Operating Instruction

Firstair Screw Air Compressor of PM
FPM 08-75



Thank you for choosing our series of screw air compressor!

Our Company reserves the right of design change for products and we have no obligation to modify and improve products already leaving the factory. We might modify the specification or components of some products in the future without further notice.

Instructions: 1. Unless otherwise being specified, pressure hereof refers to gauge pressure;

2. When you contact with us regarding the maintenance, service and relevant issues of compressors, please clearly specify the model and exhaust pressure class which can be seen on nameplate and quality warranty card of the machine.

Machine Model_____

Manufacturing Number_____

Startup & Debugging Date_____

Preface

Thank you very much for choosing our screw air compressor with frequency converter. Our products have been strictly inspected and tested before leaving the factory. However, to guarantee the safe, reliable and durable use of the machine, please carefully read this Operating Instructions in details before use to know about the operation specifications and skills so that the machine can be in good working condition for a long time.

To guarantee your rights and interests, please send the User Profile Feedback Card back to our service department so that you can get the best service in the shortest time.

Thank you!

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1 Safety Caution

- **Before operation, please make sure to carefully read the following safety precautions:**

1. When welding pipes during installation, please move away the inflammables in the surrounding area and keep the welding spark away from falling into the air compressor to burn out parts in it.
2. Power supply line of the air compressor must match with its power and be equipped with air switch, fuse wire and other safety devices to guarantee safety and reliability of the electrical equipment. Besides, the compressor must be provided with grounding device and if necessary, with lightning arrester.
3. Only personnel appointed or approved by us can be allowed to have debugging on new machine.
4. Before startup, please make sure there is nobody in the machine set, check if there are articles and tools left in the machine and close the machine door. During startup, please inform personnel around the machine to be careful.
5. For the first startup or change of power supply line, it is required to check if the machine set is running in the direction of the arrow.
6. It is not allowed to operate the air compressor under exhaust pressure exceeding the pressure indicated on the nameplate. Otherwise, the motor might be burnt out due to overload.
7. In case of fault or existence of unsafe factors, please do not start the machine forcibly and please cut off the power supply and make conspicuous mark.
8. The compressed air and electrical equipment are dangerous. Please make sure to cut off the power line before overhaul or maintenance and hang such warning signs as “Overhauling” or “No switching on” at the power source to avoid injury caused by switching on by others.
9. During shutdown maintenance, it is required to wait until the entire air compressor has been cooled and compressed air of the system has been safely released. Besides, maintenance personnel shall keep away from any air outlet of the system and close corresponding isolating valve.
10. When cleaning components, please use safe non-corrosive solvent instead of flammable, combustible and volatile detergent.
11. After running for a period, please regularly check the relief valve and other protection systems to ensure their sensitivity and reliability for once a year in general.
12. Spare and accessory parts of the air compressor must be supplied by legal manufacturers and the screw oil must be special oil appointed by us for screw air compressor. It is strictly prohibited to mix two different brands of oil together in use. Otherwise, it might cause major accident due to system coking.
13. The air compressor shall be operated by fixed personnel who shall carefully read and understand contents hereof, and follow working procedure, safety precautions and maintenance specifications hereof.
14. Please regularly check the warning labels to see if they fall off or not and if the words and patterns are clear and visible or not.

NOTE:

All behaviors going against these safety precautions might cause severe consequences.

2 About Safety

2.1 Warning labels

Please carefully read and fully understand the following introductions, relevant graphs and warning label contents and mark relevant part for reminding. Please surely follow the Operating Instructions to avoid personal casualty and equipment fault.

2.1.1 Warning signs

➢ **Misoperation**



Danger

It means that operation mistake might cause dangerous situation, such as death or serious injury, and it refers to the most urgent condition (i.e. the most dangerous condition).



Warning

It indicates that operation mistake might cause dangerous situation, such as death or serious injury.



Attention

It signifies that operation mistake might cause dangerous situation, such as minor injury or equipment damage.

2.1.2 Instructions for warning labels

➢ **References**



References

Refer to assistive materials for operating instruction and maintenance.

➢ **Graphical contents**

Refer to specific contents indicated in and near the graphs in drawings or words.



Refer to matters prohibited.

Refer to specific contents indicated in and near the graphs in drawings or words.

▪ **Instruction**



Refer to matters required to be cautious.

Refer to specific contents indicated in and near the graphs in drawings or words.

Please make sure to strictly follow attentions recorded in this document which does not include all the relevant safety precautions without any omission. Except for precautions already recorded hereof, the operation personnel and maintenance personnel shall also be careful themselves to ensure safety.

2.2 Relevant labels

Please make sure warnings and other labels are firmly sticking to the machine and they are read in details, followed and carried out. In case of missing or invisibility of labels, please contact with the dealer or our Company.

▪ Startup alert



Please carefully read the Operating Instructions before startup and those who are not familiar with contents hereof must be prohibited to operate this machine by the machine keeper.

▪ Electrical control



Please pay attention to the voltage of the control board and electric parts. Before operation, it is required to turn off the compressor and cut off the power supply.

▪ Appropriate application



Direct use of compressed air for breathing will cause severe personal injury and please do not do so for your health and safety.

▪ Protective device



Rotating machine might cause personal injury. Please do not remove all the protective and safety devices.

Before operation near parts, please stop the compressor and cut off the power supply.

▪ Fixing bolt



Before operation and commissioning, please remove the fixing bolt of the internal engine body and motor conveyance. Please contact with our authorized dealer or service unit for the commissioning of new machine.

▪ Delivery attached documentation



Attached technical materials are put in the machine. Please properly keep them for maintenance.

Safety alert



High pressure air and oil might cause severe personal injury. Please do not make compressed air outlet pointing at personnel.

- **Electric cabinet alert**



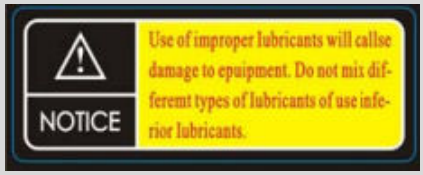
Touch of switchboard, electrical cabinet, motor and other electrical equipments might cause such danger as electric shock. Before maintenance or operation of the aforesaid equipments, please make sure to turn off the compressor and cut off the power supply.

- **Air filter nozzle**



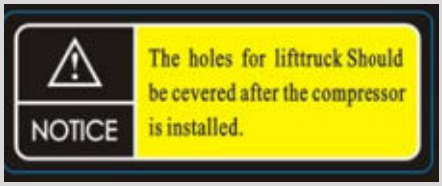
Please regularly squeeze nozzle of the air filter to eliminate dust for the sake of the operation of the air compressor and the maintenance of components.

- **Special coolant**



Please use our special oil for air compressor. It is not allowed to use or mix other brands of lubricating oil. Otherwise, it might cause damage to the machine.

- **Forklift hole covers**



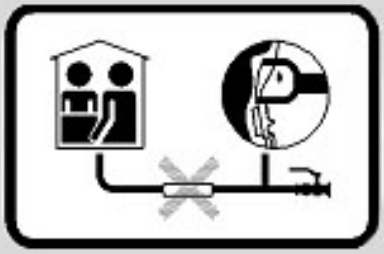
After the machine is installed in position, please cover the forklift hole covers to prevent animal entering the machine, resulting in machine damage

✧ Please keep the labels clean. In case of falling off or damage of labels, please contact with our dealer or our Company.

2.3 Safety attentions

2.3.1 Attentions before operation

Danger

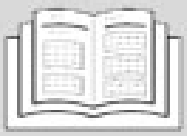


1. Compressed air in this machine is not allowed to be directly inhaled. Otherwise, it might cause death or serious injury. Therefore, please do not use the compressed air for breathing.

2. This machine is not designed to pressure compressed air to operating personnel's workroom like the pressurized operation method or diving operation. In case of fault and stop to supply air, it might cause fatal accident.

- **Appropriate application**

Warning



1. Please carefully read and understand this document and nameplates on the machine and follow the contents on them.

2. Please do not transform this machine at will. Otherwise, it might impair its safety and lower its performance.

3. Please do not use this machine to compress other gases other than air, or use it as vacuum pump. Otherwise, it might result in severe accident.

- **Work clothes**

Warning



1. Please do not wear fat uniforms, cuff with key undone, drooping tie, scarf and other clothes during operation. Otherwise, they might be hooked by the mechanical part or rolled into the machine by the rotating part to result in severe injury.

- **Personal protective equipment**

Attention



1. To be safe, please wear safety helmet, protective glasses, earplug, safety shoes, gloves, dust mask and other safety appliances suitable to the job contents.

- **Safety facilities**

Attention



1. Please prepare first-aid kit and fire extinguisher in case of injury and fire accident.

2. Please prepare ambulance, emergency car and the telephone number and emergency contact address of the fire brigade in case of use at any time.

2.3.2 Attentions during operation

- **Air/Oil Separator Tank**

Warning

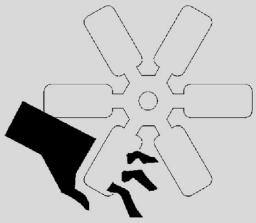


1. It is not allowed to open the oil inlet of the air/oil separator tank during operation or immediately after shutdown since there is internal pressure which might blow the oil inlet and spray high temperature of compressed air and screw oil.

2. When filling oil into the air/oil separator tank, please make sure the machine is stopped and the pressure gauge indicates 0MPa. Besides, please confirm there is no residual pressure in the tank and then slowly open the oil inlet and fill in lubricating oil.

- **Cooling fan**

Warning



1. Please do not put your hands near the cooling fan during operation in case of being rolled into it and cause severe accident.

2. Make sure the machine is stopped when having inspection and maintenance near the cooling fan.

- **Rotating parts**

Warning

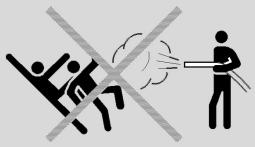


1. Please do not put your hands near the rotating part during operation in case of being rolled into it and cause severe accident.

2. When adjusting, it is required to cut off the power supply, stop the machine and hang the sign of “In overhaul and maintenance” before operation.

- **Compressed air outlet**

Warning



1. Please do not blow compressed air towards people since there are impurities and dusts or foreign matters in the compressed air that might hurt human skin and eyes and result in serious injury accident.

