# ULVAC

## Instruction Manual For Mechanical Booster Vacuum Pump

## Model

# MBS-053 MBS-053-01

## Request to Users

When perform installation of the pump and operation, please read this manual by all means.

Please keep this manual to be able to refer anytime.

Manual contents have a case to modify without advance notice to realize a performance gain.

**Original instructions** 

ULVAC KIKO, Inc.

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Safety Data Sheet (SDS)

Pump Usage Check Sheet (Use this sheet for requesting an overhaul.)

Contact address of sales and service departments

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### 0. Introduction

### 0.1 Before using the MBS-053/MBS-053-01

Thank you for purchase of mechanical booster vacuum pump model MBS -053/MBS-053-01.

This pump is only for vacuum pumping, and may malfunction or cause accidents if not handled appropriately. Please use instruction manuals after attention enough for check / maintenance / security sides after a reading well.

#### **Personnel Handling the Equipment**

The handling of this product has you read this instruction manual, and a person understood enough shall perform attention in the security, the specifications of this pump and a matter about operation method.

#### Read the Manual Thoroughly

This product please uses instruction manuals after a reading before use definitely well. Please read the [to have you use it safely] [instructions in the security] in particular by all means.

Keep This Manual in a Safe Place

Please keep the instruction manual carefully. Please keep it by all means in the place that used one can read after having read.

#### **Copying This Manual Is Prohibited**

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

#### **Statutory Requirements for Disposal**

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

#### Safety During Repair

When it is asked us for repair, please inform the use situation of having hazardous substance or not in particular for the safe management of the repair worker.

The use situation declines repair in the case of lack of foresight.

Confirmation at the time of the unpacking

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.A normal accessory is vacuum-pump oil and a connector of power supply

voltage change use and a power cable is an option parts.

- (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.

### 0.2 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.

# ▲ Danger

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

# \land 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.

# \Lambda Note

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

# Aigh temperature Caution

Some parts of the pump may reach temperatures of 90°C or more during operation. Touching such components may result in burns.

## A Electric Shock Caution

Always switch off the main power supply before installing electrical wiring or performing any electrical work on the pump. Failure to do so may result in electric shock.

# 

The Inlet pipe of the pump

# G→

The Outlet pipe of the pump

## 0.3 Cautions for safety

## \land Warning

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.

## \land 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.



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).



The Vacuum Pump Unit is device a built-in device. Do not install it without adequate protection against heat hazard. The surface temperature of the vacuum Pump Unit can exceed 90 degrees in case it is operated under high pressure (atmospheric to 10kPa).

## Warning

It gets an electric shock touching the motor energizing part. Please work after pulling out the power plug without fail when wires electricity is connected, it checks, and it transfers it.

## Warning

Do not run with opening a cover of the driver box. It causes electric shock and the ignition.

## \land Warning

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



At the time of shipping, set electric voltage by request in an order. Do not run by 200-240V line source as 100-120V system connection. Power supply circuit is damaged when you install wrong power supply voltage selection connector and in addition of ignition might. In order to operate with 200-240V class, the changeover connector in the terminal box must be changed into 200-240V class as shown in fig.4.3"Changing the voltage class."

# A 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.

# A 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.

# A 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.

## A 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 accidents, and ask the company from which you purchased the pump or the manufacturer for inspection and repair.

# \land Note

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

## 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. The pump is not to be used with toxic of flammable gases.

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

Cause		Prevention method and measures
Injury due to touching toxic	⇒	①Before overhauling and disposing of the
pump oil in the pump or harmful		pump, ask a waste disposal specialist to
substances attached to the		make it safe.
pump during inspection or		②Ask an authorized waste disposal
disposal		specialist to carry out disposal.



This pump is for dry air or the dry nitrogen suck only.

MBS-053-01 has surface treatment to MBS-053 and it is increasing resistance to corrosive gases.

