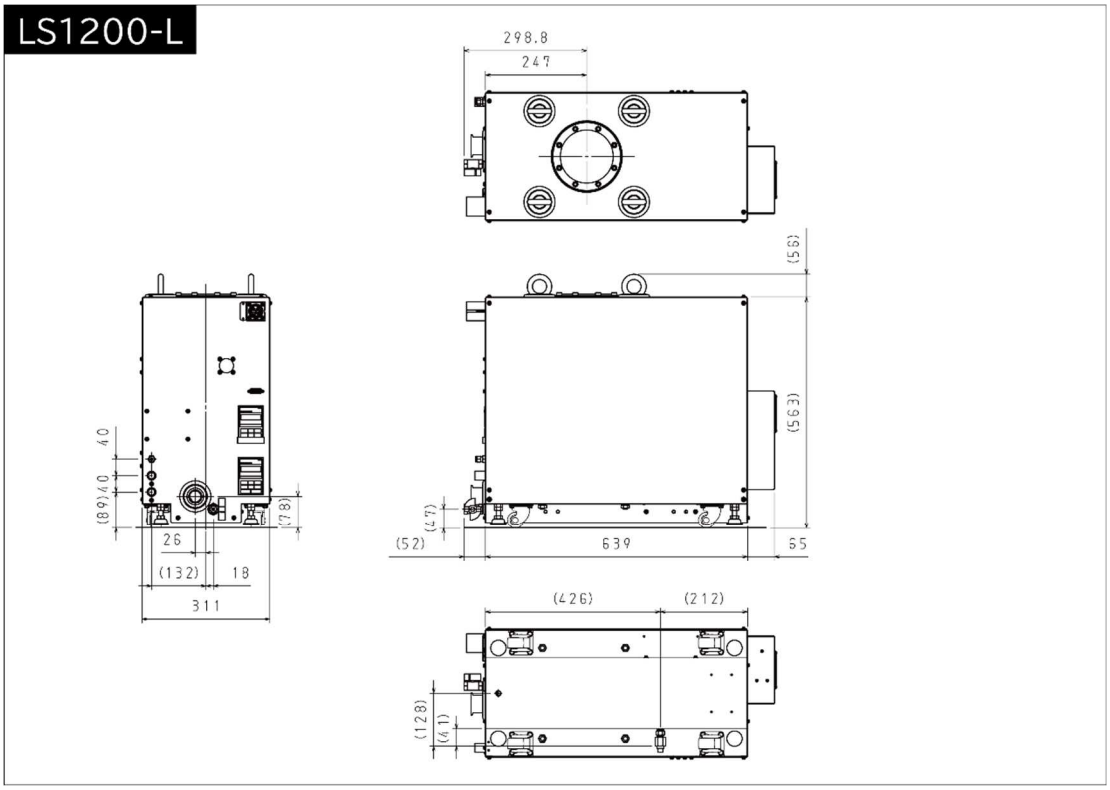


Fig. 32 LS1200-L dimentional drawing

Appendix

Major Replacement Parts

The list of parts that must be replaced during an overhaul is as follows. The replacement timing differs depending on the part. The recommended replacement periods indicated in the table below are for reference. Actual periods may differ depending on usage conditions and the environment.

Table 18 Major replacement parts

Type	Part name	Target Models
Recommended replacement parts for the ECO-SHOCK	Diaphragm	All C type models
	Suction/Exhaust valves	All C type models
	Head gasket	All C type models
	Bearings	All C type models
Parts that must be replaced during an overhaul	ECO-SHOCK	All C type models
	Bearings	All models
	Power lock	All models
	Cooling water piping	All models
	O-ring	All models
	Lubricant	All models
	Oil seal	All models
	Level gauge	All L type models
	Check valve	All models
	Bearing pressure spring	LS300, LS600, LS1200
	Parallel key	All models
	LAN cable	All models
	Rubber vibration isolator	All models
Parts that must be replaced every two years	Bearing case	All models
	Seal slinger	All models
	Slinger	All models
Parts that must be replaced every three years	Inverter	All models
	Cooling fan	All models
	Relay	LS300, LS600, LS1200

Type	Part name	Target Models
Parts that must be replaced every five years	Cylinder	All models
	Rotor shaft	All models
	Side cover	All models
	Motor	All models
	Timing gear	All models
	Thermistor	LS300, LS600, LS1200
	Controller	All models
	Power supply	All models
	Noise filter	All models

ULVAC

Form: A003S1268-04

ULVAC Components / Certificate of Decontamination

This is a certificate of decontamination for repair and inspection request of ULVAC Components. All material must be certified as decontaminated and this certificate must be submitted to your closest local ULVAC service center or sales office prior to shipment.
Please consult with your closest local ULVAC service center or sales office if our components are used with toxic gases or contaminated with reactive products or substances produced by reaction.

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

Contaminant (Check an applicable box.)

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

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

To: ULVAC, Inc
Attn: _____

Date: / / (YYYY/MM/DD)

Your company _____
Division _____
Contact _____
Phone _____
Fax _____
E-mail _____

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

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

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.

Table1. 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	○	○	○	○	○	○
Panel	○	○	○	○	○	○
Base	○	○	○	○	○	○
Electrical Parts	○	○	○	○	○	○

○: 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.

ULVAC

Form: A00315268-02-00

ULVAC Components / Certificate of Decontamination

This is a certificate of decontamination for repair and inspection request of ULVAC Components. All material must be certified as decontaminated and this certificate must be submitted to your closest local ULVAC service center or sales office prior to shipment.
Please consult with your closest local ULVAC service center or sales office if our components are used with toxic gases or contaminated with reactive products or substances produced by reaction.

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

Contaminant (Check an applicable box.)

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

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

To: ULVAC
Attn: _____

Date: / / (YYYY/MM/DD)

Your company _____
Division _____
Contact _____
Phone _____
Fax _____
E-mail _____

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

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

ULVAC

株式会社アルバック
規格品事業部
https://showcase.ulvac.co.jp/ja/

製品情報・サービス拠点・お問い合わせはこちらから

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Components Division
https://showcase.ulvac.co.jp/en/

Please contact us for products, Service Base or other Inquiries from here.

showcase.ulvac.co.jp/en

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