2. No blowing on food.

- **Fire disaster**

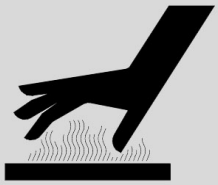
Attention



1. Please make sure to not put cigarette, match and other kindling materials near the screw oil. Otherwise, it might result in fire disaster.

- **High temperature components**

Attention



1. Please do not work near high temperature components of the machine during operation.

2. Be sure to not touch high temperature components of the machine when checking the status of each part during operation.

3. Especially the exhaust branch, radiator, oil cooler, compressor body, oil-air tank and air supply pipe are under high temperature and might cause scald once being touched.

4. The screw oil is also under high temperature. Please do not supplement and check during operation.

- **Operation instructions**

Attention



1. Please be sure to open the exhaust valve even if the machine is stopped and the pressure gauge indicates 0MPa so as to safely release the residual compressed air before operation.

2. In case of residual pressure, high pressure air will be sprayed and might cause severe injury accident.

2.3.3 Attentions during equipment inspection

- **Protective tools**

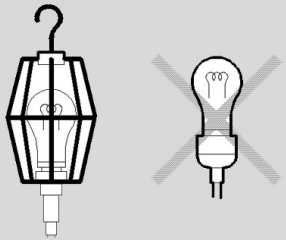
Warning



1. Please wear protective glasses when using compressed air to clean dust from the air filter and other parts.

- **Special lighting equipments**

Attention



1. It is suggested to use safe operation lamp with protective cover at dark and invisible places since searching with hands or operation by feel might cause unexpected accident.

2. The use of ordinary lamp without protective cover might cause fire to fuel once being damaged.

3 Appearance and Structure

3.1 Appearance

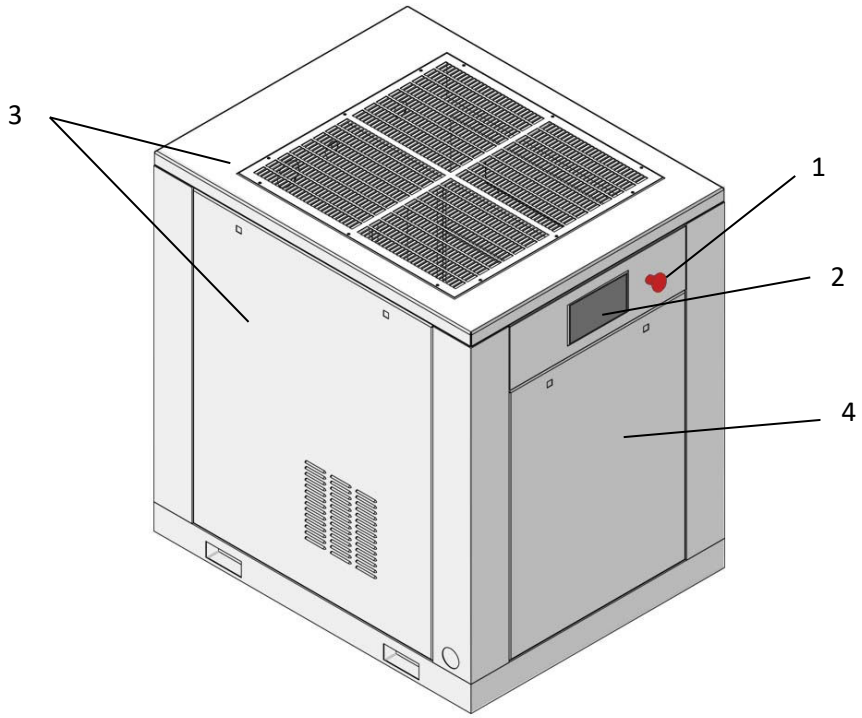


Figure 1: 37 kW Screw Air Compressor

1. Emergency stop key
2. Control panel
3. Sound insulation covers
4. Electric cabinet

Remark:

Different models mainly differ on the dimension and configuration, but are with the same basic structure.

3.2 Brief introduction to micro-oil screw air compressor

Micro-oil screw air compressor has the characteristics of reliable running performance, less wearing parts, less vibration, low noise and high efficiency.

Its principle is forming pressure in the system after operation and continuously injecting lubricating oil into the compression chamber and bearing during compression. Such kind of design has the following characteristics:

1. The injected lubricating oil can form an oil film between rotors and the auxiliary rotor can be directly driven by the main rotor without help of the high-precision synchromesh gear. Therefore, with regard to the manufacturing cost, micro-oil screw air compressor is more economic than oil-free air compressor.
2. The injected lubricating oil can add air tightness.
3. Lubricating oil can reduce noise generated by the high frequency compression.
4. Lubricating oil can absorb a mass of heat from compression. Therefore, even with single stage compression ratio of 16, the exhaust temperature is not too high and there will be no friction between the rotor and casing due to different coefficients of thermal expansion.

3.3 Structure of micro-oil screw air compressor

3.3.1 Basic structure

Our micro-oil screw air compressor is a kind of rotary type compressor with two shaft positive displacement.

The air inlet is at upper part of the casing and the exhaust outlet is at the lower part with a pair of high-precision main (positive) and auxiliary (negative) rotors being mounted in the casing horizontally in parallel. There are five M-teeth on the main (positive) rotor and six M-teeth on the auxiliary (negative) rotor. The main rotor has a larger diameter and the auxiliary rotor has a smaller diameter. The tooth form is spiral, circling around outside of the rotors and meshing with each other. There are bearings at both ends of the main and auxiliary motor respectively for supporting with a roller bearing at the air inlet end and an axial thrust bearing and a roller bearing at the exhaust end. The roller bearings bear the radial force and the axial thrust bearings bear the axial thrust.

3.3.2 Meshing

The motor drives the main rotor via the coupling. Since the two rotors are meshing with each other, the main rotor will directly drive the auxiliary rotor to rotate. The cooling lubricating oil is directly injected into the meshing part between rotors via the nozzle from lower part of the compressor casing, and mix with the air, take away heat from compression and achieve

cooling effect. At same time, it will form an oil film, preventing the direct metal contact between rotors and seal the clearance between rotors and the casing. The injected lubricating oil can also lower the noise from high speed compression. Because of different exhaust pressures, weight of the injected oil is about 5－10 times of the weight of the air.

4. Technical Data

4.1 Standard specifications list

4.1.1 Operating conditions

- **Environment**

Data	Numeric Value	Unit
Temperature range	0 ~ 40	°C
Maximum relative humidity	80	%
Maximum installation altitude	1000	m

4.1.2 Consumables

- Screw air compressor 7.5-75 kW

Type	Consumable	Lubricating oil amount	Unit
FPM 08	Lubricating oil	8	L
FPM 11	Lubricating oil	8	L
FPM 15	Lubricating oil	8	L
FPM 18	Lubricating oil	12	L
FPM 22	Lubricating oil	12	L
FPM 30	Lubricating oil	18	L
FPM 37	Lubricating oil	18	L
FPM 55	Lubricating oil	55	L
FPM 75	Lubricating oil	60	L

4.1.3 Air inlet and cooling

- Screw air compressor 7.5-75 kW

Type	Compressed air outlet	Cooling air volume
	G / DN	m³/h
FPM 08	G 3/4	4500
FPM 11	G 3/4	5600

Type	Compressed air outlet	Cooling air volume
	G / DN	m³/h
FPM 15	G 3/4	5600
FPM 18	G 1	6246
FPM22	G 1	6246
FPM30	G 1-1/4	8730
FPM37	G 1-1/4	8730
FPM 55	G 2	18800
FPM 75	G 2	18800

4.2 7.5-75 kW screw air compressor with frequency converter

4.2.1 Product information

- Screw air compressor 7.5-75 kW

Type	Nominal motor output	Screw air compressor with frequency converter	
	kW	L x W x H [mm]	Weight[kg]
FPM 08	7.5	680 x 680 x 1220	245
FPM 11	11	680 x 680 x 1240	260
FPM 15	15	680 x 680 x 1240	270
FPM 18	18.5	780 x 780 x 1300	300
FPM 22	22	780 x 780 x 1300	320
FPM 30	30	920 x 840 x 1422	425
FPM 37	37	920 x 840 x 1422	450
FPM 55	55	2250 x 1344 x 1694	2220

Type	Nominal motor output	Screw air compressor with frequency converter	
	kW	L x W x H [mm]	Weight[kg]
FPM 75	75	2250 x 1344 x 1694	2350

4.2.2 Motor current load

50 Hz standard screw air compressor with frequency converter

- Screw air compressor 7.5-75 kW

Type	380 V / 50 Hz current value
	Full load current
	A
FPM 08	16.4
FPM 11	23.4
FPM 15	30.8
FPM 18	39.3
FPM 22	48.0
FPM 30	63.2
FPM 37	81.6
FPM 55	118.0
FPM 75	157.0

5. Installation Details for Air Compressor

5.1 Installation

The installation site might be ignored by working personnel and the air compressor is often mounted at a random place and immediately put into use after piping without planning in advance, which is, in most cases, the reason for maintenance difficulty and bad quality of compressed air of the air compressor in the future. Therefore, choosing an appropriate installation site is the precondition for correct use of the air compressor system.

(1) Please choose a wide place with good lighting so as to facilitate the operation and overhauling.
(2) The place shall be provided with low relative humidity, less dust, clean air and good ventilation.
(3) The environment temperature shall be below 40℃ since the higher the environment temperature is, the less air will be output.
(4) If the factory environment is bad and dusty, it is required to add a pre-filtration equipment.
(5) Please reserve the access and installation of crown block (especially required for high-power air compressor) so as to be convenient for the maintenance.
(6) Please reserve the maintenance space with a distance of at least 700mm between the air compressor and the wall.
(7) The air compressor shall be more than one meter away from the top.

5.2 Attentions for piping, foundation and cooling system

5.2.1 Attentions for piping of air pipeline

(1) During piping of the main pipeline, there shall be a gradient of 1~2° so that condensation water in the pipeline can be drained out.

(2) Pressure drop of the piping pipeline shall not be over 5% of the setting pressure of the air compressor. Therefore, you had better select larger pipe diameter.

