

Instruction Manual

for

Direct-Drive Oil Sealed Rotary Vacuum Pump

Model GCD-051X GCD-136X GCD-201X

Before using the product, be sure to read this manual.

Keep this manual in a place where it can be referred to at any time and look after it carefully.

The contents of this instruction manual are subject to change without prior notice due to improvements in performance and the functions of the product.

ULVAC KIKO,Inc.

0. Introduction

0.1 Before using the vacuum pump

Thank you for purchasing our vacuum pump (hereinafter called "pump"). When you have received the pump, check that the delivered pump is as per your order and that it has not been damaged in transportation, etc.



Warning _____

In order to use the pump for as long as possible, read this instruction manual thoroughly before performing installation, operation, inspection and maintenance, and sufficiently understand the cautions for safety, the specifications and operation methods of the pump.



No part of this instruction manual may be copied for use by a third party without our permission.

0.2 Safety symbols

In this instruction manual and on warning labels attached to the pump, the following symbols are used so that matters which must be strictly adhered to can be readily understood. These symbols are divided as shown below.



When mishandled, there is an imminent danger of the operator suffering a fatal accident or serious injury.



⚠ Warning _____

When mishandled, there is a possibility of the operator suffering a fatal accident or serious injury.



⚠ Caution _____

When mishandled, there is a possibility of the operator suffering an injury (light or medium injury) or of damage occurring to property.



When mishandled, there is a possibility of the pump being damaged or malfunctioning.

0.3 Cautions for safety



∕!\ Danger ___

When toxic or flammable gases are exhausted from the pump, they may leak not only from the pump outlet but also from the pump unit itself. Take proper measures suitable for the type of gas.



⚠ Danger _____

After the pump has been used for exhausting toxic gasses, not only the pump itself but also vacuum pump oil (hereinafter called "pump oil") get toxic. Keep this in mind when performing the maintenance.



Marning ______

Never allow people other than repair engineers to disassemble or repair the pump. Failure to do so may result in ignition or malfunction, leading to injury or electric shock.



✓!\ Warning ____

Before performing inspection or repair, always turn off the power switch. Failure to do so may result in electric shock or the unexpected start of the pump, leading to injury.



Warning _____

Connect the earth wire correctly. It is recommended that a dedicated earth leakage breaker should be installed. If the earth wire is not connected, there is a possibility of electric shock occurring in the case of a malfunction or electrical leakage.



∕!\ Warning

There is a risk of explosion. Never block the outlet or operate the pump with equipment mounted at the outlet side which blocks the passage of gas. Otherwise, the internal pump pressure increases causing the pump to explode, the oil level gauge to protrude or the motor to be overloaded. This pump is not resistant to pressure. The internal pump pressure is limited to 0.03 MPa (gauge pressure).



✓!\ Warning _____

Do not use the pump in an explosive atmosphere. Failure to do so will result in injury or fire.



Mount vacuum valve and leak valve between the vacuum chamber and pump. To stop the pump, always close vacuum valve and then open leak valve. If this procedure is neglected, the pump oil fills the cylinder, making restart difficult or causing damage to the pump. The pump oil also may flow back to the vacuum chamber side.



∕!\ Caution ———

Do not insert fingers or objects into the opening of the motor. Doing so may result in electric shock, injury, or fire.



!\ Caution

Never touch the rotating section of the motor, shaft or coupling while the pump is in operation. Failure to do so will result in injury.



Caution ______

Never place combustible materials around the motor or pump. There is a risk of fire.

Also, do not place objects which block ventilation around the motor. Abnormal heat generation may result in burns or fire.



✓!\ Caution

Do not touch the motor while the pump is in operation or when the pump is still hot immediately after it stops. Touching it will result in burns.



Caution ______

Arrange wires correctly in accordance with the "Electrical Equipment Technical Standard" and "Wiring Regulations." Incorrect wiring may result in fire.



✓!\ Caution

If the pump ceases operation or malfunctions, turn off the power switch immediately to prevent acidents, and ask the company from which you purchased the pump or the manufacturer for inspection and repair.

^ Caution

Fluoride rubber material is used for the internal parts of a pump.

There are some for which the chemical resistance of Fluoride rubber material is not suitable.

Especially, be careful of the following chemical.

Ammonia, Acetone, Ethylene oxide, Ethylene diamine, Zinc acetate,

Amyl acetate, Aluminum acetate, Isopropyl acetate, Ethyl acetate,

Lead acetate, Calcium acetate, Cellosolve Acetate, Nickel acetate,

Butyl acetate, Propyl acetate, Methyl acetate, Nitroethane, Nitropropane,

Nitromethane, Freon



Do not operate the pump without adding pump oil. If it is operated in an oil-less condition, the pump will be damaged.

0.4 Acceptance and storage of the pump

0.4.1 Acceptance of the pump

Although the pump is delivered with great care, check the following after unpacking.

- ① The delivered pump is in accordance with your request.
- 2 The specified accessories (enough pump oil to use the pump once; optional equipment) have been provided.
- ③ No parts have been damaged in transportation.
- 4 Neither screws nor nuts have become loose nor were lost in transportation.

If there are any problems, contact the company from which you purchased the pump or the sales department of the manufacturer.

0.4.2 Environmental conditions for storage, installation and operation

Since this pump is precisely engineered, ensure that the following conditions be satisfied during storage, installation and operation.

- ① Ambient temperature, relative humidity: 7° C ~ 40° C, 85% RH or less
- ② Height above sea level during storage and installation: 1,000 m or less
- 3 Other conditions for storage and operation
 - a) Free from corrosive and explosive gases
 - b) No condensation
 - c) Dust-free environment
 - d) Indoors
 - e) Do not place pumps on top of each other or place a pump on its side.
 - f) Not subject to direct sunlight
 - g) Far from heat sources



Do not subject the pump to shocks or place the pump on its side. Doing so may damage the pump.

0.5 Protective device

The pump is provided with a single-phase 100V 50/60Hz (GCD-051X, 136X), three-phase 200V 50/60Hz (GCD-201X) motor.

An overload protector (manually reset thermal protector) is incorporated.

The use of another protective device (such as an earth leakage breaker) in addition to the overload protector is recommended.



Use the pump only at the rated voltage. Use at other than the rated voltage will interfere with correct operation of the overload protector, and result in the motor burning out, or fire.

Contents

0.	Ir	ntroduction			01
	0.1	Before using the	vacuum pump		
	0. 2	Safety symbols			
	0.3	Cautions for saf	ety		
	0.4	Acceptance and s	torage of the pump		06
	0.	4.1 Acceptance o	f the pump		06
	0.	4.2 Environmenta	I conditions for storage	, installation and operation ··	06
	0. 5	Protective devic	е		06
1.	Fc	or Safe Operatio	n		1
	1.1	Hazards peculiar	to the pump and safety	measures·····	1
	1.	1.1 <u> </u>	Leakage of hazardous ga	ses and substances ·····	1
	1.	1.2 🔨 Warning	Electric shock		1
	1.	1.3 🗥 Warning	Explosion		2
	1.	1.4 🛕 Caution	High temperature		2
	1. 2	Safety Data Shee	t (SDS)		2
2.	0ι	utline of the Pu	mp		3
	2. 1	Specification			3
	2. 2	Dimensional draw	ing		4
3.	Ir	nstallation			7
	3. 1	Installation			7
	3. 2	Lubrication			7
	3.3	Vacuum piping			9
	3.4	Electric wiring			10
	3.	4. 1 GCD-051X · 136	X (in the case of GCD-201X si	ngle phase motor specification) ····	10
	3.	4. 2 GCD-201X (in	the case of GCD-136X three ph	ase motor specification) · · · · · · · · · ·	10
	3. 5	Fluctuation in t	he power voltage and fre	quency·····	11
4.	0p	peration			13
	4. 1	Cautions for ope	ration		13
	4. 2	Start of operati			14
	4. 3	Stopping the ope	ration		14
	4. 4	Operation in col	d climates		15
	4. 5	Backflow prevent	er		15
	4.6	Thermal protector			15
	4. 7	Gas ballast valv	е		16
	4. 8	Installation of	the oil mist separators	(Option)	17
	4.9	Restriction on o	peration when the oil mi	st separators is installed ····	17

