Evaporation Coating Equipment

Using Instruction

[CCZK-PL / 7th generation]

Factory Serial Number:

Production Date:

Preface

Dear Customer,

Thank you very much for purchasing and using the high-quality and high-performance vacuum coating equipment produced by Jiangsu Cicel Vacuum Technology Co.,Ltd. This equipment is a specialized mechanical device used for metalizing the surface of workpieces in a specific vacuum environment, involving knowledge related to vacuum, mechanics, and electrical engineering. To ensure that you can safely, correctly install, operate, and maintain this equipment and fully utilize its performance, please carefully read this manual before use. Please be sure to make preparations for water, electricity, and gas as per the requirements of this manual to ensure the efficient and stable operation of the equipment and create greater economic benefits for you.

Due to technological advancements, products are constantly updated. Our company reserves the right to modify the content of this manual without prior notice. This manual does not form part of the sales contract or agreement.

⚠safety tips:

The operators of this equipment must undergo professional training to understand the structure, working principle and safety operation procedures of the equipment. The installation, debugging and electrical maintenance of the equipment must be carried out by professional technicians.

When the equipment is in operation, do not extend any part of your body into the vacuum chamber. During the operation of the diffusion pump, the bottom temperature is very high. Do not touch it and do not disassemble it before it has cooled to room temperature and has been evacuated. The equipment must be reliably grounded, with a grounding resistance of less than 4Ω. In an emergency, immediately press the 【Emergency stop】 emergency stop button to stop the operation of the equipment.

Catalogue

Chapter 1 Equipment Overview and Main Parameters

1. Equipment Overview

The CCZK-PL dual-chamber evaporation coating equipment is developed based on an evaporation coating system, focusing on providing high-quality silicone oil protective films for various product surfaces. Its core technology is the combined process of evaporated aluminum coating and silicone oil plasma deposition, and its key value lies in merging the two traditional independent steps — aluminum deposition and protective lacquer spraying — into one single process completed within the same vacuum chamber of the same equipment.

The main applications of the CCZK-PL equipment include the coating treatment of automotive lamps, such as reflector bowls for various car headlights, taillight reflectors, and reflectors used in other lighting industries. Apart from automotive lamps, this equipment is also suitable for coating plastic workpieces that demand high protective performance, including high-end cosmetics, decorations, crafts, and the like.

The equipment adopts a unique vertical double-door structure, enabling workpiece loading/unloading and coating to be performed alternately between two chamber doors, greatly improving production efficiency. Equipped with three operation modes: fully automatic, semi-automatic and manual, it is centrally controlled by PLC + touch screen, featuring simple and flexible operation and stable performance, making it an ideal choice for mass production.

2. Main Technical Parameters

(1) Vacuum chamber size (Diameter × Height): (varies between machines)
(2) Maximum workpiece rotation size: 6-axis φ 560mm, 8-axis φ 450mm or customized
(3) Ultimate vacuum degree (new equipment, no load): 5×10^{-4} Pa
(4) Pumping time (no load, from atmospheric pressure to 5×10^{-2} Pa): ≤6 minutes
(5) Working power supply: 380V/50Hz, three-phase five-wire (provided by user)
(6) Evaporation voltage: 0–12 V
(7) Evaporation current: 0–5000 A
(8) Control mode: manual / semi-automatic / fully automatic

Core Basic Parameters

- Chamber type: vertical vacuum chamber
- Control mode: one-key switch between manual / automatic
- Evaporation mode: multi-group water-cooled resistance evaporation sources (tungsten boat / molybdenum boat compatible)
- Suitable coating materials: aluminum, chromium, copper, special alloy evaporation materials
- Suitable workpieces: this evaporation-type PVD vacuum coater can coat acrylic sheets and various plastic products

3. User Installation Preparation

(1) Working power supply: power supply transformer capacity ≥120KVA (consult engineer for details), 380V/50Hz, three-phase five-wire system. Voltage fluctuation ≤±5%; 150KVA voltage stabilizer recommended.
(2) Cooling water: water pressure 0.2–0.3 MPa, water temperature ≤25° C, water flow ≥20 tons/hour. Soft water (purified water) and cooling tower recommended.
(3) Compressed air: air pressure 0.4–0.8 MPa, air flow ≥0.1 m^3/min, dry and oil-free.
(4) Foundation: flat site, maximum inclination ≤2°, anchor bolt holes reserved according to equipment foundation drawing.

★ Note:

380V voltage fluctuation ≤ ± 5%; cooling water inlet temperature 18 – 25 ° C, temperature difference between inlet and outlet controlled at 3 – 5 ° C. Soft water recommended to reduce pipeline scaling. Oil- water separator required in compressed air line, pressure 0.4 – 0.8 MPa.

Chapter 2 Working Principle and Main Configuration

1. Working Principle

In a vacuum environment, the equipment resistance-heats and evaporates aluminum wire to form a highly reflective aluminum film, while simultaneously introducing silicone oil that is treated by plasma ionization, thereby completing the composite coating of a metallized layer and a dense protective film in a single process.

After aluminum evaporation coating, a silicone oil protective film is further applied in the same chamber without unloading, providing silicone oil adhesion to the product. This process outperforms ordinary evaporation coating by offering the following

advantages:
-Prevents yellowing and delays product aging;
- Super-hydrophobic and anti- fouling, self- cleaning;
- Anti- corrosion, isolates acid/alkali contaminants;
- Repairs slight loss of gloss, enhances light transmittance and brightness;
- Reduces fine scratches, etc.

2. Main Configuration and Function Introduction

(1) Vacuum Chamber

Also called coating chamber or cavity, vertical structure, inner size (Diameter × Height), welded by Q235 carbon steel or 304 stainless steel. Hinged rotating double-door structure, manual door opening. Each door equipped with one set of evaporation electrodes and one set of workpiece holder with clamping and rotating device. Alternate double-door operation facilitates workpiece loading, reduces waiting time and improves efficiency.

- Main pump: two sets of KT-800 high-vacuum oil diffusion pumps
- Booster pump: one set of ZJP-1200 Roots vacuum pump
- Backing pump: one set of 2X-15 rotary vane vacuum pump
- Roughing pump: two sets of HGL-150 slide valve pumps
- Valve group: roughing valve, backing valve, high-vacuum valve (main valve), holding pump valve, vent valve and various gas filling valves

(2) Ion Bombardment Cleaning System

The equipment is equipped with a high- voltage ion bombardment cleaning system, incorporating a 5 kW bipolar cleaning power supply. Before the coating process, the surface of plastic workpieces can be subjected to ion bombardment to activate the surface, significantly enhancing film adhesion. In addition, comprehensive utility support is provided, including water pressure (≥0.2 MPa, 3 m^3/h), water temperature (≤25 ° C), and air pressure (0.4- 0.8 MPa).

(3)Evaporation System

Evaporation source: tungsten filament heater, made of multi-strand tungsten wires. Coating material (e.g., aluminum wire) placed in tungsten filaments, heated and evaporated by high current. New tungsten filament heaters should be cleaned before use: boil in 30% sodium hydroxide solution until white, rinse with clean water and dry.

Evaporation electrodes: transmit high current of 0 – 12V, 0 – 5000A to tungsten filaments.

Here is the English translation of the provided text:

(4) Silicone Oil System

The system employs a high- precision silicone oil flow control valve from a leading U.S. brand, which serves as the core precision component of the system. The flow control is highly accurate; together with the cleaning power supply, it ensures uniform silicone oil spraying and a high ionization rate, resulting in more stable product quality.