- Periodic check of sealing material and exchange of it.
- Before starting operation, leak check shall be performed.
- $\boldsymbol{\cdot}$  When pump is in the abnormal condition, pull off the power plug.
- A risk assessment has to be performed for the location of use.
- When replace the pump, suction gas shall be purged.
- $\cdot$  Don't use for other suction gas without over whole the pump.
- Cleaning after suction gas is purged.
- Prior to use with corrosive gases, install a system removing the toxicity.
   Or dilute it in nitrogen or air to become the concentration which you can discharge outdoors, and exhaust it.





Cause	Prevention method and measures	
The energized part of the motor was touched.	⇒ ① When connecting electric wires, alway turn off the power and be sure to connect the earth wire. It is feared that get an electric shock in an electrical leak.	ys at
	2 When remove a cover of the driver	
	stand of the second sec	- 11

when remove a cover of the driver circuit box, remove a power cable by all means.

In addition, open the box after remove an electrical cable, and passing more than 10 seconds

There might be electrical shock hazard before capacitors of driver discharges electricity.

③ Never insert hands, fingers, or thin objects through the motor operating.



## Caution

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

# 1.1.3 \Lambda Caution



## High temperature

ignition might.

Causa	Provention method and measures			
Cause	Fie	vention method and measures		
Power supply circuit is damaged $\Rightarrow$		At the time of shipping, set electric		
when you install wrong power		voltage by request in an order however		
supply voltage selection		confirm setting just to make sure.		
connector and in addition of		For AC 100-120V $\rightarrow$ Red wiring		
ignition might.		For AC 200-240V $\rightarrow$ Blue wiring		
	2	Power supply circuit is damaged when		
		you install wrong power supply voltage		
		selection connector and in addition of		

Ŵ	Caution		High temperature	
Cause	•		Prevention method and measures	
High te	mperatures caused burns.	⇒	<ol> <li>The pump reaches a high temperature during operation.</li> </ol>	
			(Temperature increasing) Pump main unit during non-load operation → 10ГK1	
			Motor during non-load operation	
			→ 10[K] Pump main unit during high-load operation → 50[K]	
			Motor during high-load operation → 25[K]	
		2	<ul> <li>(High-load operation: Operation at a pressure of 5[kPa]- 10[kPa])</li> <li>If you use the pump in a high ambient</li> </ul>	
		temperature and have a high gas throughput, the temperature of the		
			pump-body may exceed 90°Cand you must	
			fit suitable guards to prevent contact with hot surfaces.	
		3	Please be sure to protect and cool surface	
			of vacuum pump and away from human body. Use this pump as built-in type.	
		4	Since the surface temperature is hot,	
			touching the surface accidentally may	
		result in burns. Never touch the pum during operation. When carrying out inspection, wait for 10 minutes until t		
		pump has cooled down completely after		
۸			stops.	
<u>!</u>	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.

# 1.1.4 🕂 Warning

### Explosion

Cause		Prevention method and measures
The pressure in the pump		The maximum internal pump pressure is
increased causing the pump to explode.		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.



## Warning

This pump does not become the withstand pressure structure. The limit value of the inside pressure of the pump is 0.03 MPa (gauge pressure). Pressure in the pump rises when the pump is driven with the equipment that obstructed the street of the gas to blockage and the exhaust entrance side of the exhaust vent put up , and there is a thing that the motor becomes an overloaded.

## 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

SDS is submitted as reference information to ensure safe handling of hazardous and harmful materials. Personnel handling the pump oil should be aware that proper measures must be taken depending on the conditions of use as their responsibility. Keep in mind that the SDS itself is not a warranty for safety. Newest SDS shall be used when the safety of material is investigated