(3) The branch pipeline must be led out on top of the main pipeline to avoid condensate water flowing downwards into the working machine or returning back into the air compressor. The air outlet pipeline of air compressor shall be provided with one-way valve.

(4) Tools to be lubricated shall be provided with the combination (air filter water filter, pressure regulator and oil feeder) to maintain the service life of tools.

(5) The main pipeline shall not be reduced. If it is necessary to reduce or enlarge the pipeline, it is required to use reducing pipe. Otherwise, mixed flow might occur at the joint, resulting in greater pressure losses and affecting service life of the pipeline.

(6) If there are air receiver, drying machine and other purification and buffer facilities after the air compressor,
or resonance, which might cause hidden

the ideal piping shall be air compressor ＋ air receiver ＋ drying machine, in which way, the air receiver can filter out part of the condensate water and reduce the exhaust temperature. Then, the air with lower temperature and less water content can enter into the drying machine.

(7) Because of the large air consumption and short time of system, it would be better to add an air receiver for buffering so as to reduce the frequency of idling and reconditioning and help the air compressor.

(8) For compressed air with system pressure below 1.5MPa, its flow rate in the delivery pipe must be under 15m/sec to avoid excessive pressure drop.

(9) In the pipeline, please reduce the use of elbows and various valves so as to decrease pressure losses.

(10) The ideal piping is to make the main pipeline surrounding the entire plant, in which way, compressed air can be obtained in both ways at any position. If the air consumption of a branch pipe suddenly increases, it can reduce the pressure drop. Besides, please mount appropriate valves on the loop main line for cutoff for overhaul.

5.2.2 Foundation

(1) The foundation shall be hard soil and the foundation surface shall be horizontal before installation to avoid vibration and thus the loud noise of air compressor.

(2) If the air compressor is mounted upstairs, please make anti-vibration treatment to avoid vibration to downstairs trouble to the air compressor and the building.

(3) Since the vibration of screw air compressor is minor, there is no need for the foundation. **However, the ground shall be flat and cannot be soft soil.**

5.3 General specifications and safety specifications for electrical equipment

(1) **Please select correct power line route based on power of the air compressor** and do not use too small wire diameter. Otherwise, the power line might be burnt out due to high temperature and cause danger.

(2) **It would be better to provide an independent electrical power system for the air compressor**, especially avoiding the parallel connection with different power consumptions. Otherwise, it might cause overload to the compressor due to excessive voltage drop or three phase current unbalance and thus result in halt of protective device, which is especially notable for high power air compressor.

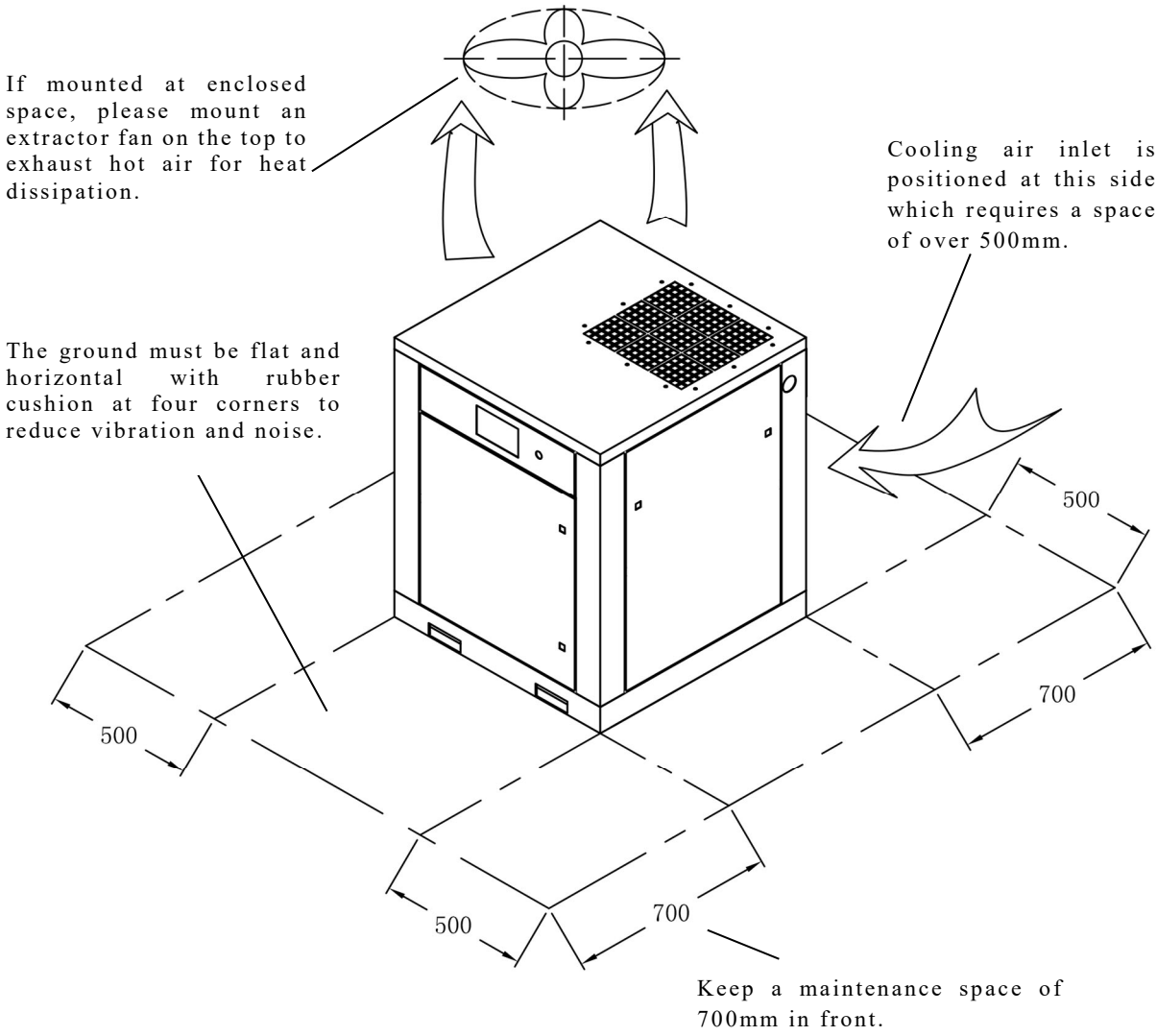
(3) Please mount appropriate NFB (no fuse breaker) as per the power of air compressor to maintain the safety of the electric power system and maintenance.

(4) Please confirm the accuracy of the voltage during power distribution of air compressor.

(5) Grounding wire of the motor or system shall be set up and cannot be directly connected with the air delivery pipe or cooling water pipe.

(6) The air compressor must be reliably grounded to prevent danger caused by electric leakage.

Installation Details for Air Compressor



Schematic Diagram for Installation Requirements of Air Compressor

6. System Flow and Component Function

6.1 Air flow (refer to the system flow chart of each model)

6.1.1 Air flow

Air first comes into the air filter to remove dust, then enters into the main compression chamber for compression via the inlet valve and mix with the lubricating oil, and then flows into the oil-air tank, the oil separator, the minimum pressure valve, the after-cooler, the water separator and at last the using system.

6.1.2 Function description of each component in the main air circuit

(1) Air filter

Air filter is a dry type paper filter and shall be removed to clean the surface dust every 1000 hours in the way of blowing from inside to outside with low pressure air. The replacement of air filter shall be in the way of timing. If the controller panel indicates air filter blocking, the air filter must be cleaned or replaced. The cleaning or replacement interval of air filter is closely related to the environment cleanliness.

(2) Inlet valve

a. Control of empty and heavy load

Inlet valve is piston control, with which it is required to slightly turn on the oil drain valve before startup to eliminate condensate water in the oil-air tank.

There is an oil inlet “1” on the tank for oil filling. Because of the large section area of oil tank, compressed air can reduce the flow velocity of screw oil and separate oil. This is the first section of oil removing.The empty and heavy load is controlled by the up and down movement. In case of startup, shutdown or idling, actuation of the draining solenoid valve is used to control the inlet valve piston upwards and close the valve. At the same time, the minimum pressure valve is also used to maintain the minimum pressure required for system circulation. After full load operation of the motor, the draining solenoid valve is power on and draining is stopped. At this time, the inlet valve piston is sucked downwards due to the inlet pressure difference into air inlet condition. If the pressure reaches the set upper limit valve for pressure switch, the pressure switch will actuate and the draining solenoid valve begins draining. Besides, if the inlet valve piston is pushed upwards to close the valve, it will enter into the empty load condition.

b. Capacity adjustment control (optional)

When the system pressure gradually increases (before reaching the set valve of pressure switch) and first reaches the set value of the capacity adjustment valve, little air will pass by. If you push the inlet valve piston upwards, the inlet air will gradually decreases and the system starts capacity adjustment at this time. If the pressure continuously increases, the inlet piston is upwards and closed.

On the contrary, if the system pressure decreases, the inlet piston is opened with more inlet air until being lower than set value of the capacity adjustment valve which will stop. The capacity adjustment valve can be used to control air inlet of the inlet valve and maintain system pressure stability.

(3) Air/Oil Separator Tank

The air/oil separator tank is provided with oil immersion lens. The static lubricating oil level shall be between the high oil level and low oil level with oil drain valve under the air/oil separator tank.

(4)Air/Oil Separator

Please refer to instructions later for details.

(5) relief valve

In case of improper regulation or malfunction of pressure switch that pressure in the oil-air tank is more than 0.1MPa over the set exhaust pressure, the relief valve will be automatically opened to make pressure drop below the set exhaust pressure. The relief valve has been adjusted before delivery. Please do not adjust at will.

(6) Drain valve

The drain valve is a normally open two-way solenoid valve. It is open in the event of shutdown or idling. Please discharge pressure in the tank and close the valve to make sure the air compressor can be started with zero load or operate with zero load during re-operation.

(7) minimum pressure valve

It is positioned at outlet of the oil separator above the oil-air tank with startup pressure at about 0.45MPa. The minimum pressure valve has the following functions:

a. Create circulating pressure required for lubricating oil in startup in priority to ensure lubrication of the machine body.

b. Be sure open it at the pressure over 0.45MPa to reduce the air velocity passing the oil separator. this can guarantee the air/oil separation effect and also protect the air/oil separator from being damaged due to too large pressure difference.