(5) Water Cooling System

User shall equip 20- ton/hour cooling tower and circulating water pump to ensure sufficient cooling water and stable water pressure (0.2 – 0.3 MPa), water temperature <25° C. Equipped with water pressure detection and alarm device. In case of water interruption, insufficient pressure or forgetting to turn on water before startup, the diffusion pump pressure controller alarms (flashing buzzer and beeping on electric cabinet panel), cuts off diffusion pump heating power.

(5) Pneumatic System

User shall equip 0.1 m^3 /min air compressor to supply compressed air for pneumatic valve opening, pressure 0.4 – 0.8 MPa when opening valves.

(6) Electrical Control System

The electrical control system adopts a Programmable Logic Controller (PLC) + touch screen (MHI) combined control method, enabling manual, semi- automatic, and fully automatic control functions. Evaporation process parameters can be set online, and detailed fault alarm records as well as user prompts can be browsed. The system includes vacuum pumping control, ion bombardment cleaning system, evaporation control, silicone oil protective film, and vacuum measurement. (For details of the electrical system, please refer to the electrical schematic diagram and the instruction manual of the compound vacuum gauge.)

Chapter 3 Installation and Commissioning

1. Working Environment and Equipment Installation

Working environment must be clean, dust-free, free of corrosive and harmful gases. Sufficient water and gas supply, 380V/50Hz three-phase five-wire AC power required. Power cable: each phase ≥ BV50mm². 150KVA three-phase voltage stabilizer recommended in case of large voltage fluctuation or low grid voltage.
Installation site must be flat and firm. User shall prepare power, cooling water, compressed air and install grounding electrode before installation. Concrete foundation with reserved bolt holes required; fill holes after installation.
During installation, vacuum chamber, pipelines and sealing surfaces must be clean, seals in good condition, screws firmly fastened. Electric cabinet and main unit must be grounded (resistance <4Ω). Check all installation parts, ensure main power switch, electrical components and grounding intact, all switches at "zero" or "off" position.

2. Commissioning

2.1 Pre-Commissioning Preparation

Check loose wiring in electric cabinet, connect power, motor circuits, control circuits, cooling water and compressed air according to electrical diagram. Check electrode insulation in vacuum chamber, reliable tungsten filament contact, smooth workpiece holder rotation, good coupler and input electrode contact, good seals (especially dynamic seals). Check oil quality and rotation direction of diffusion pump, slide valve pump, Roots pump and rotary vane pump. Note: Roots pump rotation direction must be checked under vacuum.

2.2 Commissioning Content

First, the user should supply water, compressed air, and power to the equipment, and check whether there is any leakage or dripping from the cooling water pipes, and whether the air pressure remains stable. Then check whether the roughing pump, Roots pump, and backing pump operate normally, and whether the three-phase current of the diffusion pump is normal.
(Note: The cleaning system requires the customer to provide a cylinder of argon gas to assist in vacuum adjustment. The rotation direction of the Roots pump must be checked under the condition that the vacuum degree is better than 1×10^{3} Pa.)

The vacuum interface adopts RS485 communication for readings, allowing users to directly set the start-up pressure points for the diffusion pump, Roots pump, ion cleaning, backing valve, evaporation, and silicone oil protective film on the touch

screen.

After confirming that all inspection items are working properly, the user can begin the pumping test. Note: Before starting the test, please be sure to double- check that the cooling water and compressed air have been activated and that their values are normal. This is extremely important! Otherwise, it may result in a major safety accident.

2.3 Test Steps:

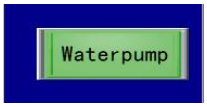
(1) Turn on the vacuum gauge power, start the backing pump, and check whether the backing vacuum is normal. Under normal conditions, after a few minutes the vacuum should be better than 10 Pa; at this point, start the diffusion pump, and begin heating the silicone oil and the silicone oil pipeline.
(2) The diffusion pump will take about 1.5 hours to reach normal operating temperature. Then start the roughing pump, close the chamber door, and open the roughing valve.
(3) When the chamber pressure reaches 9×10^{2} Pa, start the Roots pump.
(4) When the pressure reaches 6×10^{0} Pa, turn on the ion bombardment. The customer can set the cleaning vacuum and the argon flow range on the touch screen to maintain the required vacuum for cleaning.
(5) After cleaning is completed, turn off the ion bombardment and the gas flow valve. When the chamber pressure reaches 3×10^{0} Pa, close the roughing valve and open the backing valve (if the Roots pump is not running, the backing valve cannot be opened). Then open the high vacuum valve to continue pumping.
(6) When the pressure reaches 3×10^{-2} Pa, press the evaporation button to evaporate the coating material, and observe whether the pneumatic valve of the evaporation electrode operates; this process should be accompanied by the sound of electrode switching. At the same time, press the workpiece rotation button to check whether the workpieces in the corresponding chamber are rotating. After the evaporation test, press the evaporation button again to stop evaporation.
(7) After evaporation is completed, close the high vacuum valve and the backing valve, open the roughing valve. When the vacuum reaches 3×10^{0} Pa, turn on the ion bombardment, open the silicone oil valve, adjust the silicone oil valve flow and adjust the Roots pump speed to maintain the optimum vacuum for silicone oil adhesion.
(8) Sequentially close the silicone oil valve, ion bombardment, roughing valve and Roots pump, then open the vent valve and wait for the chamber door to open. After the chamber door opens, the vent valve will close automatically.

If equipment is unused for a long time and vacuum chamber exposed to atmosphere, perform “ultimate pumping”: run roughing pump, Roots pump and diffusion pump continuously without coating to check vacuum stability. Process usually takes several hours.

Chapter 4 Manual Coating Operation

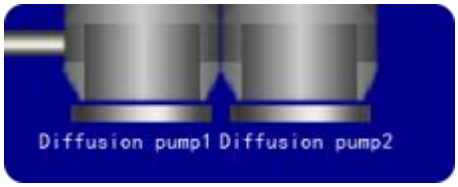
4.1 Diffusion Pump Preheating

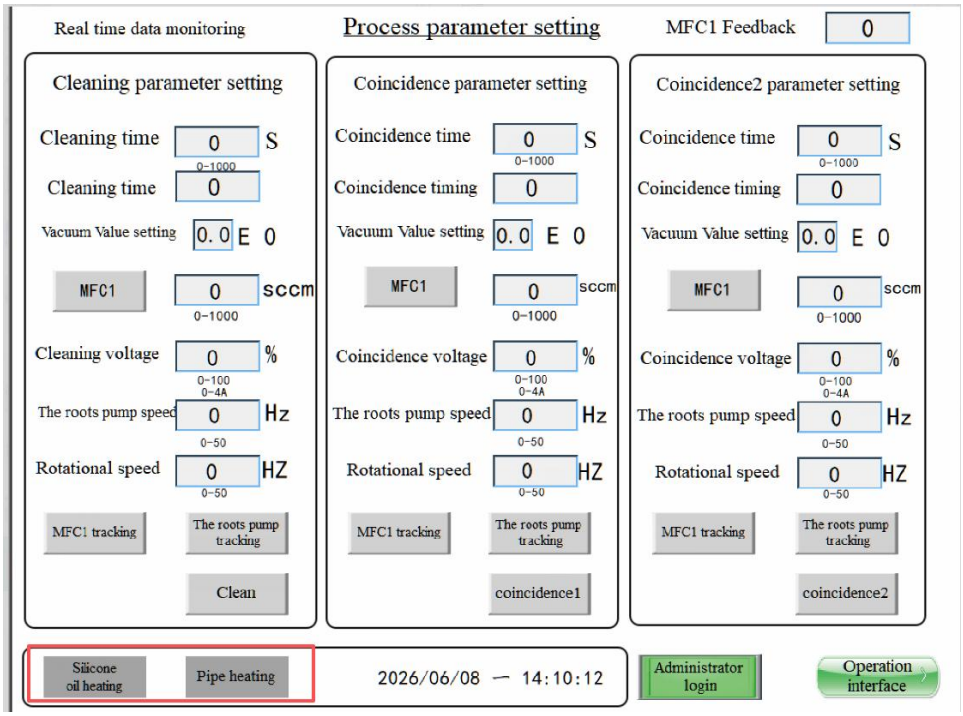
1.Turn on main power, cooling water and air compressor.



