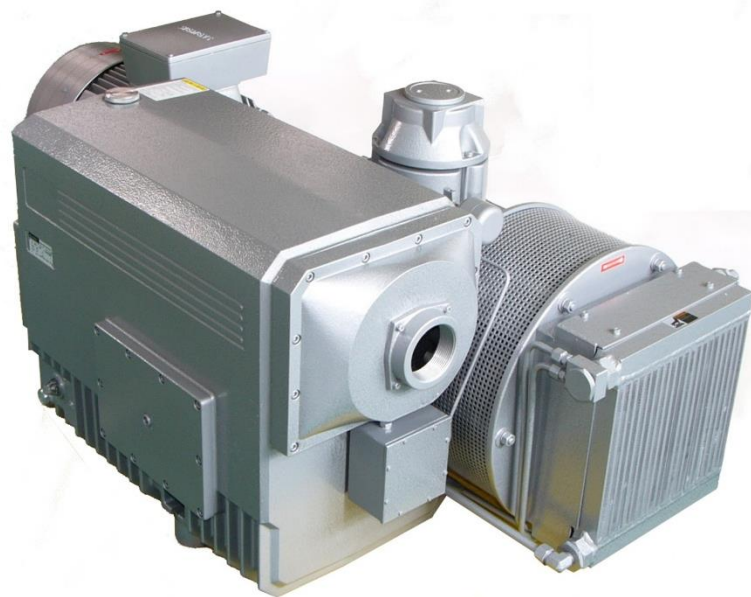


USER'S MANUAL

Rotary Vane Vacuum Pump
(Oil-Circulated)

Type: MVO 010~630



Please, read this manual through before to operate your vacuum pump.

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1. Foreword

The information in this manual is provided for the proper installation, operation, maintenance and general troubleshooting for oil-circulated rotary vane vacuum pump, MVO type of our product.

The pump has been designed with safety as a primary consideration and being the most efficiency of the pump under your correct use in accordance with the procedure detailed in this manual.

Before attempting to the first run test, operate or service the product, carefully read this manual thoroughly and understand fully in order to your safety as well as the most efficiency and be economical on the product.



This manual and any other documents supplied with this product, are the property of Dooil Engineering which reserves all right.

They may not be reproduced in whole or in part, without prior written approval from dooVAC CO.,LTD.

The product warranty will be void if any modification to the product or using non-compatibility oil is carried out without prior written approval from Dooil Engineering.

Dooil Engineering reserves the right to make changes to this manual contents described in it without notice.

All specifications and information concerning products are subject to change without notice.

■ if you require more technical assistance, please contact us at our below contact points.

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OPERATING DATA

Please record the below blanked items correctly in order to solve clearly the problem arising out of your operating.

Model No. _____ Oil Type _____

Serial No. _____ Operating Vacuum _____

Startup Date _____ Inlet Gas Composition _____

Motor HP _____ RPM _____ Accessories supplied _____

NOTE;

2. Safety Instructions



This section contains important safety information for your as well as others safety and the pump itself.



Read manual through before to operate your pump.

You may also find additional safety tips throughout this manual.

Dooil Engineering bears no responsibility for personnel injury or damages of the product due to misuse, neglect, attempt to repair, unauthorized alteration or modification by your intentionally.

2.1 Safety Warnings

- Safety warnings are defined in this manual as 'Danger', 'Warning', 'Caution', and 'Note'. These regulations should be observed to ensure the prevention of personnel injury and damages or malfunctions of the product.

Please pay attention to *Danger* , *Warning* , *Caution* and *Note* signs, since they may indicate a potential hazard that may result in death, serious personal injuries, or damages to the machine.



Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



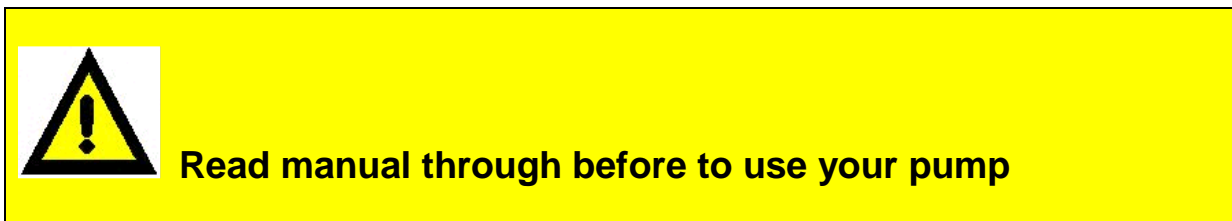
Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, will result in minor or moderate injury, or alerts against unsafe damage the product.