(8) After-cooler

In the air-cooling cooler, cooling fan is used to draw in cold air and cool the compressed air via the cooler. Cooling effect of the air-cooling cooler is closely related to the environment temperature. Please pay due attention to the ventilation conditions when selecting the place.

(9) Water separator (optional)

It is a vortex separating water separator, being able to remove condensate water, oil and impurities after air cooling. Compressed air can be delivered to each user department after passing the water separator. During operation of the air compressor, it is required to slightly open the regulating valve under the water separator until the condensate water can just flow out without leaking the air, or an automatic drainer can be added.

(10) Automatic drainer (optional)

It can automatically drain out condensate water in the water separator and is mounted as required by the customer. Generally, there is no need to add the automatic drainer so long as you open the regulating valve in the aforesaid way.

6.2 Lubricating oil flow (refer to the system flow chart of each model)

6.2.1 Instructions of oil injection flow

Because of the pressure in the oil-gas tank, lubricating oil is pressed into the oil cooler, cooled in the cooler, removed the impurities and particles in the oil filter and then divided into two ways: one way is injected into the compression chamber via the lower end of the machine body to cool the compressed air; the other way is used to lubricate the bearing set at both ends of the machine body; and then (lubricating oil of each part) will get together at bottom of the compression chamber and be discharged together with the compressed air. The compressed air mixed with oil will enter into the oil-air tank with most of oil being separated and the rest air with oil fog will pass the oil separator again to remove the residual oil and flow into the after-cooler for cooling via the minimum pressure valve before being delivered to the using system.

6.2.2 Function description of each component in the oil circuit

(1) Oil cooler

Oil cooler and after-cooler are with the same cooling mode. If the environment condition is bad, fins of the air cooling cooler might easily be covered with dusts and affect the cooling effect with high exhaust temperature and halt. Therefore, in each appropriate period, it is required to blow away dust on the fin surface with low pressure compressed air. If it cannot be blown clean, you must use solvent to clean. Please make sure to keep the cooler radiating surface clean.

(2) Oil filter

Oil filter is a kind of paper filter, being able to remove impurities in the oil, such as metal particles and oil degradations, etc with filter fineness of below 10μ so as to protect bearings and rotors. You can judge if it is necessary to change the oil filter by the controller. If it is indicated on the controller panel that the oil filter is blocked, it is required to be replaced. Both the oil and oil filter shall be replaced after the first operation of 500h for new machine. After that, they can be replaced every 2000h. If you fail to change the oil filter, it might cause insufficient oil inlet, and then high exhaust temperature and then halt, and also affect the service life of bearings due to insufficient oil.

(3) Air/Oil Separator

Filter element of the oil separator is made from multilayer fine glass fiber and all the mist oil in compressed air can almost be eliminated after passing the oil separator to below 3PPM. During normal operation, the lubricating oil quality and contamination degree of the surrounding

environment will greatly affect its service life. If the environmental pollution is severe, it is suggested to add a pre-air filter. With regard to the selection of lubricating oil, it is required to use special screw oil appointed by us. At outlet of the air/oil separator, relief valve, drain valve and minimum pressure valve are provided, where compressed air is led out to the after-cooler.

Oil filtered by the air/oil separator gathers in the central small round concave and returns back to the bearing end via oil return pipe to avoid filtered lubricating oil being discharged together with the air.

Generally speaking, you can judge if the air/oil separator is damaged in the following ways:

- Oil in the air pipeline increases.
- The replacement of air/oil separator shall be in the way of timing. If the controller panel indicates air/oil separator blocking, it shall be immediately replaced.
- If the air/oil pressure is greater than the air pressure, it signifies severe blocking and even over load protection.
- Check if the oil pressure is high.
- Check if the current increases.

(4) Heat control valve (optional)

There is a heat control valve before the oil cooler, being able to keep the exhaust temperature above the pressure dew point temperature. Shortly after startup, the lubricating oil temperature is low and the heat control valve will automatically open the return circuit when oil can enter into the machine without passing the oil cooler. If the oil temperature rises above 67℃, this valve will slowly open and will be full open until 72℃. At this time, all the oil will pass the oil cooler and flow into the machine.

7 Safety Protection System and Warning Device

7.1 Overload protection of motor

There are two main motors in the air compressor system, one machine driving main motor and cooling fan motor. Under normal conditions, when operating current of the motor exceeds set upper limit of the current protective device, the over-current protective device will automatically cut off the strong current control. After shutdown, the air compressor cannot be started unless otherwise being reset in the way of pressing down the set switch manually. The current protective device has been set before delivery, which is very important for protecting normal use of the compressor. Please do not modify the settings at will.

1. Human operation mistake: such as increase of exhaust pressure or improper system adjustment, etc without permission.

2. Mechanical fault: such as startup with load caused by internal loss of motor, phase failure operation of motor, relief valve's failure to actuate, system setting failure, oil separator blocking and incomplete closure of inlet valve, etc.

In case of overload of motor during operation, please immediately contact with the manufacturer, ask it to dispatch personnel to check and find out the reasons. Otherwise, the motor might be burnt.

7.2 Exhaust over-temperature protection

The maximum exhaust temperature of the system is set as 95℃ and the display panel will flash and give an alarm if it is over 95℃, and the system will automatically cut off the power supply if it is over 100℃. In general, there are many causes for exhaust over-temperature, but the most common reason is oil cooler failure. If fins of the air cooling oil cooler are blocked by dusts, cold air cannot pass the cooler freely and the lubricating oil temperature will gradually rise and cause high temperature shutdown. Therefore, it is required to clean dusts on the fins with low pressure air at short intervals. If obstruction on the fins cannot be blown clean, it would be better to use cleaning solution or solvent.

The maximum environment temperature of the air compressor is designed as 46℃ and it is consequently necessary to select a place with low environment temperature and good ventilation. In case of exhaust over-temperature protection and halt, the system starting circuit is cut off and it can be restarted by pressing the reset key.

7.3 Warning device

There is a warning device in this system and blocking of the air filter, oil filter and oil separator can be indicated on the controller panel. In case of such indication, it means a filter is blocked and users must replace it with spare part as soon as possible. Otherwise, it might affect performance and safe operation of the air compressor.

8 Control System and Electrical Circuit

8.1 Control system

1. Variable frequency soft start of motor

In the meantime, the inlet valve is fully closed and the drain solenoid valve is fully opened when the air inlet side is high vacuum, and the lubricating oil required for the compression chamber and bearing is ensured by the pressure difference between vacuum in the compression chamber and atmospheric pressure in the oil air tank.

2. Full frequency operation of motor

After soft start to operate in the maximum frequency, the time delay (which can be set up) makes the drain solenoid valve power on and then closed when pressure in the air tank gradually rises and the inlet valve gradually opens. Therefore, pressure in the air tank continuously rises so that the inlet valve is fully opened and the air compressor starts full load operation. When the pressure rises to 0.45MPa, the minimum pressure valve is opened to output compressed air.

3. Heavy load constant pressure air supply/zero load operation

When the exhaust pressure reaches the set upper limit for variable frequency pressure parameter, the frequency converter will control the air compressor motor to reduce the speed for operation via reducing the frequency based on the feedback signal of exhaust pressure so as to control output air volume of the compressor and realize the purpose of air supply in constant pressure. If the system air consumption continues to decrease to the minimum output frequency of frequency converter and the pressure rises to the set unloading value, the LCD controller of air compressor will give unloading order and cut off the power supply of drain valve; meantime, the drain solenoid valve is fully opened and the inlet valve is closed to discharge air in the oil-air tank into the atmosphere via the air filter (with the effect of back flushing the air filter). At this time, the air compressor is running under zero loading and the lubricating oil pressure required is ensured by the idling pressure.

4. Shutdown

Press the OFF key, the drain valve is opened and air in the oil tank is discharged into the atmosphere. In the meantime, close the inlet valve and wait for pressure in the oil tank drop to a certain value, the motor will change frequency, slow down and stop.

5. Emergency shutdown

When the exhaust temperature exceeds 100℃ or the over-current protective device actuates due to motor overload, the over-current protective device will automatically cut off the strong current control.

The control panel will display overload alarm and the motor will immediately stop running. In the meanwhile, the drain valve will be opened and the inlet valve will be closed to stop lubricating oil being injected from the compressor. Only in case of exceptionally emergent conditions during operation, it is allowed to press the emergency shutdown key. Otherwise, it might cause system malfunction and oil injection from the air inlet.

6. Long-time zero load automatic shut-down system

If air consumption of the system is zero and the air compressor keeps running at low frequency (the minimum frequency) with zero loading for a time longer than the specified time, the air compressor will automatically stop and the motor will stop running. When air consumption of the system increases, the system pressure will reduce and the air compressor will automatically start with variable frequency to supplement air volume. The time for zero load running shutdown shall be set in the principle of ensuring no more than three times of startup of the motor each hour. Since there is no hint for automatic start, please be careful when choosing this function in case of personal injury accident.

Be sure to avoid frequent start of motor which might be burnt otherwise.