5. Pump Performance	
5.1 Ultimate pressure	18
5.2 Pumping speed	18
5.3 Power requirement	18
6. Maintenance, Inspection and Repair	20
6.1 Maintenance	20
6.2 Periodic inspection	20
6.3 Replacement of the pump oil	22
6.4 Replacement of the coupling spider	24
6.5 Trouble check list	25
7. Disposal	27
8. Maintenance prats	28
8.1 Maintenance parts list	28
8.2 Disassembly drawing	31
Warranty	
Safety Data Sheet (SDS)	
Usage Status Check Sheet (for use in Instruction	n Manual)
Contact address of sales and service departments	

Figures and Tables

FIg.	1	Dimensional drawing of GCD-051X oil sealed r	rotary vacuum pump ·····	4
Fig.	2	Dimensional drawing of GCD-136X oil sealed r	rotary vacuum pump ·····	5
Fig.	3	Dimensional drawing of GCD-201X oil sealed r	rotary vacuum pump ·····	6
Fig.	4	Lubrication of the oil sealed rotary vacuum	$pump \cdot \dots \cdot $	8
Fig.	5	Basic piping diagram to the vacuum chamber		9
Fig.	7	Change region of the voltage and frequency		11
Fig.	9	Replacement of the coupling spider		24
Fig.	10	Disassembly drawing of GCD-051X oil sealed r	rotary vacuum pump ·····	31
Fig.	11	Disassembly drawing of GCD-136X oil sealed r	rotary vacuum pump ·····	32
Fig.	12	Disassembly drawing of GCD-201X oil sealed r	rotary vacuum pump ·····	33
Table	e 1	Specification		3
Table	e 2	Electric capacity of motor fault load protec	ction equipment	10
Table	e 3	Characteristics of the thermal protector		15
Table	e 4	Periodic inspection table		
Table	e 5	Trouble check list		
Table	e 6			
Table	e 7	GCD-136X Maintenance parts list		29
Table	e 8	GCD-201X Maintenance parts list		30

Attached table: Safety Data Sheet (SDS)

1. For Safe Operation

1. 1 Hazards peculiar to the pump and safety measures

Before operating or inspecting the pump, read this section carefully to fully understand potential hazards and prevention methods.

1.1.1 **A** Danger Leakage of hazardous gases and substances

Cause		Prevention method and measures
Leakage of toxic and flammable gases	\Rightarrow	Dilute hazardous gases to a safe concentration before they enter the pump inlet.
Injury due to touching toxic pump oil in the pump or harmful substances attached to the pump during inspection or disposal	\Rightarrow	 Wear protective equipment suitable for toxic substances when carrying out inspection. Before overhauling and disposing of the pump, ask a waste disposal specialist to make it safe. Ask an authorized waste disposal specialist to carry out disposal.

1.1.2 🛕 Warning Electric shock

Cause	Prevention method and measures
The energized part of the	\Rightarrow ① When connecting electric wires, always turn off the
motor was touched.	power and be sure to connect the earth wire.
	② When inspecting and transferring the pump, always turn
	off the power.
	3 Never insert hands, fingers, or thin objects through the
	motor opening.

1.1.3 **M** Warning Explosion

_			
('	9	11	CP

Prevention method and measures

The pressure in the pump increased causing the pump to explode.

 \Rightarrow The maximum internal pump pressure is 0.03 MPa (gauge pressure).

Measure the pressure at the outlet side and, if the pressure is 0.03 MPa or more (gauge pressure), remove objects which block the passage of gas from the outlet side. When an oil mist trap is adopted, replace or clean it so that it will not block the passage of gas.

1.1.4 <u>A</u> Caution High temperature

Cause

Prevention method and measures

High temperatures caused burns.

 \Rightarrow ① The pump reaches a high temperature during operation.

pump body $\,\,
ightarrow\,$ 50 $\,\sim\,$ 80 $\,^\circ\mathrm{C}$

motor \rightarrow 40 \sim 80 $^{\circ}$ C

② Since the surface temperature is hot, touching the surface accidentally may result in burns. Never touch the pump during operation. When carrying out inspection, wait until the pump has cooled down completely after it stops.

1. 2 Safety data sheet (SDS)

The attached "Safety Data Sheet (SDS)" shows chemical materials which may be used or touched when operating the pump. Read the SDS carefully in order to understand the harmful properties of these materials.

Contact us before using chemical materials (vacuum pump oil) other than those mentioned in this instruction manual.



Caution

The SDS is provided as reference information for safe use of dangerous and toxic chemicals. Persons handling pump oil are, on their own responsibility, required to implement the necessary safety measures in use. The SDS is therefore not to be considered as a guarantee of safety.

2. Outline of the Pump

2.1 Specification

This oil sealed rotary vacuum pump is a rotary vane pump (hereinafter called Gaede type pump) in which the pump is directly driven by the motor. Since the pump is small, light, and quite simply constructed, it is easily maintained and repaired.

Table 1 Specification

Model Pumping speed (L/min)			GCD-	-051X	GCD-	·136X	GCD-201X	
		el	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz
				Rotary van	e (2 vanes)			
		•	50	60	135	162	200	240
Ulti	mate	G.V. close			6.7 ×	10 ⁻¹		
pressu	ıre (Pa)	G.V. Open			6	.7		
	1-phase	V	100	100/110	100	100/110	100	100
Motor	1-pilase	W(Pole)	200	0(4)	400	400(4))(4)
Motor	3-phase	V		_	200	200/220	200	200/220
	3-piiasc	W(Pole)			400	0(4)	700)(4)
Full	ll-load rent (A)	1-phase	5.6(100V)	4.8(100V) 5.1(110V)	5.6(100V)	5.4(100V) 5.1(110V)	7.5(100V)	7.2(100V) 7.0(110V)
curre		3-phase			1.9(200V)	1.8(200V) 1.7(220V)	3.5(200V)	3.0(200V) 2.9(220V)
Revo	lution	1-phase	1,440(100V)	1,730(100V) 1,740(110V)	1,425(100V)	1,715(100V) 1,725(110V)	1,420(100V)	1,715(100V) 1,725(110V)
(r/r	nin)	3-phase			1,440(200V)	1,730(200V) 1,740(220V)	1,430(200V)	1,705(200V) 1,730(220V)
	Dil	Standard oil			SO	-M		
	711	Oil amount (mL)	500~	~800	1,0	000	1,1	00

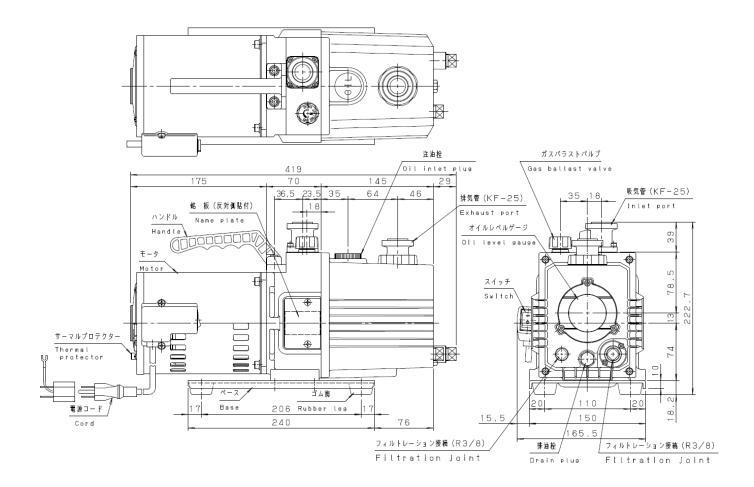
Note 1: The ultimate pressure values in the above table are indicated by a Pirani gauge.

Note 2: Vacuum pump oils have different steam pressures, viscosities, and oil properties depending on the type. Always use the oil sealed rotary vacuum pump oil specified by us. The use of other oils will affect the pump's performance.

Specified oil: SO-M

Note 3: "G.V." is an abbreviation for gas ballast valve.