2.Start vacuum gauge and holding pump.

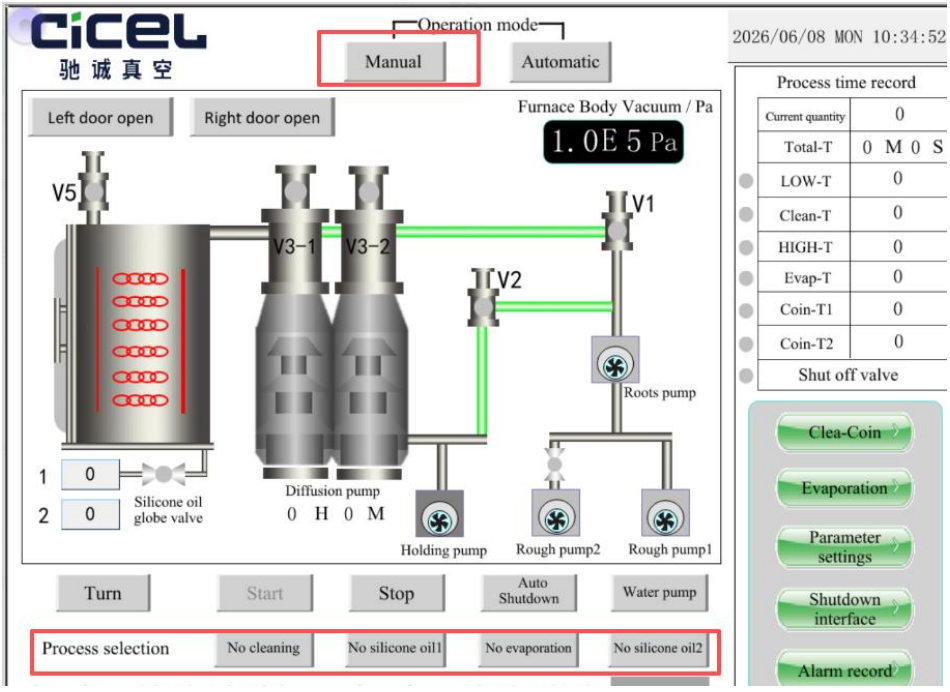
3. After confirming vacuum >8.0×10⁰ Pa, start diffusion pump heating and preheat for 1－2 hours，And activate the silicone oil heating and the pipe heating.





Warning: If vacuum drops below 8.0×10^{1} Pa during preheating, stop heating immediately; resume heating only after vacuum recovers. Do not stand in front of vacuum chamber door during heating.

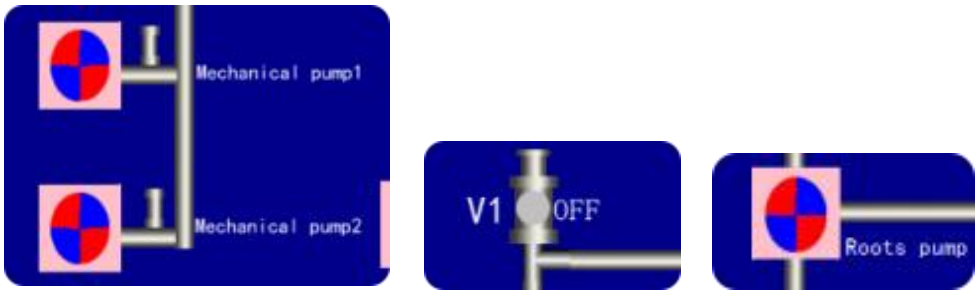
4.2 Standard Manual Coating Process



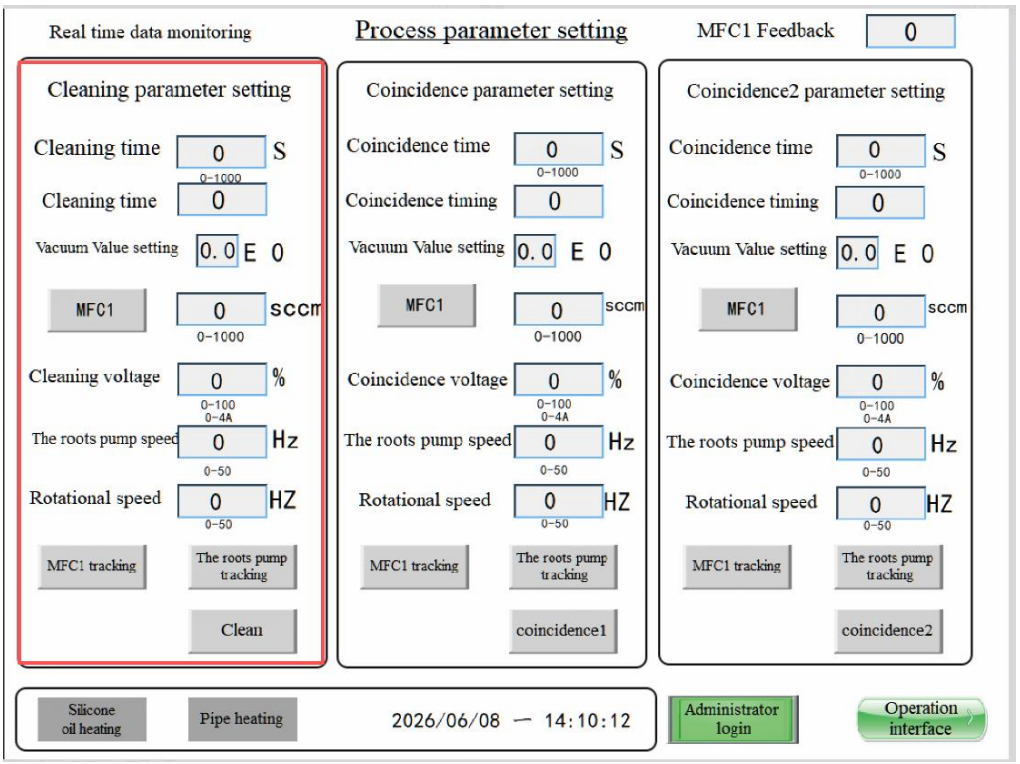
1.Loading: open chamber door, install coating material and workpiece, close and

fasten door.

2.Rough pumping: start roughing pump (mechanical pump), open roughing valve (V1). Start Roots pump when vacuum reaches 9×10^{2} Pa.