## 2. Specification table

## 2.1 Specification

	ltem	C	ontents	Remarks			
1	Dumping aroad	$50m^3/Hr$ at $1\times10^2$ Pa	$1 \times 10^2 \text{Pa}$	See Fig 3			
1	Fumping speed			Change by a fore pump.			
				When used GLD-136 or			
2	Ultimate	4	×10 <sup>-2</sup> Pa	GLD-201 for a fore pump. Different by an ultimate			
	pressure			pressure of the fore pump.			
		· · · ·		Refer to 3.3.			
3	Recommended	Pumping spe	ed 130~240L/min				
	fore pumps	Two stage oil-seal	ed rotary vacuum pump				
4	Maximum	Atmosp	heric pressure	Refer to 3.4			
-	Pressure	Autoop					
-	Maximum		05				
5	compression		25				
6	Temperature		n-40℃				
0	range						
_	Power supply specifications	AC 100-120V	1φ 50Hz or 60Hz	Setting of a driver circuit is			
1		AC 200-240V 1 ø 50Hz or 60Hz		200V system.			
	-		-	Refer to 4.3			
		Туре	DC brushless motor				
		Out put	200W				
8	Motor	Nominal speed	3500min <sup>-1</sup>				
		Maximum power	250W/	Have to power supply when			
		consumption	25000	take external control. Refer to 5.6			
_	speed control						
9	voltage	External rotating	speed control voltage	DC 1-5V			
10	Intake flange	11	S VG-40				
10	size	51	5 VO- <del>1</del> 0				
11	Outlet flange	JI	S VF-40				
12	Lubricating oil	vacuum-pu	Imp oil SMR-200				
13	Oil quantity		70ml				
14	Weight		11kg				
	-		-	Fore pump is set in the			
15	Noise level	ا محد ۱	hen 65 dB( $A$ )	outside of the measurement			
	110130 16461	L-33 (		room when the measurement			
				room when the measurement.			

**Table 1 Specification** 

Note 1:The ultimate pressure values in the above table are indicated by an Ionization 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: SMR-200)

Note 3:MBS-053-01 has surface treatment to MBS-053 and it is increasing resistance to corrosive gases.

## 2.2 Outside drawing



Fig.1 Dimensional drawing of MBS-053/MBS-053-01 mechanical booster vacuum pump.



**Fig.2 Driver Box Interior** 

## 3 .Design of vacuum pumping system

### 3.1 Pumping system.

Cannot use mechanical booster vacuum pump with a unit, and combine it with a backing vacuum pump (Fore Pump) by all means.

# \land Note

Please do not take evacuation with only mechanical booster pump. A protection feature of a motor works when you perform evacuation only with a mechanical booster pump, and there is it when step out of magnet coupling occurs and, in addition, gives a pump damage of a mechanism.

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.

# \land 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.

# ▲ Note

The inlet filter of the inlet prevents foreign matter from getting into the pump inside. Please use it without taking it off.

Show a normal exhaust system drawing in Fig.3.

- (1). Connect a fore pump to a downstream side of a mechanical booster pump.
- (2). Install main valve between a mechanical booster pump and vacuum vessel.
- (3). Vent valve2 is a thing to prevent vacuum-pump oil of an oil-sealed rotary vacuum pump of a fore pump from flowing upstream to a mechanical booster pump.

Close main valve, and open vent valve after having stopped a mechanical booster pump and a fore pump.

Can omit it in the case of a fore pump

comprising a backflow prevention facility.

When you exhaust an active gas, toxic gas, use a nitrogen gas for vent.



Fig.3 Basic piping diagram to the vacuum chamber

# \land Note

When open velocity of main valve is early, there are the cases that step out of magnet coupling comes, and please adjust speed control valve so that in this case open velocity becomes late.

# ▲ Caution

Because this pump is complete seal structure. But this pump is for dry air or the dry nitrogen suck only. (MBS-053-01 has surface treatment to MBS-053 and it is increasing resistance to corrosive gases.)Please confirm whether a fore pump supports these gases. It is feared that explosion of a fore pump, When you design an evacuation system, confirm a type of an exhaust-gas, and please execute appropriate plans.

#### 3.2 Fore pump.

A normal fore pump to combine to this mechanical booster pump is model GLD-202(201) or GLD-137(136). 130 ~ 240L/min is most suitable for pumping speed.