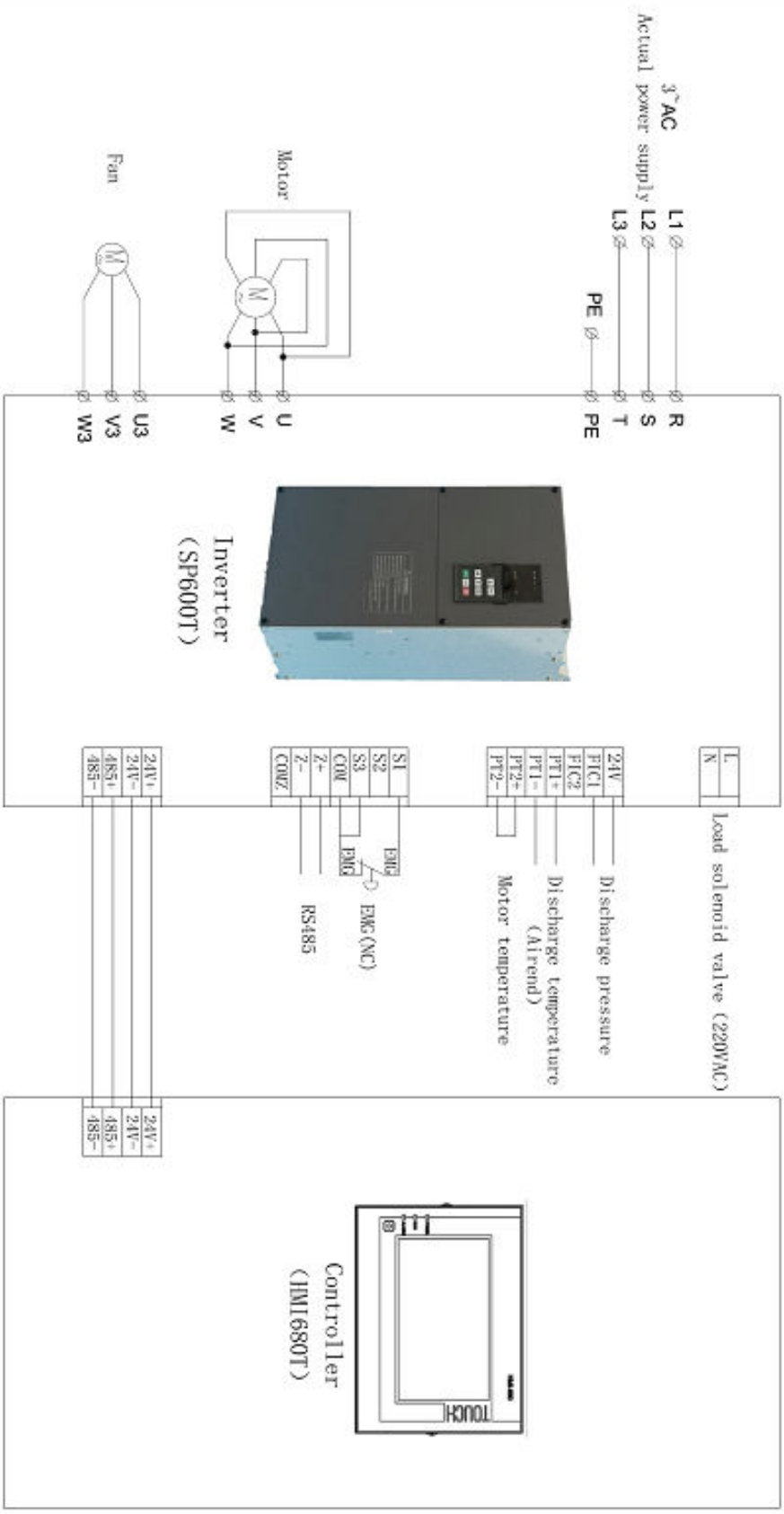
8.2 Electrical circuit

Electrical control of the air compressor falls into two systems, one LCD control system and one variable frequency startup disk system.

The variable frequency startup disk adopts variable frequency soft start control and the control section is LCD control which will not be introduced in details hereof because of its complex internal wiring and control. Please refer to the operating instructions of frequency converter for specific details which will not be introduced hereof. In case of damage or fault of the LCD control part and frequency converter, please directly contact with our service unit. For the LCD control part, you can directly change the circuit board; and for problems of the frequency converter, service engineer of the frequency converter manufacturer will solve them.

8.3 Electrical schematic diagram (see the next page)

Control System and Electrical Circuit



9. Operation

9.1 Commissioning, startup and shutdown

1. Connect the power line and grounding wire to test if the power supply voltage and the three-phase supply are correct.
2. Loosen the fixing bolt for transportation on vibration isolation table on the base.
3. Check if oil level in the oil-air tank is between the upper oil level H and the lower oil level L.
4. If commissioning is carried out long after delivery, it is required to fill in about 0.5L coolant from the inlet valve and manually rotate the air compressor for several times, so as to prevent air compressor from being burnt during startup. Please make sure to not let foreign matters fall into the compressor in case of damage.
5. Check the cooling system.
6. Press “ON” to start and immediately press the “emergency stop” key in a few seconds to check if the rotating direction is correct (as shown by the arrow). If not correct, please exchange any two of the three wires.
7. Press “ON” again and the compressor comes into operation.
8. Observe the meter and indicator light to see if there is abnormal indication.
9. Press “OFF” and the controller will control the motor to stop 10~15 seconds later, which is to avoid direct stop of air compressor under heavy load and the occurrence of spraying.
10. Press “OFF” and the drain valve will automatically discharge compressed air in the system.

9.2 Inspection before startup

Inspection before startup is required for avoiding major fault of compressor and improving its service efficiency.

1. Check if the liquid level is between H and L and make sure the coolant is neither too much nor too little and add the coolant if inadequate. It is strictly prohibited to use other coolants instead of our Company’s special coolant. Please make sure there is no pressure in the system before opening the liquid inlet cover to add.
2. It would be better to check the liquid level 10 minutes after stop and liquid level during operation might be slightly lower than that after stop.

9.3 Attentions during operation

1. Please immediately stop the machine in case of abnormal noise and abnormal vibration in operation.

2. There is pressure in the pipeline and vessel during operation. Please do not loosen the pipeline bolt plug, nor open unnecessary valves.

3. During long-term operation, in case of insufficient coolant on the liquid level meter and gradual liquid temperature rise, please immediately stop the machine and observe the liquid level 10 minutes later. If it is still insufficient, please add coolant after there is no pressure in the system.

4. There will be condensate water in the after-cooler and water separator. Please often discharge the water or add an automatic drainer. Otherwise, the water will be brought into the system.

5. In operation, please check the meters every 2 hours and record the voltage, current, pressure, exhaust temperature and oil amount, etc for reference in overhauling in the future.

9.4 Handling method for lengthy shutdown

In the event of lengthy shutdown, please carefully handle in the following ways, especially in the season or at the region with high humidity.

1. Shutdown for more than 3 weeks

(1) Wrap motor control panel and other electrical equipments with plastic or oil paper in case of invasion of moisture.

(2) In case of any fault, please first eliminate it so as to make for the future use.

(3) Drain condensate water in the oil tank and after-cooler a few days later.

2. Shutdown for more than 2 months

Except for the aforesaid procedures, the following treatments are also required:

(1) Close all the openings to prevent moisture and dust.

(2) Wrap the relief valve and control panel, etc with oil paper or similar paper in case of corrosion.

(3) Renew the coolant before outage and operate for 30 minutes, and drain condensate water in the oil tank and cooler two or three days later.

(4) Move the machine to a dry place with less dust as far as possible.

3. Restart procedure

(1) Remove plastic or oil paper on the machine stand.

(2) Measure insulation of the motor which shall be above 1MΩ.

(3) Other procedures are the same as the commissioning steps.

9.5 Emergency shutdown

In case of danger, please immediately stop the machine and cut off the power supply.

Emergency shutdown

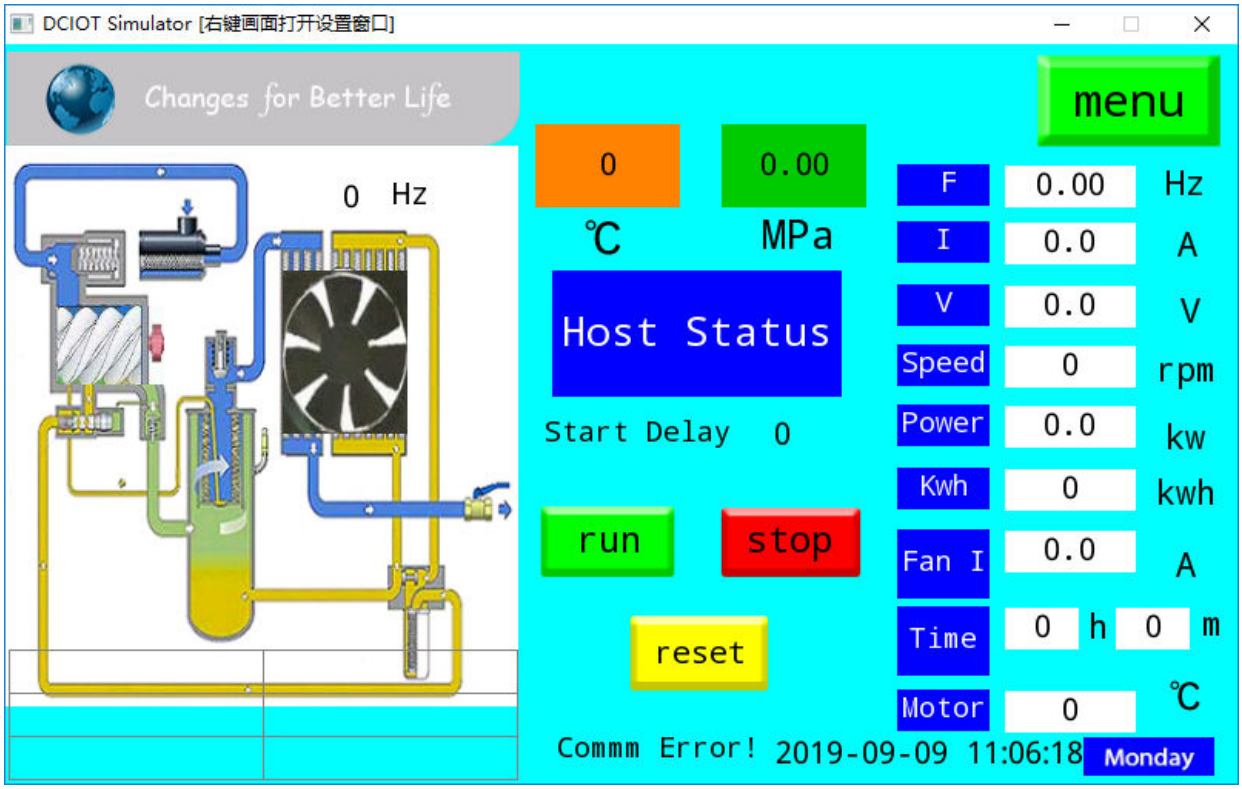
Under emergencies, please follow the following steps:

1. Immediately press the emergency shutdown key to initiate it.
2. Make sure there is no health hazard of personnel and make them leave the dangerous area.
3. Initiate first aid measures if necessary.
4. Inform the fire brigade or rescue service.
5. Inform responsible department on site.
6. Close the equipment and prevent it from being restarted.