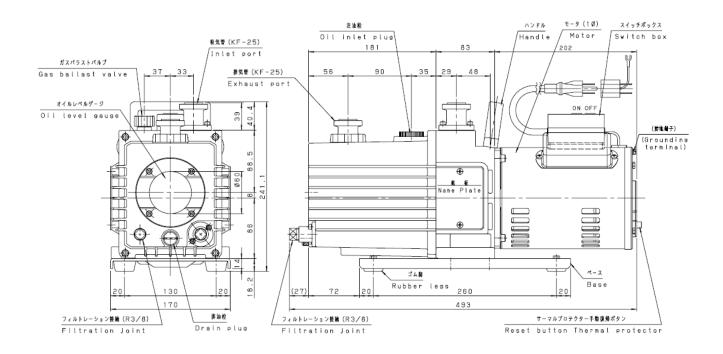
2.2 Dimensional drawing



Motor ; Single phase, 100V 50/60Hz,110V 60Hz, 200W, 4Poles

Weight; 14.1kg

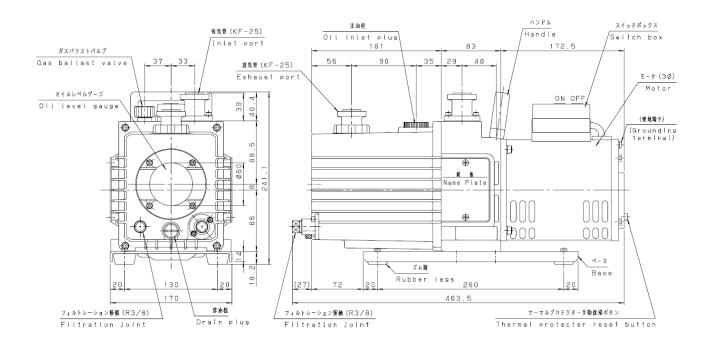
Fig. 1 Dimensional drawing of GCD-051X oil sealed rotary vacuum pump



Motor ; Single phase, 100V 50/60Hz,110V 60Hz 400W, 4Poles,

capacitor start and run

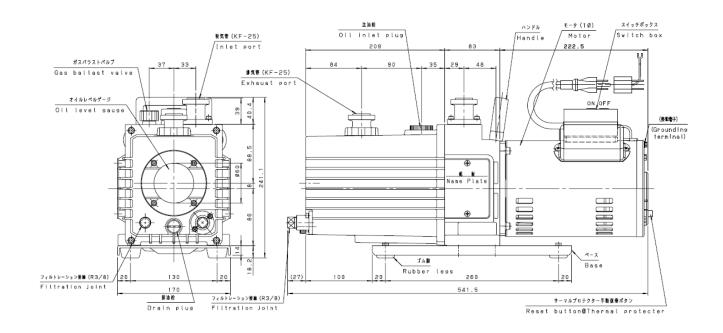
Weight ; 25.4kg



Motor ; three phase, 200V 50/60Hz, 220V 60Hz, 400W, 4Poles

Weight; 22.8kg

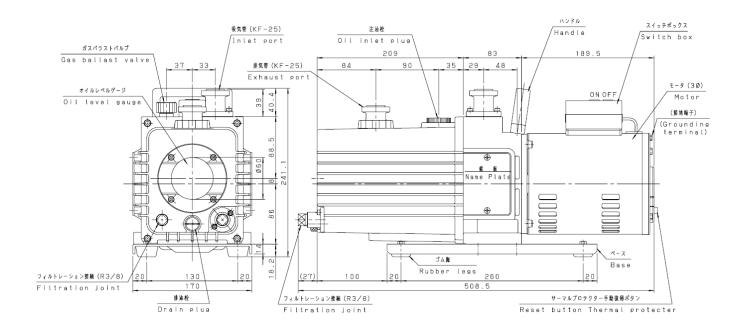
Fig. 2 Dimensional drawing of GCD-136X oil sealed rotary vacuum pump



Motor ; Single phase, 100V 50/60Hz,110V 60Hz 550W, 4Poles,

capacitor start and run

Weight; 29.4kg



Motor ; three phase, 200V 50/60Hz, 220V 60Hz, 700W, 4Poles

Weight ; 27.0kg

Fig. 3 Dimensional drawing of GCD-201X oil sealed rotary vacuum pump

3. Installation

3.1 Installation

The pump should be installed on a level surface in a location with minimal dust, dirt and humidity and be arranged with consideration given to ease of installation, removal, inspection and cleaning.

Particular attention should be paid to the ambient temperature when building the pump into equipment. Use a rubber vibration isolator to separate the pump from other equipment and to isolate the pump from the vibrations of other equipment. See "0.4.2 Environmental conditions for installation, storage and operation" for details.



✓ Note

If the pump is operated whilst it is tilted, placed on its side or upside-down. the pump will be damaged. Install the pump level with the inlet facing up as shown in Fig. 1, 2, 3.

3.2 Lubrication

Remove the lubrication plug from the lubrication port, and add the pump oil which has been delivered together with the pump or the pump oil specified by us (SO-M) up to the range marked with the line on the oil level gauge. When making the first lubrication, add oil near to the upper oil level limit shown on the oil level gauge. After lubrication, mount the lubrication plug to the pump (see Fig. 4).

Always keep the oil level of the pump within the oil limit range shown on the oil level gauge during operation. If the amount of oil is incorrect, the performance of the pump will deteriorate resulting in the malfunctioning of the pump. When the amount of oil has reduced and the oil level has reached an area below the lower line which shows the lower limit on the oil level gauge such that the level cannot be seen, the ultimate pressure increases and exhausting sound may not cease.

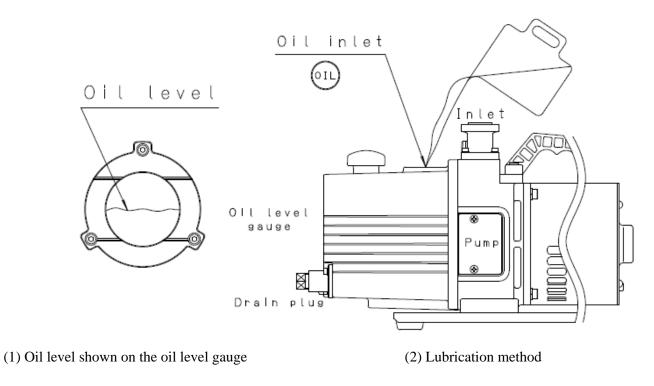


Fig. 4 Lubrication of the oil sealed rotary vacuum pump



⚠ Caution _____

- 1) Wear protective equipment such as rubber gloves and safety goggles.
- 2 Be sure to read the attached "Safety Data Sheet" before adding oil. If the oil accidentally comes into contact with your hands or enters your eyes, take proper measures in accordance with the section "First-aid treatment" shown in "Safety Data Sheet."



Use only oils specified by us. If other oils are used, the pump performance will deteriorate or its life will be shortened.

3.3 Vacuum piping

(1) Before connecting the pipe to the pump, clean the inner walls of the vacuum chamber, piping and vacuum valve to completely eliminate moisture, fine particles, dust, dirt and rust.



!\ Note _____

If fine particles, dust or dirt, etc are evacuated, the pump may malfunction. If moisture is evacuated, not only does the ultimate pressure increase but also the inside of the pump becomes rusty causing the pump to malfunction.

(2) Mount vacuum valve (A) and leak valve (B) between the vacuum chamber and pump as shown in Fig. 5.

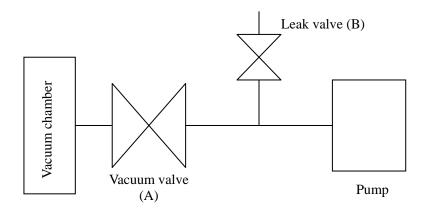


Fig. 5 Basic piping diagram to the vacuum chamber

(3) Use a KF-25 (NW-25) flange for the connection to the inlet pipe.



The wire mesh in the inlet pipe has been adopted to prevent foreign matter from entering the pump. Do not remove the wire mesh.



!\ Warning _____

Mount vacuum valve (A) and leak valve (B) between the vacuum chamber and pump (see Fig. 5).

To stop the pump, always close vacuum valve (A) and then open leak valve (B). If this procedure is neglected, the pump oil fills the cylinder, making restart difficult or causing damage to the pump. The pump oil also may flow back to the vacuum chamber side.

3.4 Electric wiring

- 3.4.1 GCD-051X·136X (in the case of GCD-201X single phase motor specification)
 - (1) This pump has performed beforehand electric wiring by the side of a pump.
 - (2) Please insert the plug of the power cord of a pump in the wall socket of single phase 100V.
 - (3) Fault load protection equipment (manual return type thermal protector) is built in this motor.

3.4.2 GCD-201X (in the case of GCD-136X three phase motor specification)

- (1) The rotation direction of this pump is seen from the pump front (level gauge side), and is a clockwise rotation.
- (2) If it wiring like fig.6, the rotation direction of a pump will be seen from the pump front (level gauge side), and will be rotated clockwise. When you rotate in the opposite direction, please shut off a power supply immediately, replace wiring connected to U and W, and check rotating in the right direction anew.
- (3) Fault load protection equipment (manual return type thermal protector) is built in this motor.
- (4) When you form fault load protection equipment in the exterior of a 3-phase motor, please refer to table 2.