Less than 10kPa are necessary for an ultimate pressure. A normal fore pump is oil rotary vacuum pump, but can use a diaphragm pump or a scroll pump, too. However, when outlet pressure runs in about 10kPa in succession, as for the gas temperature, it is necessary to be pumps of structure to bear this high-temperature gas because it is it with about 80 degrees Celsius.

#### 3.3 Ultimate pressure.

A mechanical booster pump ultimate pressure is decided on by pressure of a fore pump.For example, become P=100/25=4.0Pa with a diaphragm pump of an ultimate pressure of 100Pa than compression ratio property of Fig.4.

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

#### 3.4 Pumping speed.

As for the pumping speed, be decided with fore pump pumping speed property and compression ratio property. Show a pumping speed curve of GLD-202(201) in Fig.5.



Fig.4 Compression ratio property



Fig.5 Pumping speed curve

### 4.Installation

4.1 Installation of a pump

MBS -053/MBS-053-01 becomes design to use in an inline.

Fix flange of the outlet side, and install a pump in this flange.

## 🕂 Note

Install a pump horizontally. Horizontal admissible value of a pump longer direction is  $\pm$  0.5 degrees. Must not install a pump diagonally. Be inverted, and must not install it. There is the case that lubricating failure and inflow of lubricating oil to rotor cylinder come unless a pump is installed horizontally.

### 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: 0°C-40°C, 85% RH or less
- ② Height above sea level during storage and installation: 1,000 m or less
- ③ Minimum required distances from the wall, 100mm
- ④ Other conditions for storage and operation
  - $\mathbf{a}$  . Free from corrosive and explosive gases
  - **b** . No condensation
  - c. Dust-free environment
  - d. Indoors
  - ${\bf e}$  . 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
  - ${\bf h}$  . When you keep it for a long period of time, put pump oil into a pump and block up inlet port and outlet port.
  - ${\bf i}$  . Don't keep it, where moisture is attracted.

## Δv

Warning

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



## Note

Minimum required distances from the wall, 100mm.



## 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.

### 4.3 Power supply voltage setting

Power supply can operate with 1  $\phi$  AC100 toAC120V (50/60Hz), 1  $\phi$  AC200 to 240V (50/60Hz), but it is necessary to modify setting of motor power supply (motor driver) in 100V system and 200V system.



Fig.6 Driver circuit box position



AC power 100/200V change jumper connector For AC 100-120V For AC 200-240V Red wiring Blue wiring

### Fig.7 Driver circuit box interior

- (1). Take off a power cable of a driver circuit box of Fig.6
- (2). Remove cover of a driver circuit box 10 seconds later.
- (3). Replace the electric voltage change connector which showed in Fig.7. The connector of a red wire 100V system and connector of blue wire 200V system.
- (4). Install cover of a box certainly, and insert a power cable.

Warning

Power circuit is damaged when I apply voltage more than 150V by connector setting of 100-120V. In addition, there might be the ignition.

# $\wedge$

## Caution

Start an operation in a driver box after passing more than 10 seconds after pull out the power cable. Because electricity is stored to capacitors in the box, it is feared that you get an electric shock. Power supply circuit is damaged when you install wrong power supply voltage selection connector and in addition of ignition might. At the time of shipping, set electric voltage by request in an order however confirm setting just to make sure.

### 4.4 Electric wiring

Power cable is optional parts.

When provide in the user side, prepare an electrical cable of the following standard.

A plug of a pump side power supply inlet uses an IEC60320-C13 type.

Supply Voltage	Voltage Rating	Current Rating	Temperature Rating
100-120∨	120V or more	8A or more	70℃ or more
200-240∨	240V or more	5A or more	

Table 2 Power cable selection standards

Install the circuit protector which showed for Fig.8 in the application of power side.

Capacity of a circuit protector is 5A in 8A, 200V system in 100V system. Ear thing conductor of a pump connects with earth terminal of building or touchdown point of equipment certainly.