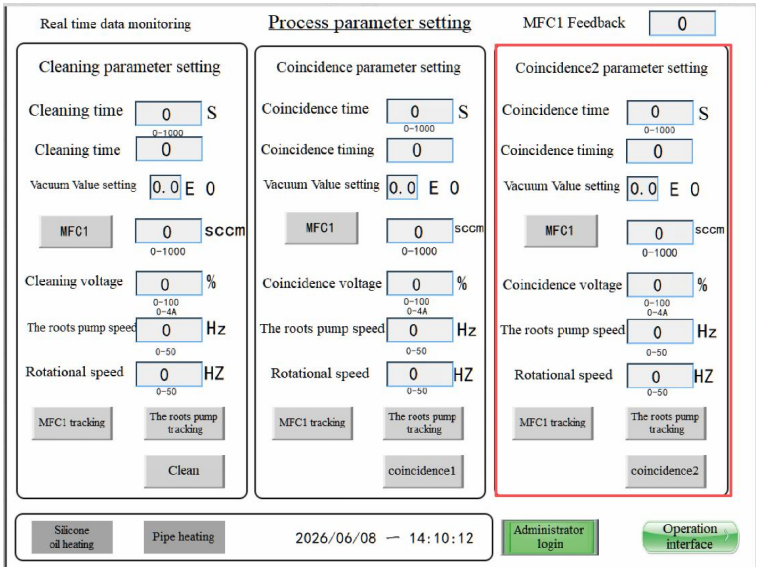
3.Cleaning: When the vacuum reaches 6×10^{0} Pa, start the cleaning process, open the gas flow valve, set the cleaning time and the gas flow rate. Alternatively, the vacuum can be maintained by adjusting the Roots pump speed. After this step is completed, close the cleaning process and the flow valve.



4.Fine pumping: close roughing valve, open backing valve when vacuum reaches 3×10⁰ Pa; open high- vacuum valve for high- vacuum pumping.

5.Evaporation coating: start evaporation when vacuum reaches 3×10⁻² Pa.
Preheating & degassing: slowly adjust evaporation potentiometer, current 400 – 500A for 10 – 20 seconds.
Pre- melting: increase current (≤1000A) to melt aluminum wire for ~20 seconds.
Evaporation: rapidly increase current to 3000 – 4000A for 5 – 10 seconds for fast evaporation.

6. After the evaporation process is completed, turn off the evaporation, close the high vacuum valve and the backing valve, and open the roughing valve. When the vacuum reaches 3×10⁰ Pa, start the cleaning process, open the silicone oil valve, set the silicone oil flow rate and the silicone oil process time, and proceed with silicone oil adhesion.



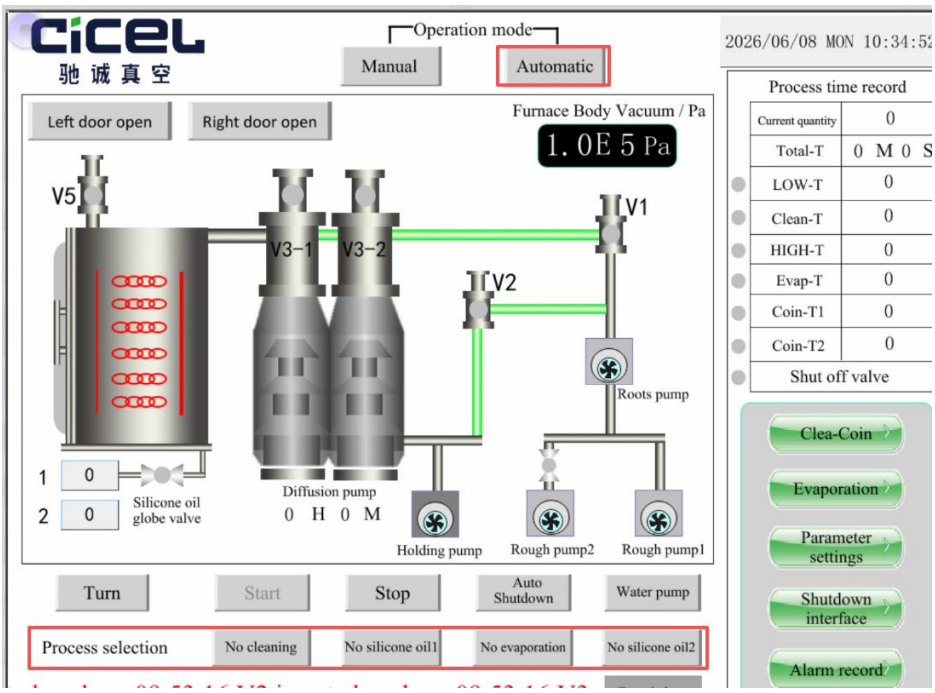
7. Completion and Venting: Sequentially close the silicone oil valve, ion cleaning, roughing valve, and Roots pump. Then open the vent valve and wait for the chamber door to open. After the chamber door opens, the vent valve will close automatically.

4.3 Equipment Shutdown

After taking workpieces, turn off diffusion pump heating; keep holding pump and cooling water running. System powers off automatically after diffusion pump cools for ~150 minutes. Turn off cooling water and compressed air, cut off main power.

Chapter 5 Automatic Coating Operation

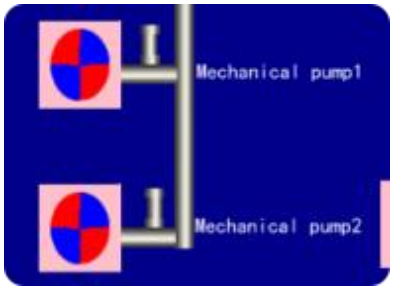
1.Fully Automatic Mode



1.First, select the process: you can choose no cleaning and no silicone oil; or you can choose to spray silicone oil once or twice. (Customer- definable)

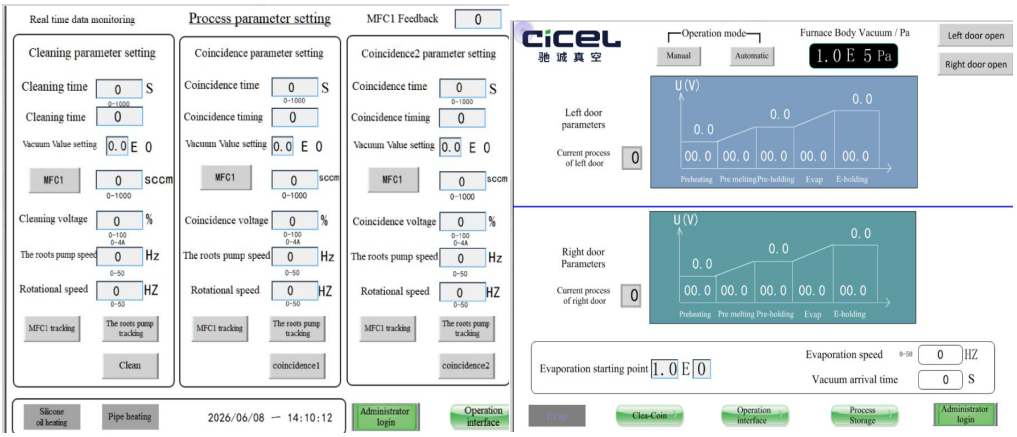
2.Open vent valve (V5), fill chamber with air; open door, install coating material and workpieces, close and fasten door.

