Guangzhou Xieyi Automation Technology Co.LTD

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Customer Instruction Manual

WVCP SERIES FAST CYCLE WATER VAPOUR CRYOPUMP

For vacuum chamber applications

Serial # _____

Model	Single Output	□WVCP 550	□WVCP 2600	□WVCP 3000	□WVCP 3600	□WVCP 4200	□WVCP 6000
	Dual Output	□WVCP 550D	□WVCP 2600D	□WVCP 3000D	□WVCP 3600D	□WVCP 4200D	□WVCP 6000D

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1 Preface

Overview

This part description of WVCP series products were briefly reviewed, according to its characteristic, subsystem, operation and specifications as well as some security prevention.

1.1 General safety precautions

Read this manual before any operation of the WVCP series fast cycle water vapor cryopump.

General safety precautions MUST be followed at any time.

⚠WARNING

GENERAL HAZARD

Not reading this manual can cause death or serious injury. Read this manual before proceeding with any operating procedures.

⚠ CAUTION

CARRYING TILTING HAZARD

This device has a higher center of gravity, and incorrect handling can cause the device to tilt, which can lead to serious bodily injury or even death. When moving the device, please make the forklift fully enter the device in the forklift and then move the device.

⚠ CAUTION

LIFTING HAZARD

The device is equipped with rings, and incorrect hoisting will cause serious bodily injury and even death. Please use 4 suspenders to carry the device. The lifting belt must have the minimum safe lifting strength. Angle between condole belt should not be greater than 60 ° to 30 ° best. The device shall not be in the air when hoisting. Please confirm whether the lifting ring and the sling are fastened before hoisting.

⚠ CAUTION

FRACTURE HARZARD

This device can be dangerous in high temperature or fire environment and can cause personal injury or even death. It is forbidden to place the device in more than 50 ° C environment.

⚠ CAUTION

CHEMICAL HAZARD

Do not release refrigerant into the atmosphere, it is carried out by certified refrigeration engineer. These operations include the installation, inspection, disassembly of cold media connections, fault diagnosis and maintenance of the cryopump. All refrigeration operations must be performed by qualified engineers.

Note: the installation or maintenance of this device must comply with the relevant requirements of the local state.

⚠ CAUTION

ELECTRICAL

All electrical work must be carried out by qualified electrical engineers or risk death or serious injury accidents. All electrical work must be performed by qualified electrical engineers.

DANGER

OPERATION AND SETTING VALUE

Do not ignore or change the setting value of any protective device. Resetting the Settings of the protective device will invalidate the warranty and cause death or serious injury. Read this guide book before proceeding with any procedure. The protective device shall be reset only in accordance with the provisions of this manual.

Particular Risk and Method Of Avoid.

The refrigeration unit (or installed steam cryopump) containing gas pressure.

CAUTION

A cold trap coil that meets the prescribed conditions can only be connected to the WVCP series of cryopumps, or it may cause minor or moderate personal injury and device damage. For more information, see 3.5 deep cold interfaces and cryogenic cold and hot bridge specifications.

CAUTION

EXTREME TEMPERATURE EXIST

Extreme temperatures (cold or heat) are present in the refrigeration unit and at least one hour after the cooling unit is turned off. Contact with cold or hot surfaces may cause mild or moderate damage.

When operating in a refrigeration unit, do not touch any of its un-insulated parts, including solenoid valves and manual valves, any insulated parts of the cold or cryogenic cooling Bridges, and deep cold interfaces. Also do not extend your hand into the WVCP cryopump.

⚠ CAUTION

Moving the refrigerant line or relocating it may cause minor or moderate damage. Don't try to move the cold media or position it. In low temperature, the heat insulation will harden and may crack.

Refrigerant Leakage

⚠ CAUTION

CHEMICAL HAZARDS

Do not release refrigerant into the atmosphere. Opening the refrigerant circuit or changing the set value of the valve and not following the instructions in the manual may cause death or serious injury accidents.
Read this manual for any WVCP cryopump operation. Do not release refrigerant into the atmosphere.