### Fig.8 Circuit protector wiring diagram

## A Warning

Unplug cords for power supply before connecting wires.

Otherwise an electric shock occurs.

# **Note** Grounding instructions

In the event of an electrical short circuit, grounding reduces the risk of electric shock by providing an escape wire for the electric current. This pump is equipped with a cord having a grounding wire with an appropriate grounding plug. The plug must be plugged into an outlet that is properly installed and grounded in accordance with all local codes and ordinances.

If power code is not equipped (option) then appropriate grounding shall be provided upon installation.

# \land Warning

Improper installation of the grounding plug is able to result in a risk of electric shock. When repair or replacement of the cord or plug is required, do not connect the grounding wire to either flat blade terminal. The wire with insulation having an outer surface that is green with or without yellow stripes is the grounding wire.

# \land Note

Check with a qualified electrician or serviceman when the grounding instructions are not completely understood, or when in doubt as to whether the product is properly grounded. Do not modify the plug provided; if it does not fit the outlet, have the proper outlet installed by a qualified electrician.

# \land Note

This pump must be connected to a grounded, metallic, permanent wiring system, or an equipment-grounding terminal or lead on the product.



Fig. 9 An Inlet (EN60320)

(2) Insert an including plug cord into an Inlet as shown in fig.9.

### a-1) Unplug-preventive hardware (Option)

Whenever you may operate the vacuum pump with your power cable, provide it with the unplug-preventive hardware, which should be selected so as to fit the shape of the power cable.

The unplug-preventive hardware allows you to secure the power cable so that the motor may not accidentally have it unplugged.

For a procedure for installing the unplug-preventive hardware, refer to "a-2 How to Install Unplug-preventive Hardware."



Whenever you may operate the vacuum pump with the power cable, does not fail to secure it with the unplug-preventive hardware.

- a-2) How to Install Unplug-preventive Hardware Install the unplug-preventive hardware in accordance with the procedure as follows:
- Let one end of the unplug-preventive hardware Catch the hole to the side of the inlet in the interior
- While pushing the unplug-preventive hardware at the other end, let it catch the hole to the side of the inlet in the interior.
- ③ Raise the unplug-preventive hardware.

④ Insert the power cable firmly enough.

and secure the power cable.

**5** Lower the unplug-preventive hardware





Now, the unplug-preventive hardware is completely installed.



#### 4.5 Fluctuations in the power voltage and frequency

Standard: Rotation electricity machine general rulesIEC60034-1:2004

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.10 Change region of the voltage and frequency

### 4.6 Oil charge

Remove an oil charge plug to show in Fig.11, and supply with lubricating oil. Lubricating oil uses vacuum-pump oil SMR-200.

Refuel it confirm oil quantity with an oil level gauge of Fig.12, and to become between two lines.

When corrosive gas is exhausted at MBS - 053 - 01, it is also possible to use fluorine oil (FOMBLIN YLVAC06/6).



Fig.11 Oil plug, oil level gauge position

Fig.12 Oil level gauge

## Caution

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Lubricating oil side must not protrude two red lines.

Oil flows into pump chamber through a clearance seal when supply too much with lubricating oil.

When oil is in pump chamber, an ultimate pressure rises, and there is a case to give a fore pump a failure.

In addition, you cause a sound level increase, the pump breakage when the pump runs with lack of lubricating oil.

# A Caution

 ${f D}$ Wear protective equipment such as rubber gloves and safety goggles.

②Be sure to read the attached "Material 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 "Material Safety Data Sheet."

# \land Note

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

## **5.Operation**

#### 5.1 Structure of pump



Fig.13 Structure of pump

This pump has three special features.

(1). DC brushless motor 10

Can run it with the rotating speed that is the optimum which accepted load of a pump by using this motor, and can pump it from atmospheric pressure.

(2). Magnet coupling 12

Arrange inner side magnets and outside magnets in the shape of coaxial including a can shield of nonmagnetic material. Transmit power of a motor to a pump using this magnetic field.