A Note is used to highlight additional information which may be helpful to you but where there are no special safety implications.



The information in this publication does not cover all hazardous incidents unexpected. The manufacturer is not liable for incidental or consequential damages in connection with its incorrect use and not fully understanding of safety instructions mentioned in this manual, this is to be liable on user's responsibility

2.2 Warranty

- **dooVAC CO.,LTD.** guarantees all materials against defects in workmanship and materials for one year from delivery
- The guarantee is limited to free replacement and shipping of any faulty part, or subassembly which has failed due to poor quality manufacturing errors.
- All claims must be supported by evidence that the failure has occurred within the warranty period.
- Only genuine **dooVAC CO.,LTD.** approved parts and oils, must be used.
- The unit warranty will be void if any modification to the unit is carried out without prior written approval from **dooVAC CO.,LTD.**

2.3 For this manual

The information in this manual is provided for reference and is believed to be accurate and complete. Dooil Engineering is not liable for errors in this manual or for incidental or consequential damage in connection with furnishing or use of the information in this manual, including but not limited to, any implied warranty of fitness or merchantability for any particular use.



- Before each intervention on this product or unpacking its package, read this manual and understand fully.
- This manual should be read and understood fully before initial start-up, operating, servicing the product by the assigned person to work the product.
- This manual can be used to assist/prepare on training of personnel, for proper and safer product operation and higher efficiency out of the product operation as well as constant maintenance of the product.
- Therefore, the person assigned to work on the product, read this manual very carefully and understand fully before handling/operating the product.
- If the product is used by more than one operator, each operator shall be aware of the contents of this manual.
- The manufacturer does not have any responsibilities for damage to the product itself or injuries to the user arising out of its incorrect use and not fully understanding of safety instructions described in this manual.
- This manual should be available to serve as a reference book for everyone who can see with easy, in an easy accessible location near by the product on working the product.
- This manual has always to be in very clean condition so that can read easily. In case the manual is not in clean condition, it has to be informed your supervisor for corrective action.
- If this manual is not understood fully by the assigned person to the product, it has to be informed your supervisor for corrective action.

2.4 Safety Warning Labels

- The safety warning labels along with the explanation of their hazards in this product are the following symbols :

① Electrical Hazards



This symbolic label marked on the covers of product contains high voltage section inside it. The electric high voltage system inside it may cause an electric shock accident by the high voltage.



If unqualified personnel open the cover without the observations may results in serious injuries or death through the electric shock.

② Mechanical Hazards



This symbolic label marked on the cover of product contains mechanical moving parts section in it.

The mechanical moving parts may cause crush / entanglement hazard.



Do not access hands into moving section in it.

Otherwise, moving section may crush hands and cause unexpected accidents.



This symbolic label marked on the surface of product contains hot surface parts section on it. The hot surface parts section may cause burn hazard.

2.4.1 Observations for safety warning

labels

- Safety warning labels are applied to the parts of the product where potential hazards are potentially being on it during operation or maintenance workings on the machine.
- Safety warning labels are in appropriate sizes and colors containing to the description of warning contents.
- Keep safety warning labels clean so that operator can read them easily. If a label becomes soiled, clean it immediately.
- Never remove the labels and if a label comes off, re-affix it at the original position.
- Warning labels contain critical information which must be strictly observed by all operators, if failure to keep this warnings, could be unexpected serious accidents.
- If not understood the contents of warning labels which contain critical information, it has to be informed to your supervisor for corrective action.

2.5 Location of safety Warning Labels on product

- Position of the labels on the product



- Electrical Power inputting side -



- Upper side of Cooling Fan Cover -



- Front upper side of Oil Cooler -



- Upper side of Oil Sump -

■ Name Plate



2.6 Keep the following obligation

- The following instructions must be obliged strictly by user before operation for this product.