A motor side grounding terminal is the screw with a display of "E" of the main part rear of a motor.

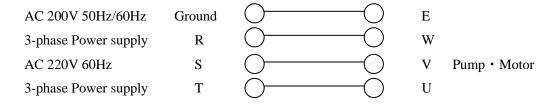


Fig. 6 Electric wiring diagram

Table 2 Electric capacity of motor fault load protection equipment

Model	(W)	Thermal relay(A)			Motor breaker
Wiodei	(W)	200V,50Hz	200V,60Hz	220V,60Hz	(A)
GCD-136X	400	1.9	1.8	1.7	1.9
GCD-201X	700	3.5	3.0	2.9	3.5

3.5 Fluctuations in the power voltage and frequency

Standard: Rotation electricity machine general rules

JIS C 4034-1:1999, JEC-2137-2000

To the voltage change and frequency change in Domain A, in main rated values, it operates continuously, and can be used practically convenient, and to the voltage change and frequency change in Domain B, it shall operate with main rated values and shall be used practically convenient.

However, operation with "it is convenient and safe is maintained on "practical use, it means not resulting in the grade which shortens a life remarkably, and the characteristic, a temperature rise, etc. do not apply correspondingly in the state of rating. Moreover, main rating shows rated torque $(N \cdot m)$.

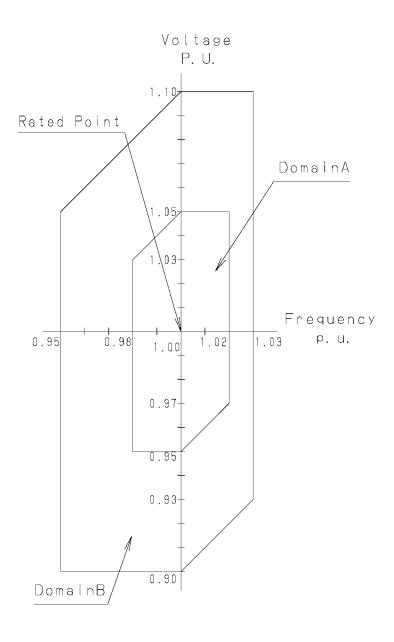


Fig. 7 Change region of the voltage and frequency



It will cause a serious damage or movement failure to the motor of GCD-051X in case of impressing the inverter controlled pressure is given towards the motor of GCD-051X itself.

Please carefully be noted and do not take the above action.



Marning ____

Before connecting wires, turn off the power switch. Never perform wiring with the power supplied as an electric shock will occur. Connect the earth wire correctly. Failure to do so may result in electric shock if a failure or earth leakage occurs. Installation of a dedicated earth leakage breaker is also recommended.



!\ Caution

Perform electric wiring correctly in accordance with the "Electric Equipment Technical Standard" and "Internal Wiring Regulation." Incorrect wiring will result in fire.

Install an overload protector suitable for the capacity of the motor. If an overload protector is not installed, or if an overload protector that is unsuitable for the motor capacity is installed, the motor will be damaged leading to fire.

4. Operation

4.1 Cautions for operation



Warning _

There is a risk of explosion. Never block the outlet or operate the pump with equipment mounted at the outlet side which blocks the passage of gas. Otherwise, the pump internal pressure increases causing the pump to explode. the oil level gauge to protrude or the motor to be overloaded.

This pump is not resistant to pressure. The internal pump pressure is limited to 0.03 MPa (gauge pressure).



Caution

Do not stop and restart this equipment repeatedly. When restarting this equipment, make sure that the pump (motor) has stopped completely before turning on the power. If the pump (motor) has not stopped completely and the equipment is restarted, the pump's (motor) current rises and either the protection device is activated or the motor may become damaged.



- ① In the process of manufacturing semiconductors, pump oil may deteriorate over a very short period of time. It is recommended that the pump oil should be replaced within 10 days after starting use of the pump, and the replacement frequency of the pump oil should be decided based on the contamination level of the pump oil.
- ② If the pump evacuate a lot of moisture, replace the oil frequently. If the pump is used with gas which contains a lot of moisture, the lubricity of the pump oil deteriorates and corrosion of the pump's components advance, causing the pump to malfunction.
- ③ If chemicals including acid has been evacuated, the pump may become rusty while it is not being operated (i.e. overnight), making operation impossible. If such chemicals are evacuated, replace the pump oil immediately.
- Solvents which deteriorate the lubricity of the pump oil will cause scoring, etc. If such a solvent is evacuated, replace the oil.
- (5) If operation is performed continuously at a high evacuation pressure of 10 kPa or more, a large amount of pump oil is consumed, causing a shortage of oil and insufficient lubrication of the pump. If such a condition continues, components will rapidly wear and become scored. Avoid continuous operation at a high evacuation pressure as much as possible and, without fail, add pump oil.
- 6 This pump uses carbon in internal member of framework. Oil may become black when it runs. However, there is not it in the aberration.

4.2 Start of operation

To start operation, close leak valve (B), open vacuum valve (A) to the inlet port, and turn on the power switch. Then the pump starts beings to exhaust (see Fig. 5).



Caution

- (1) Firing hazard. Do not touch the motor or the pump body as these surface temperature should be higher $(40 \sim 80^{\circ}C)$.
- ② If operation is performed at high pressure, oil mist is generated at the outlet side. Install an oil mist trap or connect a duct to discharge the oil mist outside the room. Or, install a ventilator.



✓!\ Note .

When the pump does not rotate correctly, take the following measures.

- a) Check the amount of oil, and adjust if necessary.
- b) In an environment where the ambient temperature is low, if the pump is left unused for a long time (three days or longer), the pump oil enters the cylinder. (This phenomena cannot be avoided even if the pump pressure is released to atmospheric pressure after last using the pump.) If the pump is restarted in this condition, an overload is applied to the pump and the overload protector may actuate. In such a case, turn the pump on and off several times in short intervals.



After operating the pump for several hours, oil temperature inside the pump may be risen up to $70 \sim 80$ °C. If the temperature is over this, the pump may have troubles. Maintain the pump, or contact us.

4.3 Stopping the operation

To stop operation, close vacuum valve (A), open leak valve (B) quickly, and turn the power switch off (see Fig. 5).



Caution

Do not stop and restart this equipment repeatedly. When restarting this equipment, make sure that the pump (motor) has stopped completely before turning on the power. If the pump (motor) has not stopped completely and the equipment is restarted, the pump's (motor) current rises and either the protection device is activated or the motor may become damaged.



!\ Caution

Firing hazard. As the surface of the pump body is higher temperature $(40 \sim 80^{\circ}\text{C})$ during operation, do not touch it until cooled down after stopping the pump.

4.4 Operation in cold climates

In winter-season, when operating the pump in cold environment, it will be difficult to start up the pump. It is called over-load operation because of high viscosity of the pump oil at low temperature.

If the pump does not restart, warm up the pump oil, or try to keep the pump within the operating temperature for a little while and then turn on the power again.

When the pump stops after rotating for a few seconds, open leak valve (B) and continuous operation may become possible. After the pump has warmed up, close leak valve (B) and return to ordinary operation (see Fig.5).

4.5 Backflow preventer

A backflow preventer is incorporated into the pump to prevent the oil from flowing back while the pump is stopped.

The backflow preventer actuates in the case of an emergency including power failure. So, after the pump is stopped due to a power failure, follow the procedures mentioned in "4.3 Stopping the operation" to stop the operation.



✓ Warning ———

- 1) To stop the pump, always close vacuum valve (A) and then open leak valve (B). If this procedure is neglected, the pump oil fills the cylinder. making restart difficult or causing damage to the pump. The pump oil also may flow back to the vacuum chamber side (see Fig.5).
- ② If vacuum valve (A) is not closed, air may leak into the device side through the pump increasing the pressure (see Fig.5).

4.6 Thermal protector

A manually reset thermal protector is incorporated in the motor in order to interrupt the power circuit of the motor and prevent damage to the motor when an over current flows through the motor due to a stop in rotation or overload resulting from the pump malfunctioning during operation. The type of thermal protector to be used depends on the pump model.