10 Operating Instructions for Controller

10.1 System startup

To touch the power supply, power supply for DC24V, wait for a few seconds to complete the system load data, enter the main interface, as the figure below :



10.2 System Settings

（1）The system main interface

① System startup is completed, enter the main interface, main show air compressor running commands (start, stop, and reset), running parameters (temperature, pressure, output frequency, output current, output voltage, output speed and output power, electricity, fan current ， operating time 、 motor temp and motor temperature.).

② The lower left corner has multiple fault display functions. When the communication between the touch screen and the frequency converter is interrupted, the communication fault is displayed at the lower end of the reset button.

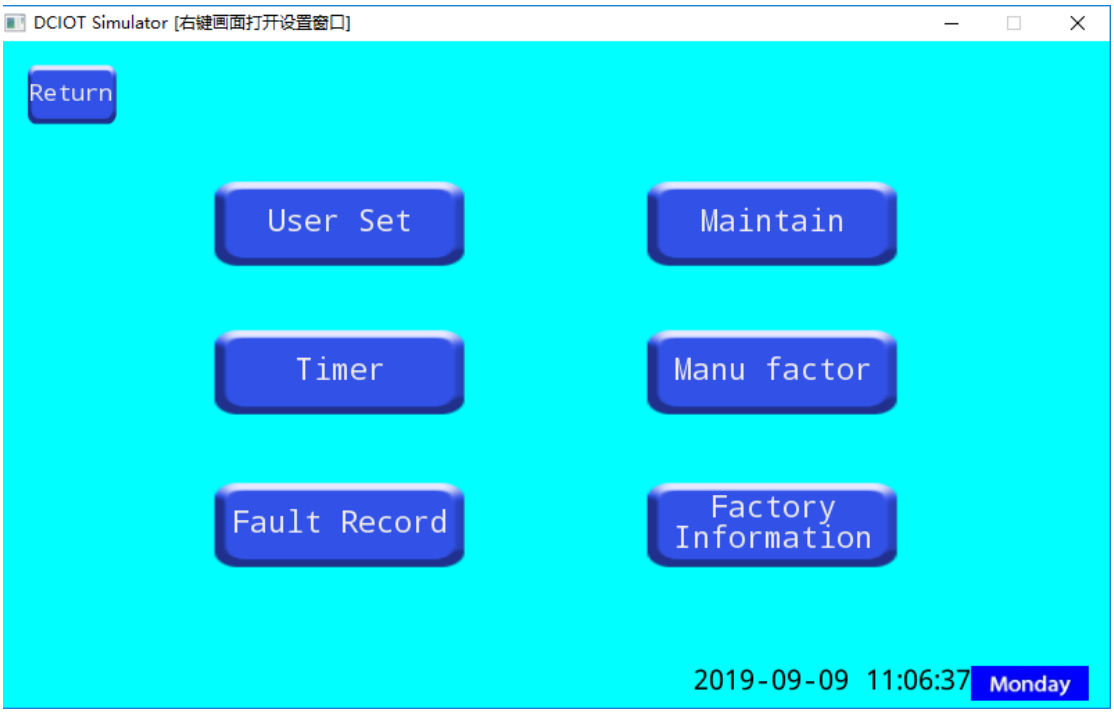
③ Current time display, the lower right corner display includes the current year, month, day and week display, long press "year" display for 3 seconds, can enter the time adjustment

mode.

（2）System to the main menu

Click "menu" option, a pop-up in the main menu including user parameters, timing control, fault records, maintenance parameter，ptions such as manufacturer parameters and manufacturer information.

Into the part of the menu to enter the password in the interface, including the "users" parameters "timing control" "maintenance parameters" parameters "manufacturer" as the figure below :

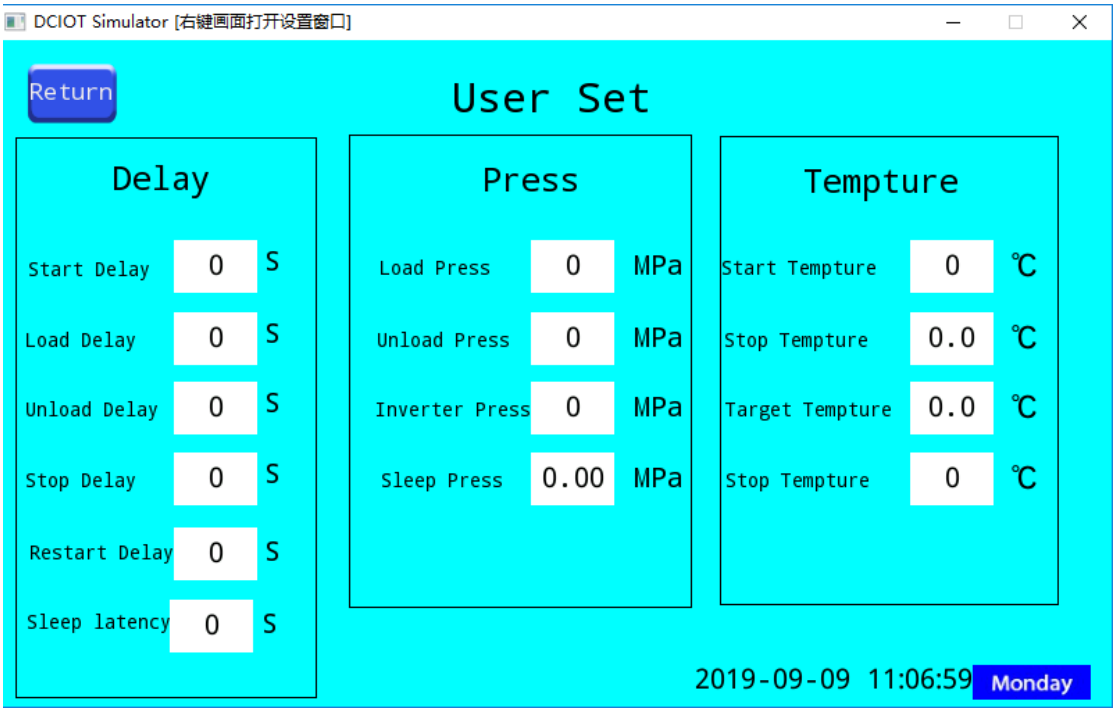


10.3 User Set

Click on the "user set" option, "password" interface, enter the password to enter parameter interface, as the figure below :



Enter a password to enter the "user parameters" interface, users can set in the "user preferences" delay, pressure and fan control parameters, as the figure below :



10.4 Timing control

"Timing control" function can be set up the system in week timing boot and shutdown time, realize the automatic operation of the system. In the corresponding input box input time Settings, click the corresponding "tick" set to complete; Do not use this function, all the "tick" no choice; as the figure below :



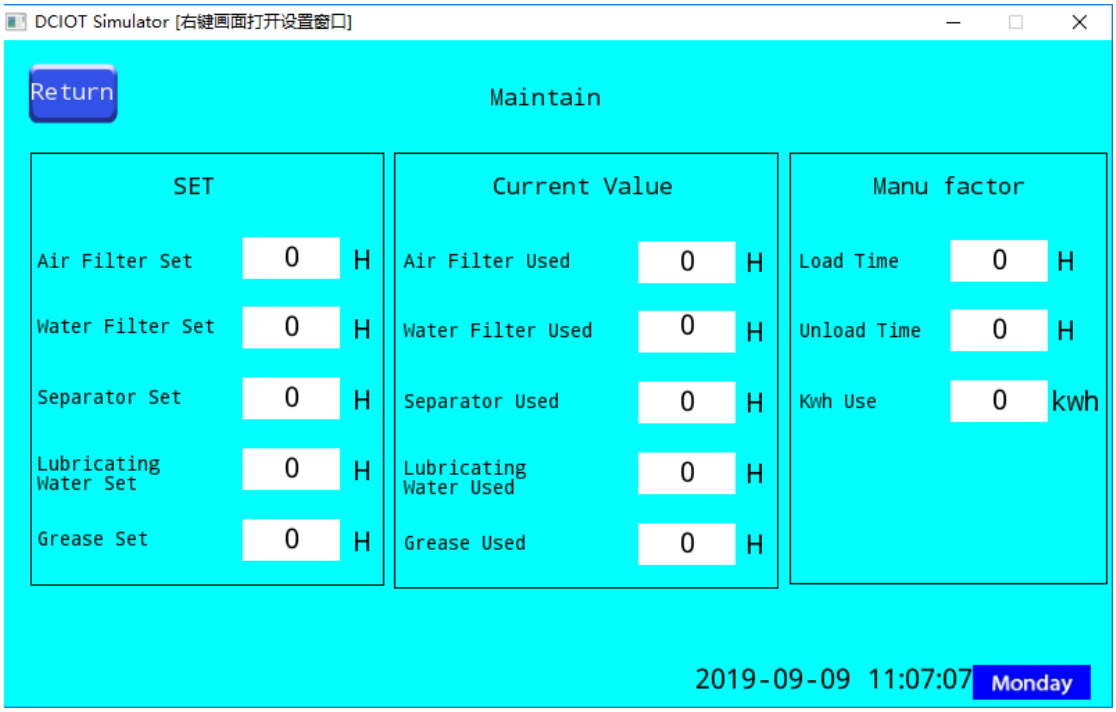
10.5 Fault record query

Click on the "failure record" "fault record" interface, real record system fault type and fault time, as the figure below :