1. Only a qualified electrician should connect power to the pump or repair of the pump. You can be severely shocked, or it can cause a fire if power is improperly applied.
2. When working the power supply to the pump, should be shut off wholly from the incoming supply.
3. Never damage, remove or relocate any parts of the safety devices and protective components without our permission, doing so could result in serious personal injury or death.
4. Do not operate the pump when the pump running is not safety or abnormal running.

5. Never place your hands on the surface of pump when the pump is on, You can be burned carried by hot surface.
6. Do not operate the pump without the cooling fan cover from the pump.
7. The manual should be kept in a well-known and easy-access place in order to anybody access when it needed.
8. Never do modify the product in any way which may decrease the safety of the product.
9. Keep in mind the safety warning indications and name plate on the product.
10. Remove power from the product before servicing. You can be shocked or cause a fire.

2.7 Safety precaution before operating

Before using the product, You should read this manual completely and be fully aware of the instructions in the manual, otherwise You get a serious injury or damage of the product.

2.8 Safety precaution on operating the product

1. The safety instructions in this manual must be obliged strictly by user on operating the product.
2. Perform function test of the product in order to check for malfunctions out of the product before actual operating.
3. The assigned operator should test the function of the product in accordance with the procedure described, step by step, in this manual.
4. if you find the malfunction product, contact your supervisor immediately.
5. Don't use the malfunctioned product.
6. Do not attempt to services the malfunctioned product without the qualified technician trained from **doovAC CO.,LTD.**

3. Information for product

3.1 Principal of operation

This vacuum pump is oil-circulated rotary vane type, which comprises rotor(7), vane(6) and cylinder(8). Rotor and cylinder center are assembled eccentrically, and 3 vanes rotate by centrifugal force in pushed state the inside wall of cylinder, At this time, cell takes place between vane and vane, happen to the vacuum whose volume change sucks, expanse, compresses and discharges. Uses oil for lubrication of rotary part and maintenance of vacuum so that stable and reliable vacuum may be obtained in order to be use for various applications. The oil lubrication and sealing is consistently supplied to cylinder without separate oil pump (5) through pressure such as suction difference and so on, and then is discharged to oil sump with air. When through the exhaust filter(3), oil mists clearing 99.9% and discharges clean air so that can using in any environment.

■ Features

◆ Reliability

High quality material, automated machining facility and computer control process, etc. Guarantee standardized and accurate product manufacturing. Where operation of vacuum pump stops during vacuum work in direct coupling operation method of flange type. Check valve is installed at the suction hole in order to prevent reverse-flow.

◆ Environmentally safe

Air cooling, internal oil re-circulation, integral oil mist separator for oil-free exhaust air, low vibration and low noise level allows this pump to be used in any environment.

◆ Easy to service

Compact design, air cooling and easy access allows rapid and simple servicing with long periods with services. It is unnecessary to do in the same way for replacing other consumables when oil charge is needed.

◆ Miniaturization

This is simple type that spindle of flange motor connect pump rotor & cylinder directly and cooling type used with cooling fan. This pump is small size and lightweight. Uses oil for lubrication of rotary part and maintenance of vacuum so that stable and reliable vacuum may be obtained in order to be use for various applications.. Vacuum packing machine, Food packing, Laboratory, Medical instrument, Vacuum molding, Vacuum dryer, Vacuum consolidate.

3.2 Characteristics of Pump

3.2.1 Using environmental and condition

This, MVO type pump is designed with using under below conditions:

- ◆ Air and inert gas
- ◆ Temperature of suction gas: 0°C~42°C
- ◆ Environmental temperature: 5°C~40°C
- ◆ Nominal Pressure: Up to the below of pump maximum pressure area

3.2.2 Specification

MODEL (MVO-)			010	020	030	040	063	100	160
Nominal displacement	m ³ /hr	50Hz	10	20	30	40	60	100	160
		60Hz	12	24	36	48	72	120	190
Ultimate pressure	mbar	A	0.5	2	2	0.5	0.5	0.5	0.5
		C	20	20	20	20	20	20	20
Sound level	db		58	61	61	67	68	70	72
Motor capacity	kW	50Hz	0.75	0.75	1.5	1.5	2.2	3	4
		60Hz	0.75	0.75	1.5	1.5	2.55	3.45	5.5
Motor speed	rpm	50Hz	1420	2850	1420	1420	1420	1420	1420
		60Hz	1700	3420	1700	1700	1700	1700	1700
Oil filling	ℓ		0.4	0.4	1	1	2	2	7
In-let port	Pt"		1/2	1/2	1-1/4	1-1/4	1-1/4	1-1/4	2
Exhaust port	Pt"		1/2	1/2	1-1/4	1-1/4	1-1/4	1-1/4	2
Weight	kg		20	20	34	38	64	75	174