Mode	el	Operating characteristic	Non-operating characteristic
GCD-051X	1ϕ ,200W	25.0(A) at 25°C	7.0(A) at 60°C
GCD-136X	1 φ ,400W	28.0(A) at 25°C	7.8(A) at 60°C
GCD-130A	3 φ ,400W	3.6(A) at 60°C	2.3(A) at 60°C
GCD-201X	1 φ ,550W	35.0(A) at 25°C	10.0(A) at 60°C
GCD-201X	2 A 700W	17.0(A) at 25°C	1.0(A) at 60°C

Table 3 Characteristics of the thermal protector

When the thermal protector has been actuated, turn off the switch and contact us.

The motor is very hot when the thermal protector has actuated. Never touch it with your hand. When the cause of the malfunction has been eliminated, check that the motor has cooled down, and then press the manual reset button to restart operation (see "6.5 Trouble check list").



Firing hazard. As the surface of the pump body is higher temperature $(40 \sim 80^{\circ}\text{C})$ during operation, do not touch it until cooled down after stopping the pump.

4.7 Gas ballast valve

The pump is equipped with a gas ballast valve in order to evacuate vapor and condensable gases such as solvent vapor.

Evacuated condensable gas that liquefies in the compression and pressurization processes of the pump is mixed with the pump oil and starts circulating through the pump together with the oil. In such a case, the same effect as when oil of a high steam pressure is used is produced, and the ultimate pressure of the pump increases. Moreover, the lubricity of oil deteriorates and the service life of the shaft seal is shortened.

If air or dry nitrogen enters through the gas ballast valve just before the compression and pressurization processes of the pump, condensable gas will not liquefy and will be exhausted together with air through the outlet valve. When the gas ballast valve is used, the "gas ballast effect" increases as the pump temperature becomes high. So, before evacuating condensable gas, perform operation for approximately 20 minutes with the gas ballast open, and after the pump temperature reaches approximately $50 \sim 65^{\circ}$ C, open vacuum valve (A) and continue operation (see Fig.5). If the temperature is low, a satisfactory "gas ballast effect" is not achieved.

If the gas ballast valve is left open when condensable gas is not evacuated, not only does the pump oil scatter and power is lost, but also the ultimate pressure increases. Furthermore, since the gas ballast valve's capacity to process condensable gas is limited, condensable gas remains in the pump oil when a lot of condensable gas is exhausted or when condensable gas (air and gas containing small amounts of moisture and other vapor which make the oil dirty) is exhausted without opening the gas ballast valve. In such a case, perform non-load operation with vacuum valve (A) closed and the gas ballast valve open. Then the oil temperature increases and the pump oil is purified due to the effect of the gas ballast valve. Continue non-load operation with the gas ballast valve closed until the specified pressure is reached. If the pump oil is not cleaned even a long time, replace the pump oil.



/!∖ Caution _____

As the surface of the pump body is high temperature $(40 \sim 80^{\circ}\text{C})$ during operation, do not touch it besides the gas-ballast valve.

Start operation after closing the gas-ballast valve.



✓!\ Note :

If the gas ballast valve is left open without condensable gas being exhausted, the pump oil scatters, power is lost, or the ultimate pressure increases. Close the gas ballast valve when condensable gas is not exhausted.

4.8 Installation of the oil mist separators (Option)

An oil mist separators can be installed in order to remove oil mist from the pump. In GCD-051X, it is an OMC-050 type, In GCD-136X,201X, they are an OMC-200 type. Attach in the outlet pipe of a pump by quick coupling of KF-25 (NW-25). The oil mist separators not only prevents oil mist generation but also reduces exhaust noise.

For details, refer to the instruction manual for the oil mist separators.

4.9 Restriction on operation when the oil mist separators is installed

When using the oil mist separators, there are some restrictions on operation. When the filter is clogged, replace it.

The internal pump pressure is limited to 0.03 MPa (gauge pressure). When the pressure measured at the outlet side has reached 0.03 MPa (gauge pressure), replace the oil mist separators filter.



⚠ Warning _____

Be sure to observe the restrictions on operation when the oil mist separators is installed. There is a risk of explosion. When the filter is clogged, replace

5. Pump Performance

5.1 Ultimate pressure

The term "ultimate pressure" as employed in the catalogue and in this manual is defined as "the minimum pressure obtained by the pump without the introduction of gas from the pump inlet (i.e. the non-load condition)." For this pump, measurement is performed using the specified pump oil with only a Pirani vacuum gauge installed at the pump inlet port.

Note that the Pirani gauge shows values approximately five to ten times higher than those shown by the McLeod gauge. This is because condensable gas components (mainly moisture) included in the measured air are removed when the McLeod gauge is used.

Also, the actual ultimate pressure of the vacuum device becomes higher than that noted in the catalogue for the following reasons.

- ① The vacuum gauge is installed at a distance from the pump, and the steam and a variety of gases are generated by water droplets and rust on the inside walls of the pump and piping.
- ② Gasifying of volatile components which have dissolved in the pump oil. (Deterioration of pump oil)
- ③ Existence of a gas supply source including vacuum leakage in the vacuum path.

5.2 Pumping speed

The pumping speed of the pump depends on the type and pressure of the gas to be evacuated. The pumping speed usually reaches the maximum at a high pressure range, and it gradually decreases as the pressure reduces.

The nominal pumping speed of this pump is the maximum pumping speed when dry air is evacuated. Fig. 8 shows the relationship between the evacuation pressure and pumping speed.

5.3 Power requirement

The power required to operate the pump is the total of the power required to overcome the rotational resistance of the pump (mechanical work) and the power required to compress the air (compression work), and reaches a maximum at an inlet evacuation pressure of around 2.7×10^4 to 4×10^4 Pa. If the inlet evacuation pressure has reduced to 13.3 Pa or less, the compression work is considerably reduced and more power is consumed in mechanical work.

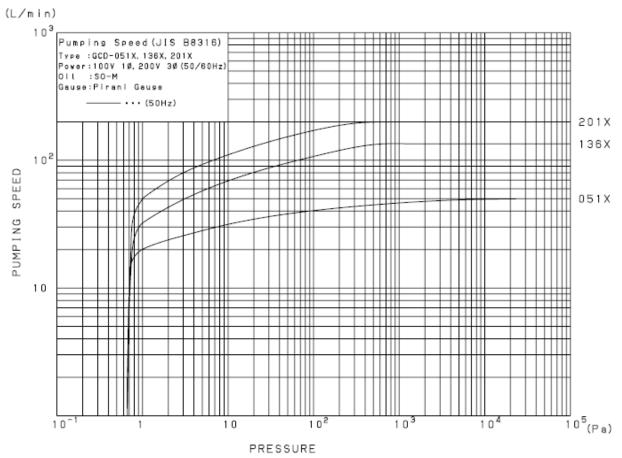


Fig. 8 Pumping speed curve

Maintenance, Inspection and Repair

6.1 Maintenance

Check the following during operation at least once every three days.

- (1) Amount of pump oil (To be within the range shown with lines on the oil level gauge)
- (2) Discoloration of the pump oil
- (3) Abnormal sound
- (4) Problem with the motor current value
- (5) Oil leak from the oil seal

If there is any problem, take proper measures in accordance with "6.5 Trouble check list."

6.2 Periodic inspection

The items to be checked should be changed as necessary depending on the environment where the pump is used. However, always check the following in order to prevent a malfunction and to lengthen the service life of the pump.



⚠ Caution _____

- ① Turn off the power before starting inspection and do not turn it on while inspection is in progress. Doing so will result in injury.
- ② The pump is very hot immediately after it is stopped. Wait for a while until the pump has cooled down completely and then start inspection. There is a risk of burns.

1) Periodic replacement of the pump oil

The pump oil deteriorates with operation. Check the viscosity and level of contamination of the pump oil with the oil level gauge, and replace the pump oil in good time. If the pump oil is replaced periodically, the deterioration of the pump oil is minimized and the service life of the pump is lengthened.

If operation is continued with a lot of moisture mixed with the pump oil, the ultimate pressure will not reach the standard value, the movement at the section where the mechanical friction is generated becomes slow, and the pump finally becomes damaged. Replace the pump oil in accordance with "6.3 Replacement of the pump oil."