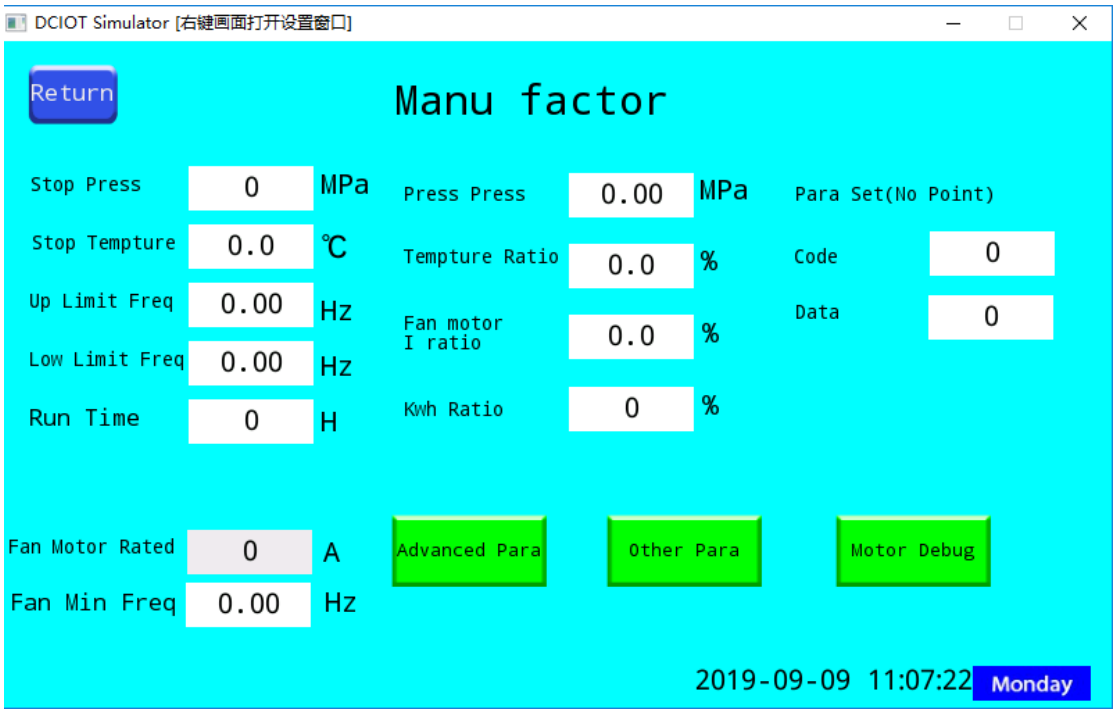
10.6 Maintain parameter

Click on the "maintenance parameter" option, "password" interface, enter the password to enter parameter interface, as the figure below :



10.7 Manufacturer of parameters

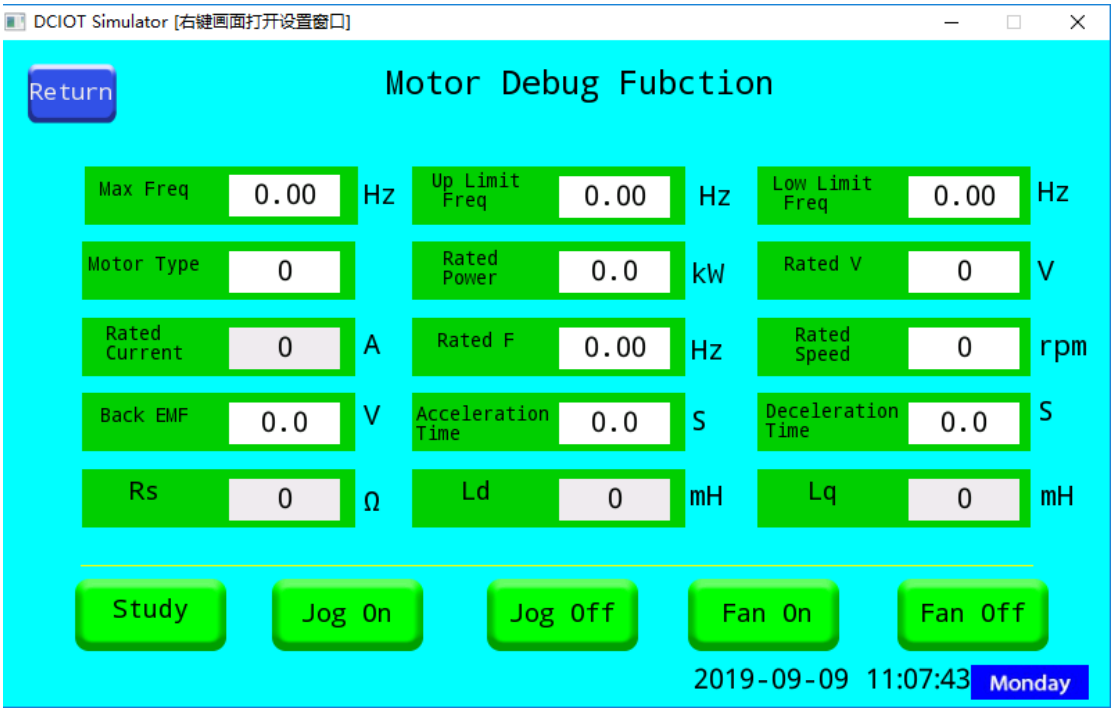
Click on the "manufacturer" parameters, the pop-up interface "password", enter the password to enter parameter interface, as the figure below :



Main features include: motor debugging, the function parameter Settings, analog keyboard and information.

①.Motor Debugging

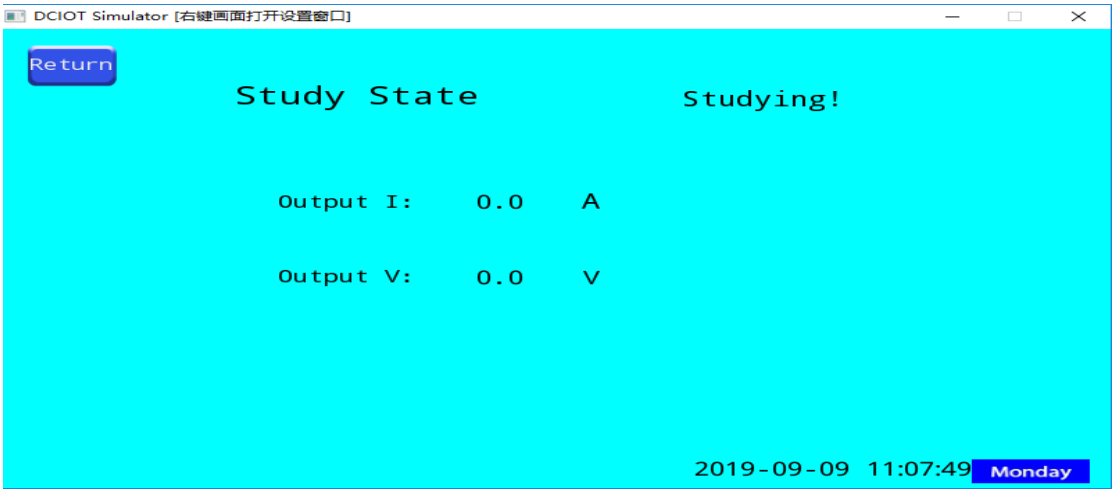
Click "motor debugging", "Motor debugging" into the interface as the figure below :



Main features include: set motor related parameters, self-learning, inching commissioning and fan start-stop control.

② Motor since the study

Click "study", and under the conditions of machine downtime, system of motor, automatically self learning, learning is completed, the system prompt "studying", if learning fails, then the system prompt "study error", the interface is shown in figure below:



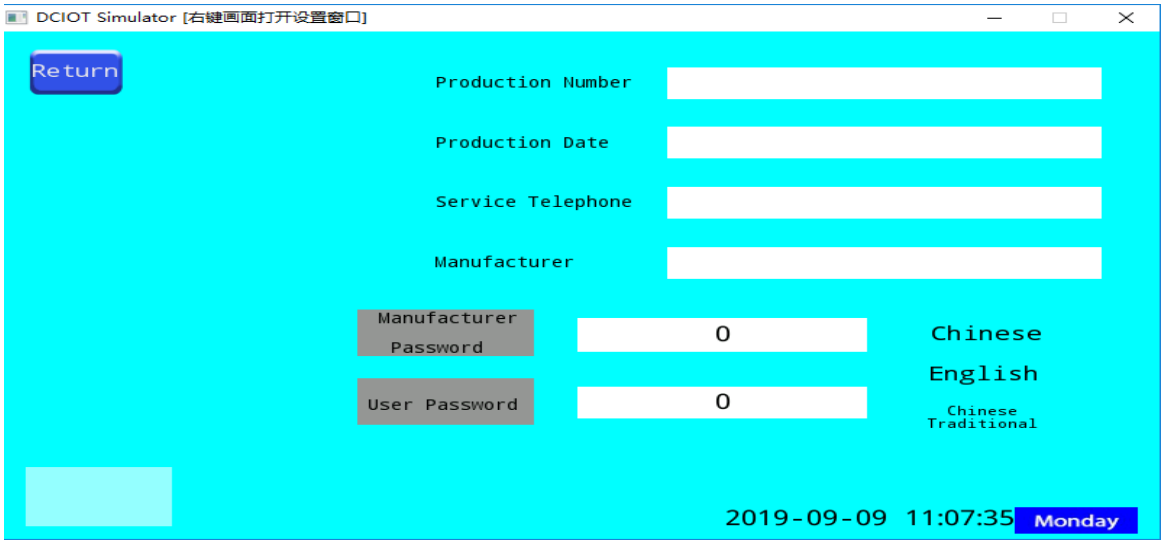
Learning success and then click the back button, enter the machine debugging interface,

inching test used to test the motor steering, the default run at 10 Hz, observe the motor turned to whether it is right, such as steering error in time click on the "point move to stop" button, change the motor line, debug step motor to appeal.

Fan, debugging, and click "run" fan, fan to observe whether it is right, such as working properly, then stop running, back to the main interface, such as reverse operation is changing any two fan thread.