3. Start roughing pump (mechanical pump).



4. Switch selector to “Fully automatic”.

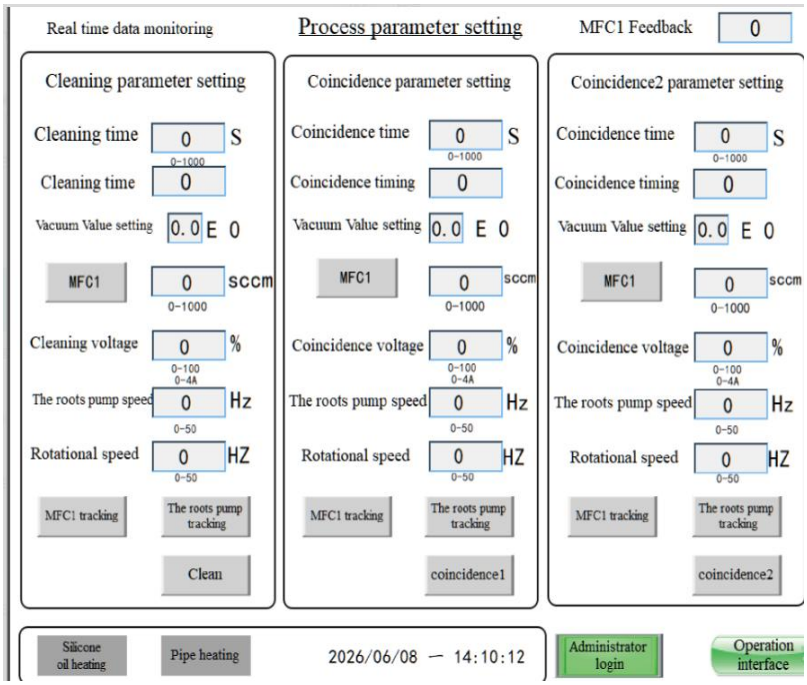
5.Press “Automatic” button; roughing valve (V1) opens automatically, equipment runs fully automatically (pumping- coating- venting completed automatically).



Note: The parameters for the cleaning, evaporation, and silicone oil processes should be properly adjusted by the customer according to their specific products.

6.After door opens, close and fasten the other loaded door; repeat step 5 for double- door alternate operation.

2. Cleaning Process and Silicone Oil Process Parameter Settings



(1). Customers can choose the vacuum tracking method for cleaning according to their product needs: gas tracking or Roots pump speed tracking.

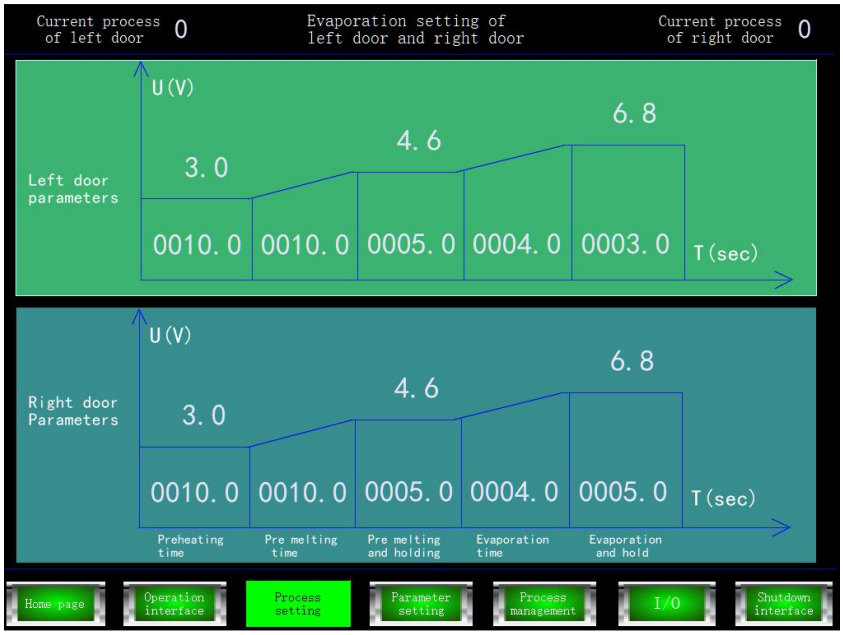
(2). In the process, you can also choose to spray silicone oil once before evaporation, and then spray silicone oil again after evaporation. Applying silicone oil twice will result in better adhesion, brightness, and bonding strength, as well as longer salt spray test durability.

Chapter 6 Process Adjustment, Storage and Recall

1. Process Adjustment

Define adjustment objectives, set left and right door parameters. After new process adjustment, tap “Save Process” on touchscreen process interface and enter process name (Process 1, Process 2, etc.).
Note: Monitor equipment status throughout adjustment to avoid parameter abnormality damage.

2.Process Parameter Storage and Recall



(1) Preheating Time

Stage: first step of evaporation (preheating & degassing)
Function: low current slowly heats tungsten and aluminum wires, removes moisture, gas and impurities to prevent splashing or pinholes
Duration: 5 – 20 seconds (depends on aluminum amount and humidity)

(2) Pre- melting Time

- Stage: after preheating, current increases
- Function: melts aluminum wire into liquid, wets tungsten surface (soft, red, no massive evaporation)

- Duration: 5 – 15 seconds (actual condition dependent)

(3) Pre- melting Holding

- Stage: after pre- melting, maintain low current
- Function: fully wets tungsten, discharges residual gas, distributes aluminum evenly; prevents “aluminum splashing”
- Duration: 5 – 15 seconds (actual condition dependent)

(4) Evaporation Time

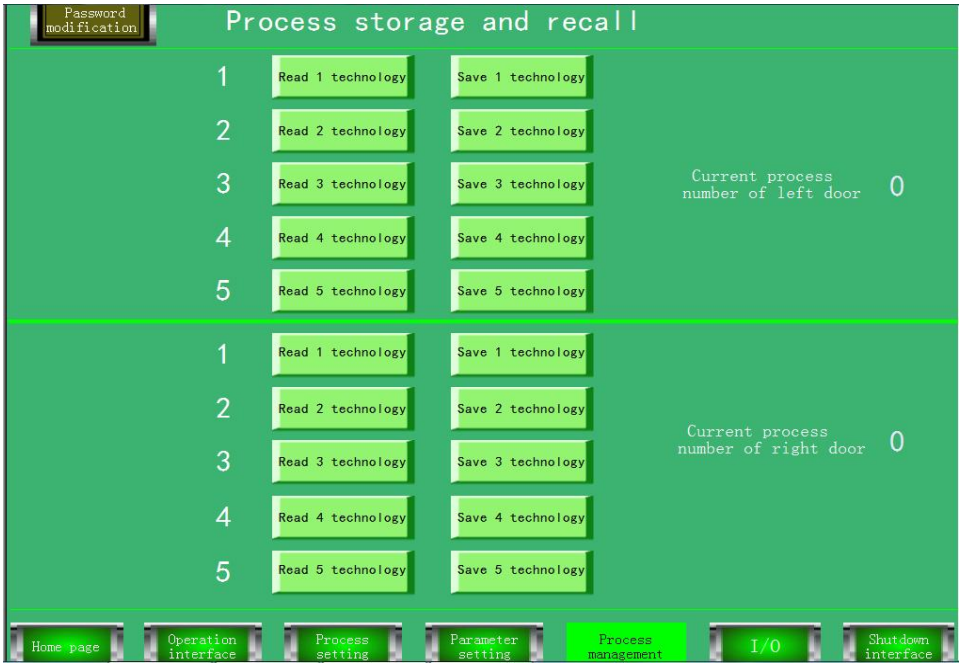
- Stage: core coating phase
- Function: high current rapidly evaporates aluminum vapor to deposit on workpiece
- Duration: 3 – 10 seconds (longer = thicker film, but may yellow or burn tungsten)

(5) Evaporation Holding

- Stage: The final stage after evaporation (some equipment is referred to as "slow descent time" or "post-evaporation").
- Function: After the evaporation current stops, a small sustaining current may be retained or it may be directly cut off.
- Equipment stores multiple evaporation processes on touchscreen. Press “Menu”, enter password, select required process to open evaporation setting interface. Set time and voltage for each evaporation stage; confirm and load parameters.