(3). Clearance seal (9)

Tend to use oil seal for shaft seal between rotor chamber and a bearing chamber. Here, use a clearance seal of non-contact of a small conductance in substitution for oil seal. Because power loss is a zero, can realize power saving operation for the seal which does not have the contact area.

### 5.2 Cautions for operation

## Ŵ

### Note

- ① Do not run with opening a cover of the driver box. It causes electric shock and the ignition.
- 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, water absorption expands the vanes of the pump, 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.
- ④ Do not block the flow of air to the motor fan as the temperature of the motor and pump will increase.

### 5.3 Start of operation

Show normal operational method of this pump with a system of Fig.3.

- (1) Close main valve and vent valve, and turn on a fore pump.
- (2) Turn on a mechanical booster pump.
- (3) Open main valve, and start pumping for vacuum vessel.

### 5.4 Stopping the operation

When you stop these pumps, close main valve, and stop the mechanical booster pump, and stop a fore pump afterwards.

Then open vent valve, and assume the pumps inside atmospheric pressure.

## Note

Let MBS-053/MBS-053-01 detects load of a pump and a condition of magnet coupling and change operation mode of the motor automatically. Rotation can reduce its speed in process of pumping down, but this is not a failure. Explain details of operation mode as follows.

#### **Operation mode 1**

#### Prevention of step out of magnet coupling

It is it with-free run till it is it in 1000min<sup>-1</sup> rotating speed when torque of a motor goes over moment  $0.8N \cdot m$ . Reduce its speed to 875min<sup>-1</sup> at a constant rate afterwards.

Accelerate at a constant rate when detect less than  $0.55N \cdot m$  of mode 2 more than 10 seconds.

#### **Operation mode 2**

#### Motor overload protection

When torque of motor detects 0.55N/m, decrease rotating speed to become less than this torque. Minimum rotating speed of this case is 500min<sup>-1</sup>. When load lightens, rotating speed rises depending on load again, and discharge pressure and difference of a suction-pressure ( $\Delta P$ )reach 3500min<sup>-1</sup> of rated speed when it is it with lower than about 10kPa.

#### Operation mode 3

#### Magnet coupling step out detection

An outside magnet usually synchronizes with an inner side magnet of magnet coupling, and a slip does not come, and, however, there is the case that does not synchronize in the case of load going over transmission capacity of magnet coupling, and a slip comes, and call this with step out. When step out occurs, load of a motor becomes very light.

When the motor controller detects torque  $0.13N \cdot m$ , and this continues it three seconds, judge it when step out came, and decrease rotating speed to zero. Rotating speed becomes zero, and raise rotating speed to rated speed again three seconds later. When a reason makes rotating speed low, a synchronization is to recover.

When be repeated torque detection here, rotating speed drop, re-acceleration three times, when lock came to the pump body, judge it, and the motor completely stops it.

In this case alarm signaling is out to interface connector. Because three kinds of operation mode which I showed here is chosen adequately automatically, operation of a mechanical booster pump from atmospheric pressure is enabled.

### 5.5 Protection feature

Protection feature to show for table 3 is incorporated in a protection feature motor driver circuit.

When even one protection that showed in table 3 works, it is output as an alarm signal by an outside interface connector.

	Protection item	Contents
1	Overheat protection	Be motor stopping when do rise in heat to 80 °C±10%
2	Power supply over voltage protection	Be more than AC144V or AC288V, and a motor stops
3	Anomaly of a Hall element IC	Motor stops unless signal from a Hall element IC are detected.
4	System error	Motor stops in computer anomaly
5	Over speed protection	When rotating speed goes over 4200min <sup>-1</sup> , be motor stopping
6	Over current protection	Be motor stopping when go over torque 0.96N•m
7	Over current electric fuse	AC250V 10A
8	Magnet coupling step out detection	Be step out detection when become less than torque 0.13N•m Operation mode 3

Table	3	Protection	feature
IUNIC	•	1 1010011011	i cutui c

A protection feature is reset by exclusion of an error cause and electric source off more than 10 second.