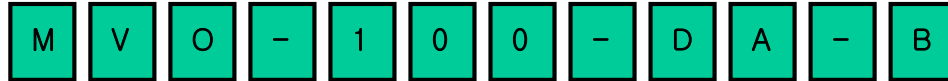
MODEL (MVO-)		200	250	300	400	500	630	

Nominal displacement	m ³ /hr	50Hz	200	250	300	400	500	630	
		60Hz	240	300	360	480	600	760	
Ultimate pressure	mbar	A	0.5	0.5	0.5	0.5	0.5	0.5	
		C	20	20	20	20	20	20	
Sound level	db		74	74	74	72	79	74	
Motor capacity	kW	50Hz	4	5.5	5.5	11	11	15	
		60Hz	5.5	7.5	7.5	15	15	18.5	
Motor speed	rpm	50Hz	1420	1420	1420	1000	1000	1000	
		60Hz	1700	1700	1700	1200	1200	1200	
Oil filling	ℓ		5	7	6.5	14	14	14	
In-let port	Pt"		2	2	2	3	3	3	
Exhaust port	Pt"		2	2	2	3	3	3	
Weight	kg		140	202	190	550	530	630	

3.2.3 Check the contents in package of product

- 1) Pump 2) Oil 3) Instruction Manual

3.2.4 Check the specification on name plate of product



Model _____

- MVO : Oil-Circulated(within Exhaust Filter)
- SVO : Oil-Circulated(without Exhaust Filter)
- MOT : Oil-Flooded
- SML : Oil-Free
- DWV : Water Sealed
- ENT : Oil-Circulated(ENT.Medical-Suction)
- DEN : Water Sealed(DEN.Medical-Suction)

Model Capacity _____

- MVO Series : m³/hr (at 50Hz)
 - SVO Series
 - MOT Series
 - SML Series
 - DWV Series
 - ENT Series
- } Liter/min(at 60Hz)

Ultimate Pressure

- None(A) : Standard(0.5 mbar)
- B : 2 mbar
- C : 20 mbar

Hertz

- A : 60 Hz
- B : 50 Hz

Main Voltage

- A : 1Phase 110/220 V
- B : 1Phase 220 V
- C : 1Phase 110 V
- D : 3Phase 220/380 V
- E : 3Phase 380 V
- F : 3Phase 220 V

4. Transportation and Installation

4-1 Transportation



1. The overall weight of the product per model are to be indicated previous **Characteristics of product** in this manual and this is to refer to transportation work
2. The unpacking process requires at least two people. You can be severely injured or crushed if you don't unpack the machine carefully.
3. Keep the following instruction on moving the product to other place during operation.



Move the product after removing the oil in oil container, otherwise being damaged oil and back pressure caused by the damaged drain filter by oil wetting.



When outgoing the product from manufacturer, the oil is to be contained in the separating container and packing with the pump.

NOTE

4-2 Installation environment

- Install the product under the below environmental condition.
 - 1) Around temperature on the place is less than 40 °C .
 - 2) The operating environment must be free of dust and humidity.
 - 3) Where the using gas is to exhaust to the outdoor easy.
 - 4) Where the product is to check and maintenance easy.



The installation work should be stopped on abnormal and unsafe operation **WARNING** arising out of installation working.



CAUTION

Install the product on the place at the distance of 25meters from wall due to flow in the cold air from outside and the pump will be cooled and exhausted.



CAUTION

The stopper equipped at the inhalation hole due to prevent incoming foreign materials from outside during transport ting and storage.

This

stopper should not be removed before installing the pipe or filter at the inhalation hole.

4-3 Installation procedure



WARNING

The pump should be installed on the flat and even ground and fixed securely at the place to be checked easily.



NOTE

Install the pump at the place to be checked the oil easily.