  This device can store various evaporation processes within the touch screen. By pressing the "Menu" button on the touch screen, a password input interface will appear. After entering the correct password, the desired process can be retrieved, and the evaporation settings interface will then be displayed.

  The evaporation parameters are set here. Set the appropriate time and voltage for each stage of evaporation. Press the parameter display button, and the set parameters will be displayed. Other spaces show the actual parameters of the automatic evaporation, and the right side of the column chart shows the evaporation voltage. These parameters will appear during the automatic evaporation operation.



After selecting the process, you can preview the details of the parameters. Once you confirm that there are no errors, click "Call Process" and the parameters will be automatically loaded into the operation interface.

Chapter 7 Maintenance and Care

1. Precautions for Maintenance During Use

1.1 Equipment (Liner) Cleaning

After the equipment has been used for one week (approximately 70 hours), apart from the coating on the surface of the workpiece, due to the non-directionality of the evaporation film, the inner walls of the chamber will also be coated with a film, and the coating material attached to the inner walls of the chamber will become thicker and thicker. Due to the loose structure of the film layer, it will adsorb a large amount of air, causing the vacuum coating machine to draw air more slowly. At this time, the chamber should be cleaned. Usually, for aluminum-coated materials, an appropriate amount of caustic soda (NaOH) can be dissolved in water and applied to the inner wall of the vacuum chamber to allow the caustic soda to react with aluminum to form soluble sodium aluminate. At this time, the film layer on the wall will fall off, and a silvery-white vacuum chamber wall can be seen. Then, rinse it clean with water, making the entire chamber as white as new. Finally, wipe the vacuum chamber dry. If there are areas that cannot be dried, use an air gun to blow dry. Before blowing dry, users should try to wipe the water in the vacuum chamber clean. Otherwise, it will cause rust. At this point, the cleaning process is complete. The cleaning method for

the workpiece holder is the same as above. Start the coating after drying. The initial coating times in the first few rounds are longer than normal because residual moisture may still exist. However, after several rounds of coating, the moisture is drawn away, and the speed will naturally increase. The coating time for the first round should be about four times longer than the original.

1.2 Regular Diffusion Pump Oil Replacement

After using the diffusion pump oil for half a year (approximately 1680 hours), under long-term high-temperature conditions, although the diffusion pump is turned on under high vacuum, the residual oxygen and other components will react with the diffusion pump oil. The diffusion pump oil may also undergo cracking at high temperatures, resulting in a deterioration of the oil quality and an extended pumping time. When the pumping time is too long, the diffusion pump oil should be replaced immediately. Remove the front-stage valve and the pipeline, remove the diffusion pump for oil discharge, and take out the pump core. Clean the pump housing and the pump core with gasoline. If there is residual oil on the pump core, the user should dry the pump core with 0# sandpaper and then clean it with gasoline. After all the cleaning is completed, wipe and dry the pump core, and then reinstall it. After refilling the oil, the diffusion pump can continue to be used.

Refueling standard: Model - 3 # Oil for each KT-1000 diffusion pump 17.5 kg, for each KT-900 diffusion pump 14 kg, for each KT-800 diffusion pump 10.5 kg, for each KT-600 diffusion pump 7 kg, for each KT-400 diffusion pump 3.5 kg.

★Note: After oil replacement, manually pump diffusion pump to vacuum; check for leaks and ensure vacuum reaches 3.0E0 before production.

1.3 Vacuum Pump and Roots Pump Oil Replacement

The oil capacity of the vacuum pump (model: FV-100) is approximately 38 liters. After using the vacuum pump oil for two months (calculated on a two-shift basis), the oil quality will change. Due to factors such as water and impurities being drawn in, the viscosity of the oil may decrease and the vacuum performance may deteriorate, requiring replacement. For new equipment, the oil should be replaced after half a month of use, because during the running-in period, the oil contains more iron powder, which will exacerbate wear.

Warning: Precautions for replacing the diffusion pump oil: When the vacuum degree is lower than 1×10^{-2} Pa, it is strictly prohibited to heat the diffusion pump or disassemble it while it is under heating. Otherwise, the oil inside the diffusion pump will come into contact with oxygen in the air at high temperature,

leading to an oxidation and combustion reaction, an increase in pressure, the bursting of the fine extraction valve, and the explosion of the cavity door, resulting in an accident. Therefore, before heating the diffusion pump oil, it is necessary to ensure that the vacuum degree is less than 1×10^{-2} Pa; only after the oil inside the diffusion pump has completely cooled to room temperature can it be charged with air and disassembled; otherwise, serious consequences will occur, causing casualties.

1.4 Other Precautions

(1) The entire system should be kept in a vacuum state normally. Before operation, gas should be introduced and the vacuum chamber should not be exposed to the atmosphere for a long time.
(2) Regularly check the rubber seals to ensure their good condition, especially the moving seals. Add vacuum grease to the moving sealing points regularly.
(3) Regularly inspect the electrical components, remove dust, and replace damaged components.
(4) Do not disassemble the diffusion pump and valves under vacuum conditions. The disassembly method is: first, evacuate the entire vacuum system to a vacuum state (note: do not heat the diffusion pump), manually open the high vacuum exhaust valve, and then press the release button to allow the system to communicate with the atmosphere. When the vacuum chamber is filled with air, the diffusion pump and valves can be disassembled.
(5) When stopping the slide valve pump and vane pump, pay attention to whether the electromagnetic valve (or pneumatic valve) is charging the pump chamber. Otherwise, it will cause oil return and contaminate the vacuum pipeline. Therefore, when the electromagnetic valve (or pneumatic valve) fails to charge properly, it must be repaired or replaced in time.
(6) In northern regions during cold seasons, appropriate antifreeze can be added to the cooling water. At night and during long shutdowns, compressed air must be used to blow out the cooling water in the cooling water pipes and the pump body to prevent the cooling water pipes (casing) and the pump body from cracking due to freezing.
(7) The vacuum pumping system can only work after the vacuum pressure reaches 3Pa. If pumping under high pressure, the diffusion pump oil will oxidize, reducing the pumping capacity and shortening the service life of the pump oil.
(8) To ensure that the vacuum coating equipment has a clean working environment, the gas discharged by the slide valve pump must be discharged through the pipeline to the working workshop. Because the gas discharged from the pump contains a large amount of tiny oil droplets. If it is not discharged from the working workshop, even if the surface of the workpiece is carefully cleaned, it will still be contaminated by tiny oil droplets, which will seriously affect the quality of the film layer.
(9) During operation, water supply must not be interrupted. The cooling water used must be clean. Do not use hard water or sewage as cooling water. Otherwise, a layer of scale will deposit on the cooling water pipes, affecting the cooling effect.

2.Precautions During Coating

Use 99.99% pure aluminum for high reflectivity; industrial pure aluminum (99%) has impurities.
Preheat and pre- melt aluminum before rapid evaporation.
Thoroughly clean workpiece surface for strong adhesion.
Keep workshop clean and dry; high humidity extends coating time.
Strictly follow safe operation rules.