But 3 4 7 of protection item becomes repair required.

Please contact store or our company overseas business division.

Customer service department copes adequately.

## \Lambda 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.

# \land Danger

Do not apply more than 150V by setting of the 100V system.

Power supply circuit is damaged when you install wrong power supply voltage selection connector and in addition of ignition might.

### 5.6 External control and alarm output

Connector for external control and alarm output is possessed to a motor driver box. (Refer to figure 6) Show pin-out and signal contents of connector for Fig 14 and table 4.

Pin number	Signal name	Contents	
1	DC power supply input	+15V±10% 18mA (50mA max)	
2	GND		
3	Rotating speed control voltage input	1-5V : 500-3500min <sup>-1</sup> Be motor stopping in the case of under 1V	
4	Alarm output	Open collector output When alarm occurred, be OFF Voltage range $5V\sim30V$ Sink current : 5mA maximum	

### Table 4 External control connector





Weidmuller SAIE-M12B-4-0.5U-FP-M16

Fig.14 External control connector pin assignment Fig.15 Alarm signal origination side circuitry %The pair of SAIE-M12B-4-0.5U-FP-M16 is SAIL-M12G-4-1.5U.

## A Note

When it operates by external control, please supply DC +15V in the user side. When take external control, please set an inside / external control changeover switch in driver circuit box in the external control side.

An electric cable for alarm output assumes it under30 meters.

## \land Note

Even when the DC+15V is not supplied (operation stopped), the mechanical booster pump motor is run by the auxiliary pump operation.

When an auxiliary pump with an pumping speed greater than 240 L/min is used and the motor reaches an rpm greater than approximately 500 rpm, the motor system starts and the alarm output turns ON.

### 6. Maintenance

### 6.1 Daily inspection

Please execute inspection of table 5.

### Table 5 Daily inspections

	Check item	Check contents	Check interval
1	0il level	Is there an oil level between two lines of level gauge?	Once a week
2	Color change of oil	Cloudiness of oil: Because the moisture of exhaust-gases gets mixed in oil, and ultimate pressure rises, change it in brand new oil. Oil becomes black: It is feared that a bearing, timing gear are worn. Please take inspection in our company service division.	Once a week
3	Oil plug, Drain plug	Check whether plugs does not loosen. When a plug loosens, rise of an ultimate pressure and oil leaking out come.	Once a week

# ▲ Caution

①Pulled out the power plug before starting inspection and do not turn it on while inspection is in progress. Doing so will result in injury.

②The pump is very hot immediately after it is stopped. Wait for 10 minutes until the pump

has cooled down completely and then start inspection. There is a risk of burns.

### 6.2 Long interval maintenance

Can use it for a long term by executing maintenance by table 6.

This maintenance needs a professional skill.

Please order it from our company service division.

Table 6 Change parts of	long-term maintenance

	Change parts name	Quantity	Maintenance interval
1	Motor side bearing	2	30,000 hours
2	Gear side bearing	2	60,000 hours
3	Motor	1	40,000 hours