4-4 Electrical power line connection



Only a qualified electrician should connect power to the pump on electrical working and it can cause a fire if power is improperly applied. When working the power supply to the pump, should be shut off wholly from the incoming **DANGER** supply.



DANGER

Install the breaker and electrical wire be suited to the capacity of motor.



DANGER

Do ground to the pump on connecting electrical power to the pump.



Install the circuit breaker and magnetic contactor for motor safety.

WARNING



The rotating direction of pump should be corrected to the direction marked on the fan cover when electrical power line connecting.

WARNING

4-5 Suction and exhaust piping installation

1. Piping installation at the suction hole

- Install the piping at the suction hole after removing the cover of suction hole and cleaning the around that is installed on the outgoing from manufacturer.

- On installing the piping at the suction hole, the length of piping should be



proper one. If the length of piping is more or less than normal length, the **NOTE** outgoing of suction capacity will be abnormal capacity.

- So, for the most efficiency of suction capacity, install the piping having the size, one grade, more than the size of original suction hole piping.



- In case of being foreign material in the vacuum pump, the rotor and vane is to be damaged caused by these foreign materials. **So pay attention the WARNING foreign materials incoming into the vacuum pump.**

2. Exhaust piping installation

- When the vacuum pump is used in the airtight place for a long time, The air contamination and bad smell may be occurred due to the minute particles of dust out of oil through the exhaust hole.

- **So, The exhaust piping can be installed thru the outdoor side.**



If the length of exhaust piping is longer or the diameter of exhaust hole is less, the back pressure in the oil container will be occurred and this is **WARNING** to effect to the motor. The motor is to be damaged caused by the overload and high temperature of motor.

5. Trail test and safety precaution on pump running

5-1 Ascertain the below items before trail test of pump

1. Ascertain the actual electrical voltage and frequency with the name plate on the pump whether wrong or correct and this is very important.
2. Check the oil level being at the nearby of "MAX" position on the oil gauge, If not, compensate the oil level is up to the "MAX" position on the oil gauge.
3. Check the connecting condition of the connecting piping.
4. Check the rotating direction of motor.



WARNING

Wrong electrical voltage and frequency, this is to be damaged to the motor seriously

5-2 Trail test performance

After the first trial test performing, the foam of white color by oil will be occurred and can be visible thru oil gauge within 5 minutes, this is normal condition of oil circulated function, otherwise, ascertain the oil filter and piping line whether wrong or correct.



WARNING

Never running the pump more than 20 minutes without the vacuum condition of pump.

5-3 Safety precaution on pump running



WARNING

Never touch your hands without any protective equipment on the surface of pump during pump running, otherwise, You may be burned caused by hot surface of pump.



WARNING

Never running the pump without the cooling fan cover of pump.



Never insert your fingers into the cooling fan cover of pump.

WARNING



When the pump running with the contaminated or shortage oil, this is to short the life of pump working and being out of order of pump function. So, check these conditions frequently.

WARNING



The pump running should be stopped on being abnormal noise or vibration arising out of pump running immediately.

WARNING

6. Maintenance

6.1 Requirements before Maintenance working



Periodic maintenance is important in order to ensure that the normal operation of the facility, the warrant, the quality and expend to the life. Before the maintenance, perform the only maintenance person qualified technician.



Disconnect the power supply wholly before performing maintenance on this product. Failure to disconnect the power supply results in serious injury or damage.



Performing regular maintenance on the product is critical to ensure proper operation and its components, and the frequency of the maintenance procedures will depend on usage.



After maintenance working.

1. Clean all dusts.
2. Clean all contact parts with dried clean cloth.
3. Oiling to the friction parts
4. The damaged parts and the cause of the problem have to be recorded on the product history book for a traceability
5. Sufficient pre-operation is required before working the product operation.



Maintenance for electrical parts.

Maintenance person should keep the following procedure prior to servicing, if,

not, it may be a cause of serious injury or damage for operator and machine.

1. Electrical parts maintenance

- 1) Maintenance person should fully understand the related documents and drawings. Maintenance person should be trained from our company.
- 2) Turn off the main power and disconnect control switches in the off position.

6.2 Check the piping of suction hole and filter

1. Check the suction hole filter frequently and clean the contaminated filter or exchange with a new filter.
2. If the net of suction hole is contaminated excessively, exchange with a new one.