1. Please follow the MSDS guidelines for all leaks, especially if the leaks are serious.
2. For the leakage of the refrigerant line or cryosurface, if the leakage is not serious, please limit the leakage of the refrigerant. Please follow 8.2 how to disassemble the cold - media.

Electrical Problems

⚠ CAUTION

ELECTRICAL HAZARD

Contact may cause shock and death or serious injury. There is still line voltage on the input end of the power disconnect switch after the power disconnect switch is put up. Disconnect the power supply from the power supply to the end user.

1. Stop the WVCP system.
2. Beat the WVCP system power rotation switch to OFF position.
3. When necessary, cut off and lock the front power supply of the WVCP system.

1.2 WVCP equipment model description

WVCP 4200-S H W-A 1 N L

Whether to choose with LOGO： 0=yes Logo (default with Logo)

L=no Logo

Noise reduction selection：0= No noise reduction is required（default mode）

N= **noise reduction is required**

Temperature feedback output signal：

0=no feedback signal（default mode）

1=voltage feedback，0---10V or -2V---+2V，switchover，corresponding to -200℃—+200℃

2= current feedback，4---20 ma corresponding to -200℃—+200℃

Remote control power mode：

A= Active, use cryogenic power supply feedback signal, voltage DC 24V

B= Passive, use customer to provide common points, cryogenic provide contacts (default mode)

C= Compatible with Polycold control mode

Load interface： P=Parker interface

V= Swagelok VCR interface

W= Welding interface

The rated voltage： H= High voltage (voltage 400V, range 342-460)

L= Low voltage (voltage 220V, range 180-230)

Type of load output： S= Single

D=double

T= triple

Refrigerating capacity： 550=550W

2600=2600W

3000=3000W

3600=3600W

4200=4200W

6000=6000W

Equipment series classification： WVCP=WVCP **series**

XC=XC **series**

Note:

1, such as the example of the equipment model: WVCP series, cooling capacity of 4200W, load output for a single high voltage, connection mode for welding, remote line interface for active control, analog output voltage, MODBUS communication, without LOGO, noise reduction processing.

2. The last four items of the model shall be optionally added according to customer needs. If not, it shall be carried out in the default mode, that is, no analog output feedback, no communication, no noise reduction, and Logo.

1.3 WVCP System description and application

The WVCP Fast Cycle Water Vapor Cryopump is a cryogenic refrigeration system, which can make the volatile molecules condense at the low temperature surface, thus achieving the purpose of capturing volatile molecules. The system includes a cooling unit, a refrigerant line, and a cryosurface with cryogenic feedthrough. The cooling unit can be used to make the cold or high temperature refrigerant flow through the refrigerant line and cryosurface through the suction and exhaust of the compressor.

The basic application of WVCP system is to capture water vapor in a vacuum chamber after opening the high vacuum valve. In this purpose, the cryosurface is usually a coil. This coil can quickly cool and defrost, consistent with the operating cycle of the vacuum chamber. See Figure 1-1.

The WVCP system can also be used to control the return oil. See Figure 1-2. In this use, the cryosurface is usually a cold trap. The term "rapid operation cycle" means the conversion between cooling and defrosting, which is usually not required or required.

Note: Backsteaming will contaminate the system because it is the process of hot vapor migrating and condensing on cold surfaces. When the vacuum pump is used, the pump oil heats up and travels opposite of pumping direction and condenses the system resulting in system contamination.

The WVCP system has two sets of two sets and one set of refrigerant circuits. Each set of refrigerant circuits works for a single cryosurface. Both cryosurfaces can be quickly defrosted.