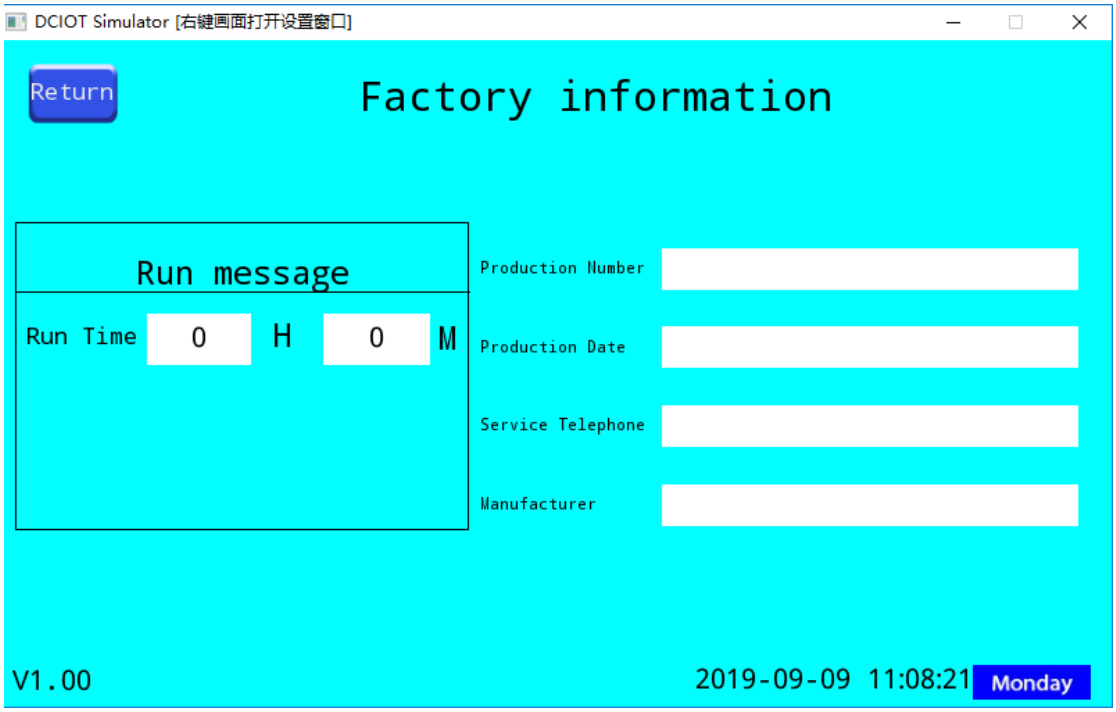
③ Information

Click on "information" button, enter the interface system parameters, the password used for manufacturer and user password change, as the figure below :



10.8 Information

Click on the "Information", "Information" into the interface, as the figure below :



Note: the above function if you have deviation with the actual use, is the function of the software version upgrades, please refer to use.

11. Quality Guarantee and Maintenance

11.1 Quality guarantee

The quality guarantee period is 18 months after delivery, or 12 months after debugging and operation, or service time within 4000 hours (being subject to the earliest one).

11.2 Replacement cycle of the three filters and oil

No.	Name	First maintenance	Replacement cycle
1	Air filter	500h	Every 2000h
2	Oil filter	500h	Every 2000h
3	Oil separator	4000h	Every 4000h
4	Lubricating oil	500h	Every 4000h

Note: if the air compressor is operated in poor environment, it is suggested to appropriately shorten the replacement cycle of the three filters and oil.

11.3 Maintenance

No.	Contents	Inspection or replacement cycle (h)						
		Every day	500 h	2000h or 3 months	4000h or 6 months	8000h or 1 year	16000h or 3 years	24000h or 4 years
1	Check the temperature of air, oil and water and pressure parameters	x	x	x	x	x	x	x
2	Check the leak of air, oil and water	x	x	x	x	x	x	x
3	Check the discharge of condensate water	x	x	x	x	x	x	x
4	Check the voltage, current and temperature rise in motor of air compressor	x	x	x	x	x	x	x
5	Often notice the vibration and noise	x	x	x	x	x	x	x
6	Clean the machine stand and air filter core		x	x	x	x	x	x
7	Replace the lubricating oil and oil filter		x	x	x	x	x	x

8	Clean or replace the air filter core		x	x	x	x	x	x
9	Check fasteners		x	x	x	x	x	x
10	Check the oil cooler and after-cooler and clean them if necessary			x	x	x	x	x
11	Check the temperature of the cooler			x	x	x	x	x
12	Clean the fan blade cover and fins of the main motor			x	x	x	x	x
13	Add lubricating grease on the main motor			x	x	x	x	x
14	Clean or replace the pre-filter screen (optional)			x	x	x	x	x
15	Measure the motor voltage and current			x	x	x	x	x
16	Check all the relief valves				x	x	x	x
17	Check or calibrate the pressure sensor and temperature sensor				x	x	x	x
18	Check the power supply control cabinet and solenoid valve				x	x	x	x
19	Replace the oil separator				x	x	x	x
20	Check or replace the damping pad				x	x	x	x
21	Clean the motor fins and ventilation hood				x	x	x	x
22	Remove the oil cooler and after-cooler					x	x	x
23	Overhaul the inlet valve and replace with spare part in the service kit					x	x	x
24	Overhaul the minimum pressure valve and replace with spare part in the service kit					x	x	x
25	Overhaul the temperature control valve and replace with spare part in the service kit (optional)					x	x	x
26	Overhaul the one-way valve and replace with spare part in the service kit					x	x	x
27	Replace the blow-down valve					x	x	x
28	Replace the post-processing precision filter core					x	x	x

29	Replace the rubber gasket of coupling (direct-connection)						x	x
30	Replace the motor bearing						x	x
31	Replace the rotor bearing and adjust the screw clearance							x

Attention: please make sure pressure in the compressor system has already been released and it has been separated from other pressure sources, and switch on the main circuit has been disconnected with safety sign of no switching on being prepared before maintenance and replacement of parts in accordance with the above table

12 Troubleshooting Table of Air Compressor

Item	Fault phenomenon	Possible causes	Troubleshooting measures
(I)	Unable to start (electrical failure light on)	1. Burning of fuse 2. Actuation of protection relay 3. Loosening wiring or poor contact 4. Too low voltage 5. Motor fault 6. Machine body fault 7. Actuation of phase failure protection relay	1. Ask electrical personnel to overhaul and replace 2. Ask electrical personnel to overhaul 3. Overhaul and tighten 4. Ask electrical personnel to overhaul 5. Ask electrical personnel to overhaul 6. Manually operate the machine and contact with our service unit if it cannot be rotated 7. Check the power supply line and connection points
(II)	High running current and self-shutdown of compressor (electrical failure light on)	1. Too low voltage 2. Too high exhaust pressure 3. Poor contact of circuit junction 4. Incorrect coolant specification 5. oil separator blocking (high coolant pressure) 6. Compressor machine body fault	1. Ask electrical personnel to overhaul 2. Check the pressure gauge and adjust the pressure switch if it exceeds the setting pressure 3. Overhaul 4. Check the coolant and change 5. Replace the oil separator 6. Manually operate the machine and contact with our service unit if it cannot be rotated
(III)	Running current under normal value	1. Large air consumption (running with pressure under the setting value) 2. Air filter blocking 3. Bad actuation of inlet valve 4. Improper pressure setting	1. Check the consumption and increase compressor if necessary 2. Clean or replace 3. Remove, clean and add coolant 4. Readjust and set pressure
(IV)	Exhaust temperature below 70℃	1. Inaccurate indication on exhaust temperature gauge 2. Cooling fan	1. Replace exhaust temperature gauge 2. Replace cooling fan

Troubleshooting Table

Item	Fault phenomenon	Possible causes	Troubleshooting measures
(V)	High exhaust temperature, automatic tripping of air compressor and exhaust high temperature indicator light on (exceed the set value 100℃)	1. Insufficient coolant 2. High environment temperature 3. Oil cooler blocking 4. Incorrect coolant specification 5. Not clean plate-fin heat exchanger 6. Oil filter blocking 7. Cooling fan fault 8. Temperature switch fault or temperature rod fault	1. Check the coolant level, stop the machine and add coolant if it is insufficient 2. Increase exhaust air, lower the room temperature and improve the environment 3. Check the temperature difference between the inlet and outlet. The normal temperature difference is 5～8℃. If it is below 5℃, the oil cooler might be blocked and please remove it and clean with reagent. 4. Check the coolant and change 5. Clean with low pressure air 6. Replace 7. Replace 8. Replace
(VI)	High liquid content in the air, short cycle for adding coolant and smoking of the filter when idling	1. High liquid level 2. Blocking of the restriction orifice on oil return line 3. Damage of O-ring on oil return core tube 4. Too low exhaust pressure 5. Damage and failure of oil separator 6. Fatigue of minimum pressure valve spring	1. Check the liquid level and appropriately discharge 2. Remove and clean 3. Replace the O-ring 4. Adjust pressure swith to the set value 5. Replace with new product 6. Replace the spring
(VII)	Unable to operate in full load	1. Pressure switch fault 2. Solenoid valve fault 3. Bad actuation of inlet valve 4. Bad actuation of minimum pressure valve 5. Leakage of control pipeline	1. Replace with new product 2. Replace with new product 3. Remove, clean and fill coolant into the control pipeline to see if it is unblocked 4. Remove and check if the valve seat and check valve are worn and replace them if they are 5. Check the leak position and fasten

Item	Fault phenomenon	Possible causes	Troubleshooting measures
(VIII)	Unable for idle operation, gauge pressure maintaining at working pressure or still rising when idling and actuation of relief valve	1. Pressure switch failure 2. Bad actuation of inlet valve 3. Failure of draining solenoid valve o blocking of draining pipeline 4. Circuit board fault	1. Overhaul and change if necessary 2. Remove, clean and add coolant 3. Overhaul and change if necessary 4. Overhaul and change if necessary
(IX)	Compressor air volume below the normal value	1. Blocking of air inlet filter 2. Bad actuation of inlet valve 3. Blocking of oil separator 4. Leakage of draining solenoid valve or pipeline	1. Clean or change 2. Remove, clean and add coolant 3. Replace 4. Overhaul and change if necessary
(X)	Frequent idling /reconditioning	1. Pipeline leakage 2. Too small differential pressure of pressure switch 3. Unstable air consumption 4. Untight sealing of minimum pres-sure valve element or fatigue of spring	1. Check the leak position and fasten 2. Reset (differential pressure being 0.2Mpa in general) 3. Increase air receiver capacity 4. Overhaul or change the valve element or spring

Service Hotline: 400-004-3599

Shanghai ESSENCE Compressor., Ltd

Add: Zone C,1st Floor,Building 2,No.28 Minyi Road,

Songjiang District,Shanghai,P.R. China

Tel: +086 021 67753599

Website: www.essenceproducts.com

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