Table 4 Periodic inspection table

Frequency	Item	Details	Measures
Once/3	Oil	Amount	Refill the oil.
days		Color (Reddish brown, dark blown, and cloudy white are not good.) This pump uses carbon in internal member of framework. Oil may become black when it runs. However, there is not it in the aberration.	Replace the oil.
	Sound	Abnormal sound	Check nuts and bolts for
	Vibration	Abnormal vibration	looseness. If not clear, contact us.
	Current value	Difference from the rated value	Check the cause of an overload. If not clear, contact us.
Once/week	Surface temperature	Surface temperature (The temperature higher than the room temperature by 50°C or more is abnormal.)	Check the cause of an overload. If not clear, contact us.
	Oil leakage	Oil leakage from the shaft seal section and plugs.	Replace seals, or contact us.
Once/3,000 operation	Evacuation wire mesh	Clogged with dust	Clean the wire mesh.
hours or once/6 months	Oil	Even if no problem is recognized, be sure to replace the oil.	Replace the oil.
Once/year	Spider	Damage or fracture	Replace the spider.

2) Inspection of the amount of pump oil

Refill the pump oil so that the pump oil level is kept within the range of the lines showing the upper and lower limits on the oil level gauge during operation.

3) Inspection of oil leakage

When oil leaks from the shaft seal section or drain plug seal section, repair is required. Our specified O-rings and seals are always available from the service departments shown at the back of this manual. When necessary, contact them.

4) Inspection of evacuation wire mesh

If the wire mesh is clogged with dust included in the evacuated gas, the pump's efficiency may deteriorate.

5) Inspection of abnormal sounds and vibration

Check the nuts and bolts for looseness.

6) Inspection of the coupling spider

Check the spider of the coupling which connects the main pump unit and motor of the pump for damage. If cracks or fractures are found on the spider, replace it in accordance with "6.4 Replacement of the coupling spider."

7) Inspection of the oil mist separators

When using the oil mist separators in replacement of the standard outlet pipe, pay attention to the clogging of the filter in the oil mist separators. If the clogging advances, evacuated gas cannot be exhausted any longer, which causes the oil gauge to protrude and oil leakage from the shaft seal section or drain plug seal section. The maximum internal pump pressure is 0.03 MPa (gauge pressure).

When the pump is operated continuously for a long time or when the pump is extremely contaminated with evacuated gas, overhaul is required. Contact the nearest sales or service department among those listed at the back of this manual.



Danger ______

When requesting the manufacturer's service department to overhaul the pump, always write the type of the vacuumed gas on the "Pump Usage Check Sheet" attached at the back of this manual and submit it. Note that if toxic gases are exhausted, both the pump itself and pump oil will become contaminated. Please be sufficiently aware that use with some gases will preclude overhaul.

6.3 Replacement of the pump oil

The pressure of the vacuum device may increase due to the deterioration of the pump oil. In such a case, close the inlet port of the pump and check that the specified ultimate pressure has been reached. If not, replace the pump oil. If substances having a high vapor pressure (such as moisture or solvents) are mixed with the pump oil, or if sludge is accumulated at the bottom of the pump, the ultimate pressure cannot be reached with only one replacement and the pump oil must be replaced several times. The deterioration of the pump oil is caused not only by the contamination due to evacuated gas but also by the changes in the properties of the pump oil itself (depending on the operation time). Periodic replacement in accordance with Table 4 showing an oil replacement guide is recommended.



Keep in mind that if the pump is used for exhausting toxic gas, both the main pump unit and pump oil will become contaminated.

Caution

- 1) Wear protective equipment such as rubber gloves and safety goggles.
- 2) Be sure to read the attached "Safety Data Sheet" before adding oil. If the oil accidentally comes into contact with your hands or enters your eyes, take proper measures in accordance with the section "First-aid shown in "Safety Data Sheet." treatment"



Use only oils specified by us. If other oils are used, the pump performance will deteriorate or its life will shorten.

- < Pump oil replacement procedure >
- (1) Release the pump inlet pipe to the atmosphere and operate the pump for five seconds. The oil remaining in the pump is discharged efficiently.
- (2) Remove the outlet pipe and drain plug to discharge the pump oil.
- (3) Mount the drain plug, and add the required amount of the new specified pump oil through the lubrication port (see Fig. 4).
- (4) If the pump oil is contaminated extremely, add new pump oil and perform operation for a while (several minutes) to clean the pump. Repeat this a few times.
- (5) After replacing with the new pump oil, operate the pump and when the pump has become warm, check the ultimate pressure.
- (6) If the pump oil is so dirty that oil sludge accumulates at the bottom of the pump, the specified ultimate pressure even after the pump oil is replaced. In such a case, overhaul the pump.

6.4 Replacement of the coupling spider

A rubber spider is used at the section connecting the pump main unit and the motor. It is recommended that this spider be periodically inspected once a year or so. If the corner is chipped or cracked, replace it. If the pump is started and stopped hundreds of times a day, increase the inspection frequency.

To take out the spider, remove the four bolts which fix the motor to the pump main unit, and remove the motor. Then the coupling can be removed and the spider taken out. After inspecting the spider, mount the spider to either of the two coupling, and adjust the position so that both claws of the couplings are engaged with each other as shown in Fig. 9.

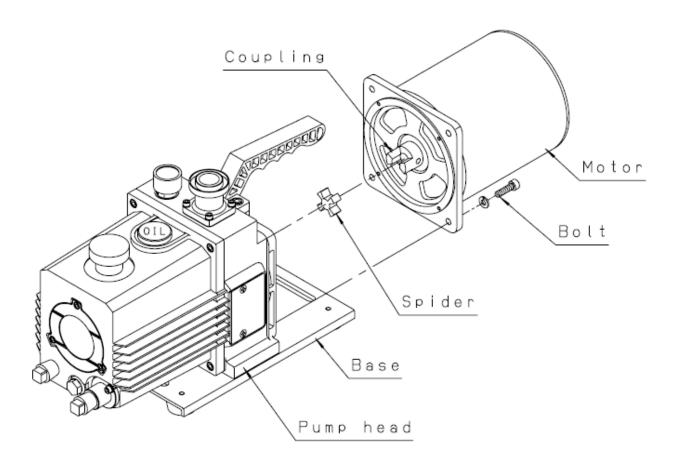


Fig. 9 Replacement of the coupling spider

Connect the concave section (female) of the pump unit with the convex section (male) of the motor, push the motor into the pump so that both connecting surfaces come completely into contact with each other, and fix the motor with bolts.

6.5 Trouble check list

Table 5 Trouble check list

Problem	Cause	Measures	Reference
The pump does not rotate.	①The pump is not connected to the power supply.	①Connect the pump to the power supply.	3.4
	②The power switch is not turned on.	②Turn on the power switch.	4.2
	③ Problem with power supply voltage	③ Set the power supply voltage to within $\pm 10\%$ of the rated voltage.	3.5
	①The overload protector has actuated.	④ Press the reset button.	0.5
	⑤The motor malfunctions.	⑤Replace the motor.	
	⑥Low ambient temperature has increased the oil viscosity.	⑥ Increase the ambient temperature to 7°C or more.	4.4
	The entrance of foreign matter into the pump caused the rotor to burn out.	⑦ Overhaul (replace the cylinder and rotor).	6.2
	Moisture or solvents were sucked in, forming rust inside the pump.	® Overhaul (replace the cylinder and rotor).	6.2
	① Components inside the pump have burnt out.	① Overhaul (replace the damaged components).	
The pump's rotation is	① Problem with power supply voltage	① Set the power supply voltage to within $\pm 10\%$ of the rated voltage.	3.5
unstable.	②Defective wiring to the pump	②Perform wiring to the pump again.	3.4
	③Low ambient temperature has increased the oil viscosity.	③Increase the ambient temperature to 7°C or more.	4.4
	④ Foreign matter has entered the pump.	④ Disassemble and clean the pump to eliminate foreign matter.	
The pressure does not	①The pump is too small for the volume of the vacuum chamber.	① Select another pump.	5.2
decrease.	②The pressure measurement method is not correct.	②Measure the pressure correctly.	5.1
	③The vacuum gauge is not suitable.	3 Measure with a calibrated vacuum gauge suitable for the pressure range.	
	(4) The pipe connected to the inlet port is small, or the piping distance is long.	④ Use pipes having a diameter larger than the inlet port diameter, or reduce the distance from the vacuum chamber.	5.1
	⑤ The wire mesh at the inlet port is clogged.	⑤Remove the piping from the upper section of the inlet port, and clean the wire mesh.	6.2