Chapter 8 Common Faults and Troubleshooting

1. Common Silicone Oil System Faults and Troubleshooting

Fault Phenomenon	Possible Cause	Solution
Silicone oil protective film uneven	1.Silicone oil flow fluctuation 2. Workpiece holder speed mismatch 3.Uneven plasma distribution	1. Check the flow stability of the MKS valve, calibrate and prepare a spare 2. Adjust the workpiece holder speed (variable frequency speed adjustable) 3.Check the working status of the discharge device
Poor adhesion of silicone oil protective film (peeling off)	1.Aluminum film surface not sufficiently activated 2.Silicone oil injection amount too high or too low 3. Unstable vacuum degree	1.Enable pre- treatment with ion bombardment cleaning 2.Optimize silicone oil injection flow parameters 3.Check the vacuum system to ensure the base vacuum meets the requirement
Silicone oil protective film is foggy, poor transparency	1.Insufficient purity of silicone oil 2. Protective film too thick 3. Vacuum chamber dirty	1.Replace with high-purity silicone oil 2.Reduce silicone oil injection amount or shorten coating time 3.Clean the vacuum chamber

Silicone oil pipeline leakage	1.Aging of sealing components 2.Loose pipeline connection	1. Inspect and replace the sealing components 2. Tighten the stainless steel pipeline fittings

2.General Vacuum System Faults

Fault Symptom	Possible Causes	Inspection & Troubleshooting
Roughing valve cannot open	Chamber door not closed; high-vacuum valve not closed; backing valve not closed; abnormal air pressure; vent valve not closed	Check door closure; limit switches; air pressure; close vent valve
Backing valve cannot open	Roughing valve not closed; abnormal air pressure; Roots pump not started	Check roughing valve limit switch; air pressure; start Roots pump
High-vacuum valve cannot open	Door not closed; roughing valve not closed; vent valve not closed; backing valve not open; low vacuum signal not reached; abnormal air pressure	Check closures; open backing valve; check vacuum signal; air pressure
Vent valve cannot open	Roughing/high-vacuum/backing valves not closed; Roots pump not off; abnormal air pressure	Check limit switches; close pumps; check air pressure
Diffusion pump cannot start	Abnormal water flow; vacuum gauge off; vacuum not reached	Check water flow; turn on gauge; wait for proper vacuum
Machine alarms	Insufficient water/air pressure; electron gun cabinet power off	Check pressures; turn on cabinet power

⚠**NOTE:**When the above faults occur, if all conditions have been checked and are normal but the equipment still fails to work properly, then the power supply circuits of each actuating device should be checked against the system's electrical schematic diagram to identify any faults and eliminate them one by one.

3.Workpiece Rotation System

Fault Symptom	Possible Causes	Inspection & Troubleshooting
Workpiece plate not rotating	Mechanical jam; motor damage; inverter parameter error	Adjust drive; check motor; reset inverter
Unstable speed	Unbalanced drive; inverter error	Balance drive; initialize inverter
Too fast acceleration	Short acceleration time	Increase acceleration time
Too fast deceleration	Short deceleration time	Increase deceleration time

4.Resistance Evaporation System

Fault Symptom	**Possible Causes**	**Inspection & Troubleshooting**
No output	Load open; power regulator failure	Check the load and crimping condition Check if the power supply of the power controller is normal. Check if there is a fixed voltage of around DC9V on the terminals (4) and (7) of the circuit board connector of the power controller, and check if there is an adjustable voltage of around DCO~9V on the terminals (6) and (7) of the circuit board connector of the power controller. Observe if the alarm indicator lights "IH" and "TH" on the circuit board are activated. If they are on, the output will be blocked. Check if the short-circuit wire between terminals (7) and (8) on the circuit board is open. An open circuit will block the output.
Insufficient power	Load mismatch	Check load
Circuit breaker trips	Load short; regulator failure	Check insulation; replace regulator

5. Ion Cleaning System

Fault Symptom	Possible Causes	Inspection & Troubleshooting
The cathode has voltage but no current.	Filament contact failure and breakage The filament has burned out.	Check the filament connection screws Check the connection wires, etc. Replace the filament
The cathode has current but no voltage.	Filament short circuit	Check the filament and connection wires, etc.
The cathode has no voltage and no current.	Cathode power supply failure	Replace the cathode power supply
The cathode's two sets of filaments are both lit simultaneously.t	Cathode power supply failure	Replace the cathode power supply or install only one filament.
The anode has voltage but no current.	The vacuum degree of the vacuum chamber is too high, and the cathode current is too small.	Reduce the vacuum level, increase the gas filling volume Increase the cathode current
High anode current and low voltage	The vacuum degree of the vacuum chamber is too low and the cathode current is too large.	Increase the vacuum level and reduce the charging volume Reduce the cathode current
The anode has no voltage, but there is current.	Anode short circuit	Check for any short circuits in the anode emission head and the input socket.
The anode has no voltage and no current.	Anode power supply is damaged.	Replace the anode power supply

5.Common Coating Defects:

▲Film black/yellow

1. Low vacuum level

(1) System leakage (conduct leak detection on the system, identify and fix the leakage points);
(2) The high vacuum valve is not fully opened (check the gas pressure in the pipeline and the valve piston, ensure the valve is properly opened);
(3) The inner wall of the vacuum chamber or the workpiece rack has an excessively thick film layer, and the adsorbed gas (regularly clean the vacuum chamber and the workpiece rack to remove the adhered film layer)

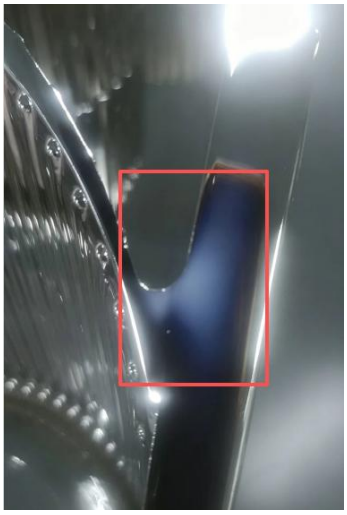
2. Return of diffusion pump oil (replace the diffusion pump oil or check if the oil baffle is deformed);

3. Excessive evaporation time (Optimize the coating process by appropriately shortening the evaporation time or reducing the evaporation current to prevent excessive heat accumulation)

4. Parameter adjustments (The voltage and time need to be coordinated and adjusted to the appropriate parameters)

(1) High voltage and long time will turn yellow.
(2) Low voltage and short time will turn black.

▲Product appears bluish or hazy



1. Silicone oil flow rate is too high, leading to uneven ionization (reduce the silicone oil flow rate and adjust the appropriate bombardment current).
2. Unstable vacuum degree (pay attention to the vacuum tracking speed to keep the vacuum within a certain range).
3. The coating layer is too thin (increase the amount of aluminum wire).

▲ The pumping cycle lengthens and the vacuum level fluctuates significantly:

1.The slide valve pump is not functioning properly (check the pump oil);
2. Leakage (checking the sealing ring);
3. The diffusion pump is not functioning properly (check the operation of the diffusion pump);
4. The inner wall coating of the vacuum chamber is too thick (remove the coating);

▲The film layer becomes thinner:

1.The amount of aluminum wire is too little (increase the amount of aluminum wire appropriately);
2. The steam generation current is low (increase the current);

▲ Return of oil for mechanical pumps and slide valve pumps:
1.Motor reversal (by swapping the two-phase power lines);
2. Excessive oil quantity (reduce the oil pump output);

▲ Beeper alarm:

1.The water pressure is insufficient (check the water pressure);
2. Pressure controller failure (Check the pressure controller);
3. Enter the "Alarm Display" interface on the touch screen to view the relevant alarm information.