6.3 Oil control

👉 **To be needed oil control:** The characteristics of oil is getting the lubrication and sealing function. If the characteristics of oil is transformed, this is to become worse for the vacuum pump condition. So, Control fully in accordance with “Oil control chart” prepared by you.



In case of the viscosity of oil is higher, Being solidification and adherence phenomena on oil condition, this is to damage to the pump critically due to blocking the oil supply piping caused by the solidification and adherence phenomena.

WARNING So, control fully the oil conditions frequently in accordance with “Oil control list” prepared by you.



In case of the viscosity of oil is lower, Being vacuum grade of pump is decreased rapidly and this is to become worse for pump working.

WARNING

👉 **Oil exchange period:**

1. The oil exchange period is depended upon oil using condition and other reasons.
2. The first exchange period will be done after 800hrs.using.
3. And then the exchange period will be depend upon running time,

- vacuum grade, ambient temperature and oil contamination condition.
4. General exchange period is done per 1000hrs.under 8hrs.working per day condition.



In case of the contamination condition of oil is higher severely due to using environment, recommend exchange the oil with new one **NOTE frequently.**



The characteristics of oil is depended upon the color of oil.

- NOTE** ① **When the color of oil is changed to a light oily-white color from standard color. : In case of the inflow of vapor and moisture.**
- NOTE** ② **When the color of oil is changed to a heavy reddish brown color from standard color. : In case of the oxidized oil.**

When you check the above conditions being, exchange the oil with new one immediately.

Oil exchange method:

- 1) Run the vacuum pump with the opening condition of vacuum of suction hole for about 30 seconds.
- 2) Shut off the electrical power.
- 3) After opening the cover of oil drain point, drain oil and then closing the cover of oil drain point.
- 4) After opening the cover of oiling opening, supply new oil and then closing the cover of oiling opening. Supply up to the "MAX" level.
- 5) Run the vacuum pump with the closing condition of suction hole for about 5~10 minutes and then check the vacuum grade and oil condition, If it is normal condition and use the pump.
- 6) If the color of oil and vacuum grade is not normal condition, repeat the above procedure. Because the contaminated oil in piping line and pump inside is not drained to outside and mixed with new oil.



In case of exchange with a new oil due to the vacuum pump operation is abnormal, oil solidification and moisture inflow, Repeat **NOTE the above procedure for 3~4 times and then exchange oil with the new oil filter finally.**



 **Oil recommendation:**

We. Dooil Engineering use the oil of VG system in accordance with the ISO as below.

Temperature	MVO-010,020	MVO-030,040,063,100,160,200,250,300,400,500,630
0~12°C	ISO VG #32	ISO VG #68
12~30°C	SO VG #46	SO VG #100



When using unauthorized oil, this is to damage to the product and then decreased function and being out of order for pump. NOTE

6.4 Exhaust filter exchange

Check the exhaust filter periodically.

The method of exhaust filter checking easily is :

1. Install the pressure gauge at the oiling opening.
2. On pump running, the pressure is increased more than 0.6bar, this is the proper time of exchanging the exhaust filter.
3. Also, on pump running, being oily-white smog out of exhaust hole, this is the proper time of exchanging the exhaust filter.
4. When exchange the exhaust filter, exchange the exhaust filter with the noise suppressor together.

 **Exhaust filter exchange period:**

1. General exchange period is done per 2000hrs.under 8hrs.working per day condition.
2. When being oily-white smog out of exhaust hole after exchanging the exhaust filter and running, check the installing condition of O-Ring

situation whether being in place or not.



WARNING When exchange the old part with new one, should be used with authorized part and particular tool for exchange. The size of exhaust filter is depended upon the type of pump, therefore, order the filter in accordance with the order number based on the part list.

6.5 Oil filter exchange

In case of exchange with a new oil due to the vacuum pump operation is abnormal, oil solidification and moisture inflow, should be exchanged with oil filter together.



NOTE General exchange period is done per 1000hrs. under 8hrs.working per day condition.

NOTE



WARNING When exchange the old part with new one, should be used with authorized part and particular tool for exchange. The size of exhaust filter is depended upon the type of pump, therefore, order the filter in accordance with the order number based on the part list.

6.6 Check gas adjustable valve

When the gas adjustable valve is contaminated by a deposition, clean the contaminated valve by a compressed air after unlocking the gas adjustable valve.