Problem	Cause	Measures	Reference
The pressure does not	(6) The specified amount of oil has not been added.	⑥Add the specified amount of oil.	3.2
decrease.	The oil has deteriorated.	7 Replace the oil.	6.3
	Our specified oil is not being used.	Overhaul the pump and replace with oil specified by us	6.3
	① Oil does not circulate, or the oil hole of the cover is clogged.	① Overhaul and clean the oil hole.	
Abnormal sound is	① Problem with power supply voltage	① Set the power supply voltage to within $\pm 10\%$ of the rated voltage.	3.5
generated.	②The motor malfunctions.	②Replace the motor.	
	③ Foreign matter has entered the pump.	③ Eliminate the foreign matter and overhaul the pump.	
	① The specified amount of oil has not been added.	(4) Add the specified amount of oil.	3.2
	⑤The coupling spider malfunctions.	⑤ Replace the coupling spider.	6.4
	⑥ Oil does not circulate, or the oil hole of the cover is clogged.	⑥ Overhaul and clean the oil hole.	
	7 Components inside the pump have burnt out.	Overhaul (replace the damaged components).	
Pump surfaces are extremely hot (50 °C or more higher than the room temperature)	① Continuous operation at high evacuation pressure	① If continuous operation is performed at a high evacuation pressure, the pump surface temperature reaches 80°C. However, this is not a serious problem.	
	②The specified amount of oil has not been added. (If the oil amount is not sufficient, the cooling effect of the pump will be reduced.)	②Add the specified amount of oil.	3.2
	③The temperature of the evacuated gas is high.	③ Mount cooling equipment such as a gas cooler at the inlet side.	
	④ Oil does not circulate, or the oil hole of the cover is clogged.	④ Overhaul and clean the oil hole.	
A lot of oil splashes out	①The pump is been filled in excess of the specified amount.	① Discharge the oil until it reduces to the specified amount.	3.2
from the outlet port.	②Continuous operation is performed at a high evacuation pressure.	②Install an oil mist separators at the outlet side.	4.8
The oil leaks outside the pump.	① Deterioration of the O-ring and the oil seal of the case and cover	①Check and replace the O-ring and oil seal.	6.2

7. Disposal

Follow state law and local government regulations for disposal of the pump.



⚠ Caution _____

- ① When a harmful toxic gas has been exhausted, ask a specialist for waste disposal. Not only the pump itself but also the pump oil become toxic.
- 2 For the disposal of pump oil, follow the instructions given under "Cautions for disposal" in "Safety Data Sheet."

8. Maintenance parts

8.1 Maintenance parts list

Table 6 GCD-051X Maintenance parts list

Product name	No.	Prats name	Q'ty
	15	Outlet valve	2
	16	Outlet valve spring	2
	18	Check valve	2
	19	Check valve spring	2
	50	Oil seal_HTC-11-25-7	1
	51	Oil seal_SC-12-25-7	1
	52	Oil seal_VC-12-22-4	1
	53	Oil seal_VC-10-20-4	1
	54	O-ring _S-3	2
	55	O-ring _S-5	1
CCD 051V	56	O-ring _S-12	2
GCD-051X Maintenance kit A	57	O-ring _S-20	1
Waintenance Kit A	58	O-ring _S-29	1
	59	O-ring _S-46	1
	60	O-ring _S-55	1
	61	O-ring _P-10	1
	62	O-ring _P-12	1
	63	O-ring _P-20	1
	64	O-ring _P-24	1
	65	O-ring _P-34	1
	66	O-ring _G-55	1
	67	O-ring _V-150	1
	68	O-ring _N-28	2
GCD-051X Maintenance kit B	4	1st vane	2
	5	Vane spring	3
	8	2nd vane	2
	34	Spider	1
	47	Bearing A	1
	48	Bearing E	1
	49	Bearing D	1

Note: For the relationship between components, see the disassembly drawing.

Table 7 GCD-136X Maintenance parts list

Product name	No.	Prats name	Q'ty
	17	Outlet valve	2
	18	Outlet valve spring	2
	24	Check valve	2
	25	Check valve spring	2
	60	Oil seal_HTC-17-40-9	1
	61	Oil seal_SC-17-30-7	2
	62	Oil seal_SC-15-30-7	1
	_	O-ring _P-6	1
	_	O-ring _P-7	1
	63 109	O-ring _P-12	2
	64	O-ring _P-20	1
GCD-136X	65	O-ring _P-34	1
Maintenance kit A	66	O-ring _P-35	1
	67	O-ring _S-10	1
	68	O-ring _S-12	1
	69	O-ring _S-16	2
	70	O-ring _S-20	1
	71	O-ring _S-30	2
	72	O-ring _S-45	1
	73	O-ring _S-70	4
	74	O-ring _G-55	1
	75	O-ring _V-175	1
	76	O-ring _JASO3056	1
	77	O-ring _N-28	2
	109	O-ring _P-12.5	1
GCD-136X Maintenance kit B	14	1st vane	2
	15	2nd vane	2
	16	Vane spring	5
	30	Tube	1
	45	Spider	1
	57	Bearing A	1
	58	Bearing B	1
	59	Bearing D	1
	110	Sleeve	2

Note 1: For the relationship between components, see the disassembly drawing.

Note 2 : The reference number 109 is the O-ring of the Drain plug. Depending on the type of Drain plug (resin or metal). Please use O ring P-12 or P-12.5.

O-ring for Drain plug

Resin made (Black) : P-12 Metal made (Silver) : P-12.5

Table 8 GCD-201X Maintenance parts list

Product name	No.	Prats name	Q'ty
	17	Outlet valve	4
	18	Outlet valve spring	4
	24	Check valve	2
	25	Check valve spring	2
	57	Oil seal_HTC-17-40-9	1
	58	Oil seal_SC-17-30-7	2
	59	Oil seal_SC-15-30-7	1
	_	O-ring _P-6	1
	_	O-ring _P-7	1
	60 104	O-ring _P-12	2
	61	O-ring _P-20	1
GCD-201X	62	O-ring _P-34	1
Maintenance kit A	63	O-ring _P-35	1
	64	O-ring _S-10	1
	65	O-ring _S-12	1
	66	O-ring _S-16	2
	67	O-ring _S-20	1
	68	O-ring _S-30	2
	69	O-ring _S-45	1
	70	O-ring _S-70	4
	71	O-ring _G-55	1
	72	O-ring _V-175	1
	73	O-ring _JASO3056	1
	74	O-ring _N-28	2
	104	O-ring _P-12.5	1
GCD-201X Maintenance kit B	14	1st vane	2
	15	2nd vane	2
	16	Vane spring	7
	30	Tube	1
	45	Spider	1
	54	Bearing A	1
	55	Bearing B	1
	56	Bearing D	1
	107	Sleeve	2

Note 1: For the relationship between components, see the disassembly drawing.

Note 2 : The reference number 109 is the O-ring of the Drain plug. Depending on the type of Drain plug (resin or metal). Please use O ring P-12 or P-12.5.