Problem	Cause	Measures	Reference
The pump does not	①The pump is not connected to the power supply.	①Connect the pump to the power supply.	4.4
rotate.	②Problem with power supply voltage to within ±10% of the rated voltage.		4.5
	③The overload protector has actuated.	③Wait till the temperature goes down to 78 ± 9℃.	5.3
	<b>④</b> The motor malfunctions.	④Replace the motor.	7
	SLow ambient temperature has increased the oil viscosity.	⑤Increase the ambient temperature to 0℃ or more.	4.2
	©The entrance of foreign matter into the pump caused the rotor to burn out.	<b>©Overhaul (replace the cylinder and rotor).</b>	7
	⑦Moisture or solvents were sucked in, forming rust inside the pump.	⑦Overhaul (replace the cylinder and rotor).	7
	8 Reaction product accumulated in the pump when the pump stops after exhausting reactive gas.	Overhaul (clean the pump inside and remove reaction products).	7
	Output Sector	Overhaul (replace the damaged components).	7
The pump's rotation is unstable.	①Problem with power supply voltage	<ol> <li>Set the power supply voltage to within ±10% of the rated voltage.</li> </ol>	4.5
	②Defective wiring to the pump	Perform wiring to the pump again.	4.4
	③Low ambient temperature has increased the oil viscosity.	③Increase the ambient temperature to 0℃ or more.	4.2
	④Foreign matter has entered the pump.	Disassemble and clean the pump to eliminate foreign matter.	7
The pressure does not	①The pump is too small for the volume of the vacuum chamber.	①Select another pump.	3.3
decrease.	②The pressure measurement method is not correct.	②Measure the pressure correctly.	3.3
	③The vacuum gauge is not suitable.	③Measure with a calibrated vacuum gauge suitable for the pressure range.	
	The pipe connected to the inlet port is small, or the piping distance is long.	Use pipes having a diameter larger than the inlet port diameter, or reduce the distance from the vacuum chamber.	3.3

 Table 7
 Trouble check list

Problem	Cause	Measures	Reference
The pressure does not decrease.	⑤The wire mesh at the inlet port is clogged.	⑤Remove the piping from the upper section of the inlet port, and clean the wire mesh.	
	©The specified amount of oil has not been added.	6Add the specified amount of oil.	6.1
	⑦The oil has deteriorated.	⑦Replace the oil.	6.1
	BLeakage occurs from the pipe connected to the pump.	BLocate the leakage with a leakage detector and stop the leakage.	
	Our specified oil is not being used.	Overhaul the pump and replace with oil specified by us	7
Abnormal sound is generated.	①Problem with power supply voltage	①Set the power supply voltage to within ±10% of the rated voltage.	4.5
	②The motor malfunctions.	②Replace the motor.	7
	③Foreign matter has entered the pump.	③Eliminate the foreign matter and overhaul the pump.	7
	The specified amount of oil has not been added.	④Add the specified amount of oil.	4.6
	⑤The coupling spider malfunctions.	⑤Replace the coupling spider.	7
	©Components inside the pump have burnt out.	<b>©</b> Overhaul (replace the damaged components).	7
Pump surfaces are extremely hot.	①Continuous operation at high evacuation pressure	(1) If continuous operation is performed at a high evacuation pressure, the pump surface temperature increasing 50K.	
		Under 50K temperature increasing 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.)	Add the specified amount of oil.	4.6
	③The temperature of the evacuated gas is high.	③Mount cooling equipment such as a gas cooler at the inlet side.	
A lot of oil splashes out from the	①The pump is been filled in excess of the specified amount.	①Discharge the oil until it reduces to the specified amount.	4.6
outlet port.	Continuous operation is performed at a high evacuation pressure.	②Install an oil mist trap at the outlet side.	7

Problem	Cause	Measures	Reference
The oil leaks outside the	①Deterioration of the O-ring and the oil seal of the case and cover	①Check and replace the O-ring and oil seal.	7
pump.	②Oiling plug or drainage plug becomes loose	Close oiling plug or drainage plug	6.1
Nasty smell.	①Applied more than 150V in 100 system connection.	①Motor replacement to switch it off (I disconnect the plug)	
		②Do not open a cover of the driver box	7

## 7. Support in trouble

In trouble, please contact store or our company overseas business division. Customer service department copes adequately.

### 8. Disposal

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



## Caution

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

### <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: 0 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 fill in.
(1) Whether there is harmful effect on human bodies Yes No (Sing your name below.)
(2) Whether there is unusual smell Yes No
(3) Type and Name of Gas:
* Industrial Safety and Health Law 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
5. Others:
Company Name: Personnel in charge:
Address:
Tel: Fax: E-mail:
Agent Name; Personnel in charge:
Address:
Tel: Fax:
* In case you do not have any direct transaction 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 (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.)