▲ The motor is not rotating:

1.The circuit breaker trips (check the line and then shut off the circuit breaker);
2. Improper operation of the contactor (check or replace)

▲ The steam generation current does not rise:

1.Evaporator transformer failure (check the transformer);
2. Electrode input contact failure (Check the input electrodes);

▲The evaporation current is large while the coating material cannot be completely evaporated:

1.Insufficient insulation between the electrodes (cleaning or replacement of the insulation material is necessary);
2. Evaporator transformer failure (repair or replacement of the evaporator transformer);
▲ Severe oil return from the diffusion pump:

1. Excessive oil volume / Degraded oil quality
2. Poor vacuum in the backing, insufficient cooling, or damaged baffle cover.

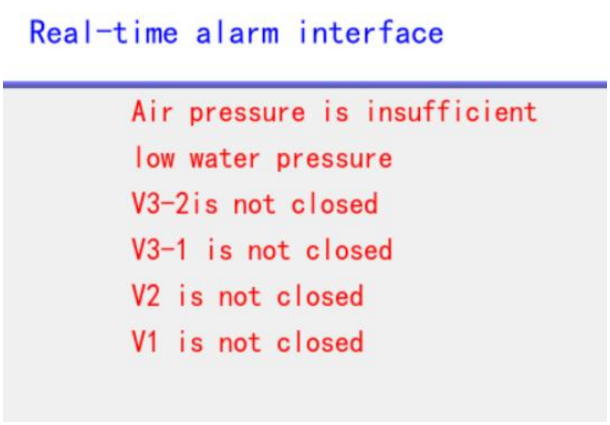
▲ Touch screen/software not responding:

1. Communication failure, software freezes.
2. PLC malfunction or power supply issue.

▲ The pneumatic valve is not operating:

1.Insufficient air pressure (increased pressure);
2. Are the electric control valve and related components malfunctioning (check the electric control valve and the pipeline)?

▲ Real-time alarm interface

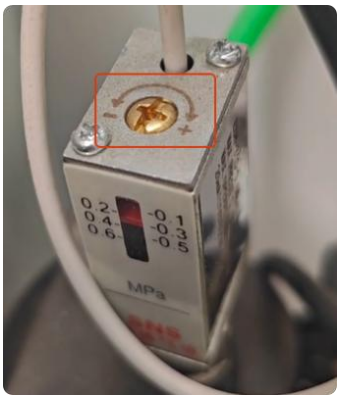


1.When the alarm page appears indicating insufficient air pressure:

(1) Check the air source pressure
(2) Confirm whether the air compressor is operating normally
(3) Adjust the hexagon screw, move it upwards to reduce the pressure, and move it downwards to increase the pressure

2. When the alarm page shows "Insufficient water pressure":

(1) Check the water supply pressure
(2) Check if the water pipe is blocked
(3) Confirm if the water pump is operating normally
(4) Adjust the hexagon screw; turn it upwards to reduce the pressure, and turn it downwards to increase the pressure



3. When the alarm page appears and the main valve 2 is not fully closed:

(1) Check if the magnetic control wire is damaged or if it has shifted position.
(2) Check if the cylinder is damaged.

4. When the alarm page appears and the main valve 1 is not fully closed:

(1) Check if the magnetic control wire is damaged or if it has shifted position.
(2) Check if the cylinder is damaged.

5. When the alarm page appears indicating that the valve has not been fully closed:

(1) Check if the magnetic control wire is damaged or if it has shifted position.
(2) Check if the cylinder is damaged.

6. When the alarm page appears indicating that the valve is not fully closed:

(1) Check if the magnetic control wire is damaged or if it has shifted position.
(2) Check if the cylinder is faulty.

★ Special Safety Reminder:

(1) Before the diffusion pump starts working, the cooling water must be connected and the maintenance pump must be turned on. The vacuum degree must be higher than 1×10^{1} Pa.
(2) The Roots pump operates under the designed conditions. Any modification of the parameters during long-term operation (such as inlet pressure, inlet temperature, and the ratio of the Roots pump to the preceding pump) may result in an unacceptable heat load. If the increased temperature cannot be resolved by appropriate compensation measures, it may damage the Roots pump or the preceding pump. The pump is not allowed to be refilled or drained when in a vacuum or operating state.

(3) To avoid motor overload, do not start the coarse suction pump more than 6 times within an hour. If necessary, control the start and stop by the inlet valve to maintain continuous operation.
(4) The main unit and power cabinet must be strictly connected to the grounding wire. Non-professionals are not allowed to open the power cabinet during work to prevent electric shock.
(5) Keep the power cabinet well ventilated.
(6) All running pumps must not be maintained or cleaned to avoid any danger.

Chapter 9 List of Main Parts and Consumables

▲Silicone Oil Consumption and Refilling

Silicone oil is a consumable process material and should be refilled regularly according to the production frequency. It is recommended to use the special silicone oil recommended by Chicheng (the formulation has been optimized for the CCZK- PL). Before using other brands of silicone oil, their suitability must be verified through process validation.

The silicone oil storage device is equipped with a liquid level observation window to facilitate daily inspection.

▲High- Frequency Consumables (Must Stock)

1.Tungsten / molybdenum evaporation boats
2.Chamber door vacuum silicone seals
3.Mechanical pump / diffusion pump vacuum oil
4.Water filter elements, air fittings, pneumatic seals
5.Evaporation electrode insulation sleeves, copper terminals

▲Medium- Term Wear Parts

1.Vacuum gauges, ionization gauge probes
2.Baffle cylinders, solenoid valves
3.Drive belts, bearings, high- temp grease
4.Thermocouples, temperature sensors

▲Core Key Spare Parts

1.Diffusion pump components, Roots pump end covers
2.PLC module, touchscreen parts, control boards
3.High- power evaporation power supply assembly

Note： For the replacement of vulnerable parts, only original equipment manufacturer or compatible parts of the same specification should be used to avoid damaging the equipment. When replacing the parts, power should be cut off, water supply should be stopped, and gas should be released to restore normal pressure. The operation should be carried out strictly in accordance with the operating procedures to prevent safety accidents.

Chapter 10 After- Sales Service and Technical Support

Thank you for choosing our company's products! Please make sure to use this equipment strictly in accordance with the instructions. Correct operation, maintenance and care can keep the equipment in good condition, ensure safety during use, and bring you greater economic benefits.

To ensure product quality and operational safety, the CCZK-PL equipment has fully passed the EU CE certification and the ISO international quality management system certification. The equipment warranty period is one year. We provide high-quality, competitively priced spare parts and wear parts over the long term, as well as excellent service beyond the warranty period.**
CICEL has established a complete customer information file, and promptly tracks the operation and maintenance status of the customer's equipment to effectively ensure the normal operation of the equipment. Damage caused by improper use or other non-faults of the equipment itself is not covered by the warranty, and spare parts are also not included in the repair scope. The warranty period starts from the date when the equipment is completed with the debugging.

If there are any other details that you are interested in but are not clearly explained in this manual, please feel free to contact us at any time.

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