O-ring for Drain plug

Resin made (Black) : P-12 Metal made (Silver) : P-12.5

8.2 Disassembly drawing

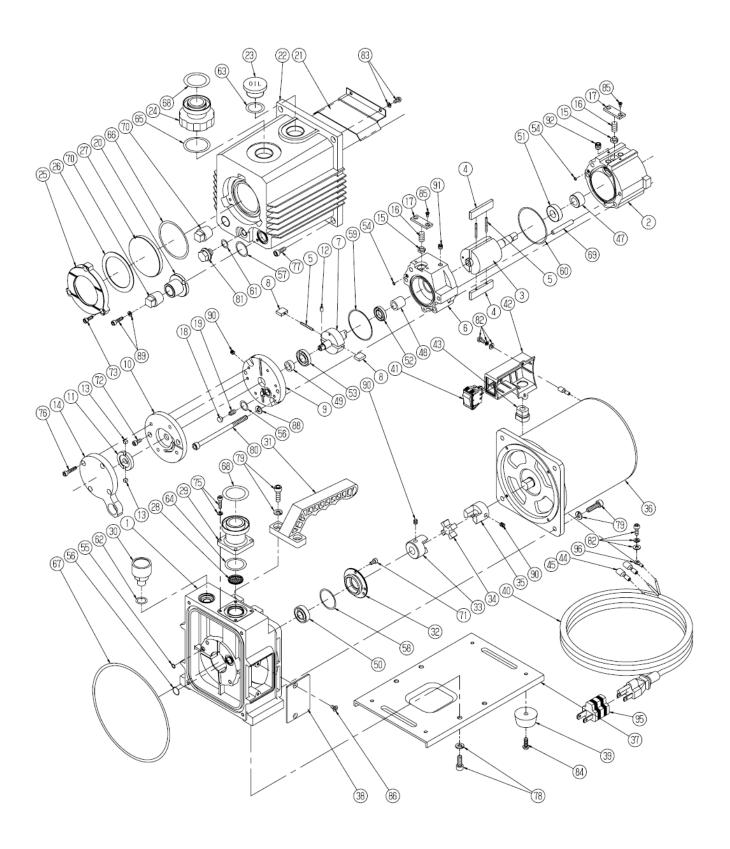


Fig. 10 Disassembly drawing of GCD-051X oil sealed rotary vacuum pump

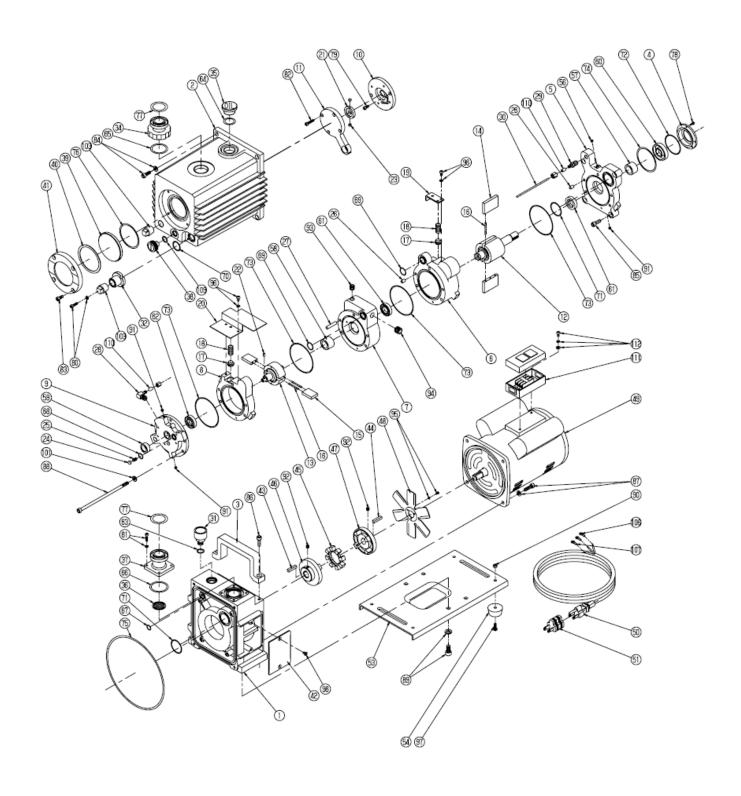


Fig. 11 Disassembly drawing of GCD-136X oil sealed rotary vacuum pump

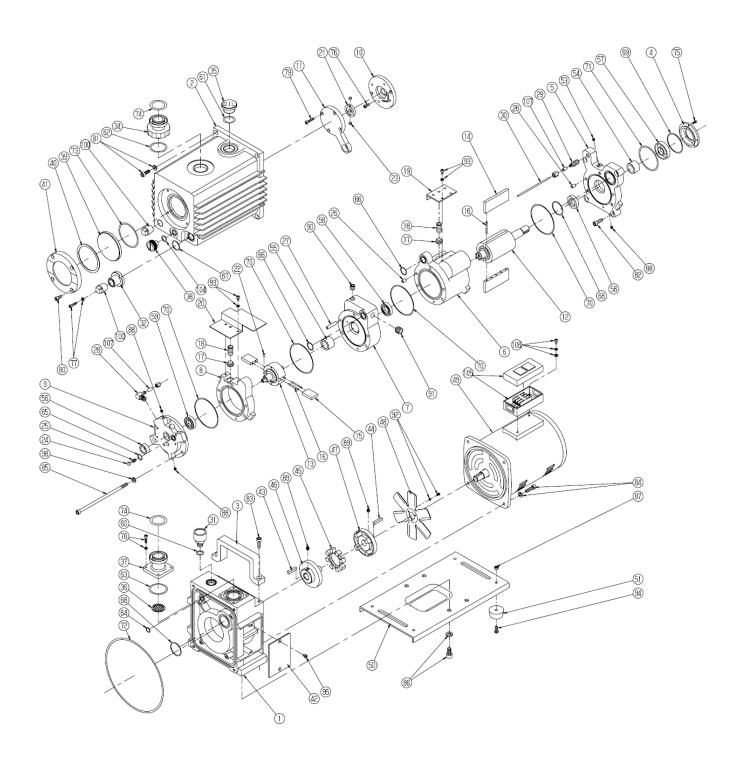


Fig. 12 Disassembly drawing of GCD-201X oil sealed rotary vacuum pump

<u>Warranty</u>

- (1) The warranty for this pump (this equipment) extends for a period of one year from the date of shipment.
- (2) Any malfunctions or defects which occur under normal usage conditions during the warranty period will be repaired free of charge.

Note, the warranty stated here is an individual warranty covering the pump. In addition, the scope of the warranty coverage concerning repairs is limited to the repair and/or replacement of parts.

Normal usage conditions refer to the following:

- a) Ambient temperature and humidity during operation: 7 40°C, below 85% RH
- b) Operation in accordance with the user manual
- (3) Repair fees will incur during the warranty period for the following cases:
 - a) Malfunctions due to a natural disaster or fire.
 - b) Malfunctions caused by special atmospheric conditions, such as salt damage, inflammable gas, corrosive gas, radiation or pollution.
 - c) Malfunctions caused by usage conditions that differ from those stated in the user manual (performance specifications, maintenance and inspection, etc.).
 - d) Malfunctions caused by modifications or repairs carried out by a party other than the manufacturer, or by a service company not approved by the manufacturer.
 - e) Malfunctions caused by noise (electric disturbance).
 - f) Malfunctions that occur when not using a rated power supply.
 - g) Malfunctions that occur when there is an abnormal rise in internal pressure due to the pump exhaust outlet being blocked during operation, etc.
 - h) Malfunctions that occur, when the pump is damaged as a result of being dropped or falling, etc.
 - i) Malfunctions which are determined by the manufacturer's technical personnel to be caused by conditions that do not comply with the usage conditions for this vacuum pump.
 - j) Malfunctions due to the replacement of consumables.

(4) Disclaimer

- a) We shall not be liable for any malfunctions of our products caused by the customer, regardless if the malfunction does not fall within the warranty period, nor shall we be liable for any loss of opportunity for the customer's clients or for compensation for any damages to other products, labor costs, production loss, transportation expenses and other related work.
- b) We shall not be liable for any claims and patent infringements, including secondary damages, filed a claim by a third party against the customer.

Usage Status Check Sheet (for use in Instruction Manual)

- * For the purpose of safety control of repair personnel, fill in within the heavy line frame and attach the sheet to the item of which repair is requested.
- * In case this sheet were not attached or filled in, your request of repair and service may not be accepted.
- * In accordance with the Private Information Protection Law, the provided information will be used only for determining the cause of failure and whether detoxifying washing should be conducted. It will never be provided to any third person.

Model Name:	Manufacturer's Serial No.:						
1. Inhaled Gas * Please be sure to fi	II in.						
(1) Whether there is harmful effect on h	numan bodies Yes No (Sing your name below.)						
(2) Whether there is unusual smell	Yes No						
(3) Type and Name of Gas:							
	designates particular substances as the materials to be						
notified.							
2. Usage Status							
Operation Method: Approx. () hours per day, () years and () months							
□ Continuous Operation □ Intermittent Operation							
Usage:							
3. Failure Status □Unusual Noise	□Abnormal Pressure □Abnormal Actuation						
□Oil Leakage	Other Symptoms:						
4. Detail of Request □Repair (Overh	aul) □Regular Checks						
5. Others:							
	Personnel in charge:						
Address:							
	E-mail:						
	Personnel in charge:						
·							
* In case you do not have any direct tra 	ansaction with us, please be sure to fill in the agent name.						
6. Confirmation							
The gas and substance used in this pump or unit is harmless to human bodies, or it is not							
contaminated by any substance harmful to human bodies.							
Signed	(coal) Date:						
Signed	(seal) Date:						

- * In order to avoid a trouble during transportation, please evacuate oil from any oil pump before shipping.
- * You are requested to ship the package to our Service Division (CS Center). (See the attached list of addresses.)