NOTE Cleaning the valve is done per 2000hrs. periodically.

NOTE

6.7 Cleaning the cooling fan

When the cover of motor fan is contaminated, this is to obstruct the cooling air flow, therefore, clean the contaminated cover periodically.

☞ When using the pump under the manufacturing process that is arising much more dust and foreign materials, should be installed a suction filter, additionally, at the suction piping part.



WARNING

When the foreign materials are in flowed into the inside of pump, this

is the reason why the pump is out of order.

6.8 Cleaning the pump

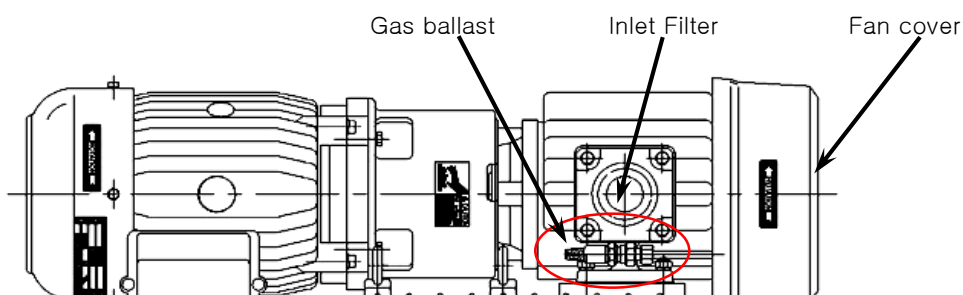
1. When cleaning the pump, after drain the oil from the oil container, fill a gasoline up to the “MIN” level on the oil gauge.
2. Running for 30~1 minutes with opening/closing the suction opening for 2~3 times repeatedly.
3. And then turn off the switch, stop for 30 minutes.
4. After draining the gasoline from the oil container, the designed new oil is filled up to the “MAX” level on the oil gauge.
5. Running the pump for 30 minutes with vacuum condition.
6. After doing in accordance with previous “**Oil exchange method**”, running the pump normally.

6.9 Pump control table

	daily	weekly	500hr	1000hr	2000hr	
Suction line	●	▲				On inflowing dust severely, continuing check and cleaning
Suction filter	●	▲				
Cooling fan			▲			On visible inspection, when being foreign materials severely, cleaning frequently
Gas adjustable valve		▲				
Oil quantity inspection	●					Maintenance being between MAX~MIN
Oil	●			◎		When being foreign materials severely, exchange frequently
Oil filter				◎		
Exhaust filter		●			◎	

● : check ▲ : cleaning ◎ : exchange

6.10 Pump structure



7. Troubleshooting



When repair working, Disconnect the power supply wholly from the product before performing this working on this product. Failure to disconnect the power supply results in serious injury or damage.

Status	Causes/Measures
Running pump is stopped	Incorrect the actual electrical power and frequency with nameplate on pump
	Check connecting condition of motor terminal
	Check working switch of motor power
	Check working overload breaker of motor
	Back pressure of exhaust pipe is overload
Suction capacity is shorter	Check contamination of suction filter
	Check connection condition of pump or piping
	Check length of suction piping is longer?
	Check diameter of suction hole is shorter?
Shortage vacuum to maximum of vacuum pump	Check defective vane
	Check leakage on pump and piping line
	Check blocking or contamination of filter net of suction hole
	Check oil quantity in oil container whether full or not?
	Check defective oil seal or sealing condition completely
Pump is running on higher temperature abnormally	Check temperature of circulation or suction is higher?
	Check flow condition of cooling air
	Check back pressure of exhaust pipe is higher severely?
	Check blocking of oil return line
	Check blocking of exhaust filter
Pump is running on abnormal noise	Check defective cylinder of pump
	Check defective vane
	Check defective bearing
Leakage oil from pump	Check defective oil seal
	Check blocking exhaust filter and being back pressure in pump
Oil to exhaust, condition of a water drop or vapor	Check blocking or leakage of oil reverse valve
	Check oil circulation condition is wrong due to pump installation is unbalancing on flat
	Check correct oil is used
Oil color is changed	Black color : Check oil exchange time
	Oily-white color: Check inflow water or vapor into pump inside
	Check oil exchange time on oil viscosity is higher