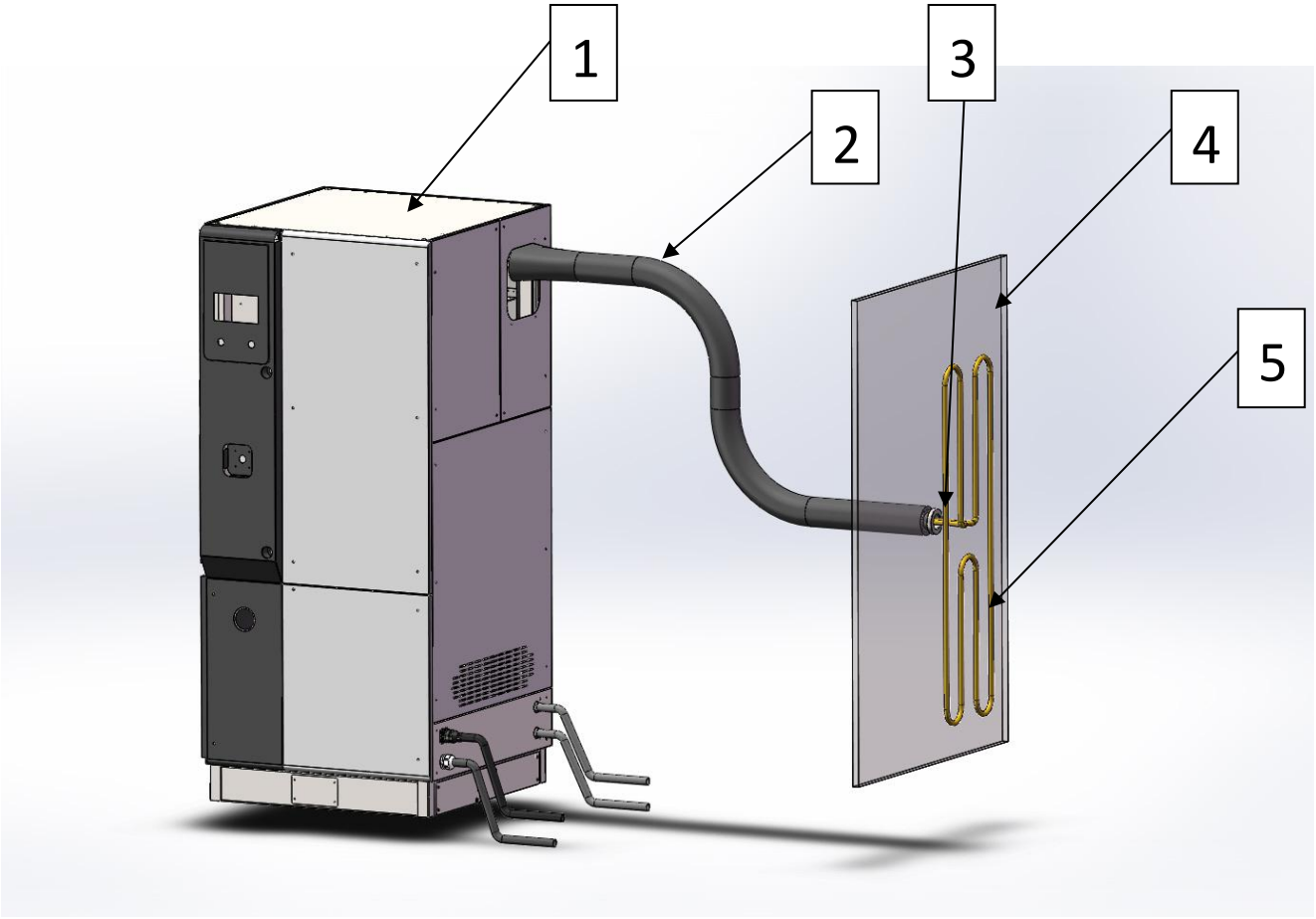


Figure 1-1. WVCP cryopump-primary application

1. Refrigeration unit
2. Refrigerant pipe
3. Cold bridge
4. Vacuum chamber wall
5. Cold trap

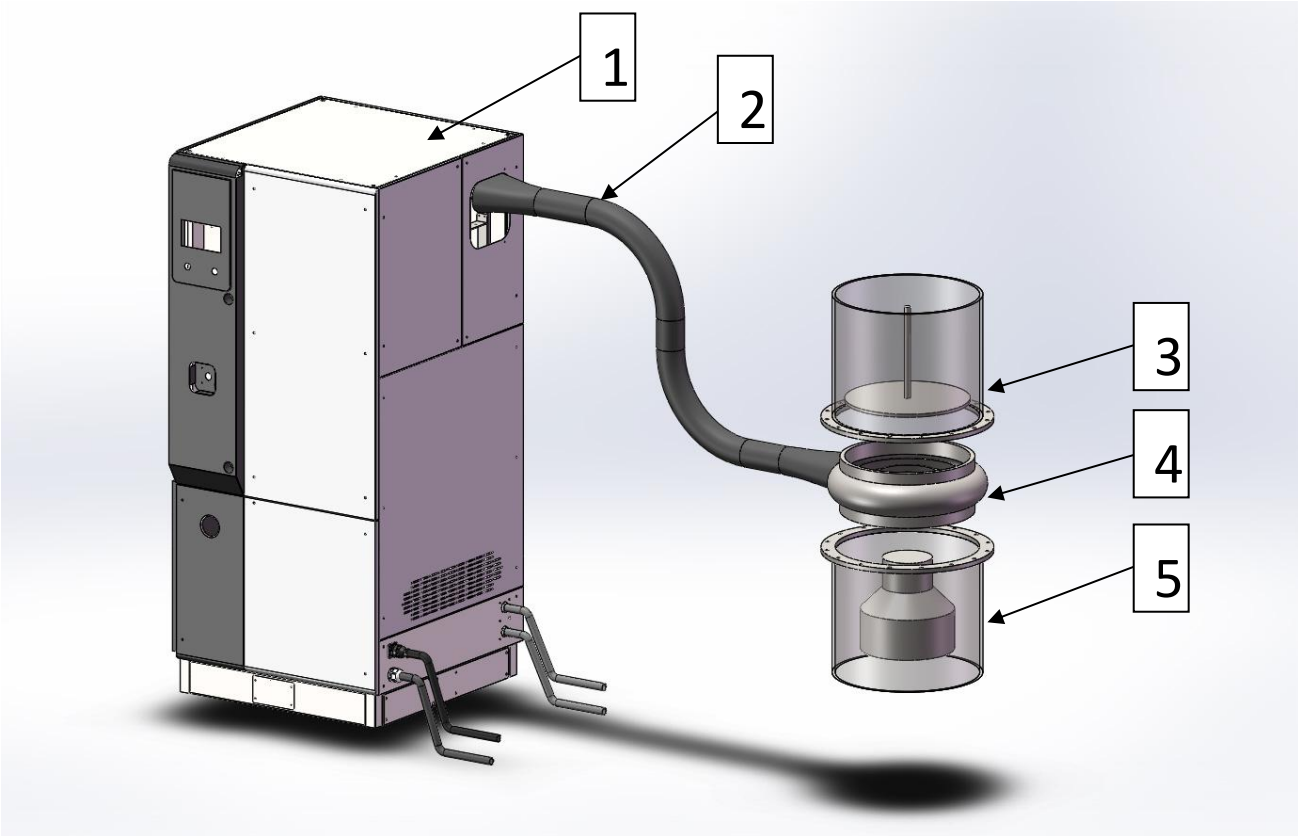


Figure 1-2. WVCP cryopump- secondary application

1. Refrigeration unit
2. Refrigerant pipe
3. High vacuum valve
4. Cold trap
5. High vacuum pump

1.4 The external features of the WVCP refrigeration unit

See Figures 1-3 and Figure 1-4:

1. The man-machine operation panel
2. WVCP system alarm lamp
3. Compressor start/stop button switch (with light)
4. The total power switch WVCP system
5. WVCP system balance pressure gauge
6. WVCP system first refrigerant feed interface
7. WVCP system first refrigerant return interface
8. WVCP cooling water system output interface
9. WVCP cooling water input interface
10. WVCP system remote control signal joint
11. Total power supply hole of WVCP system

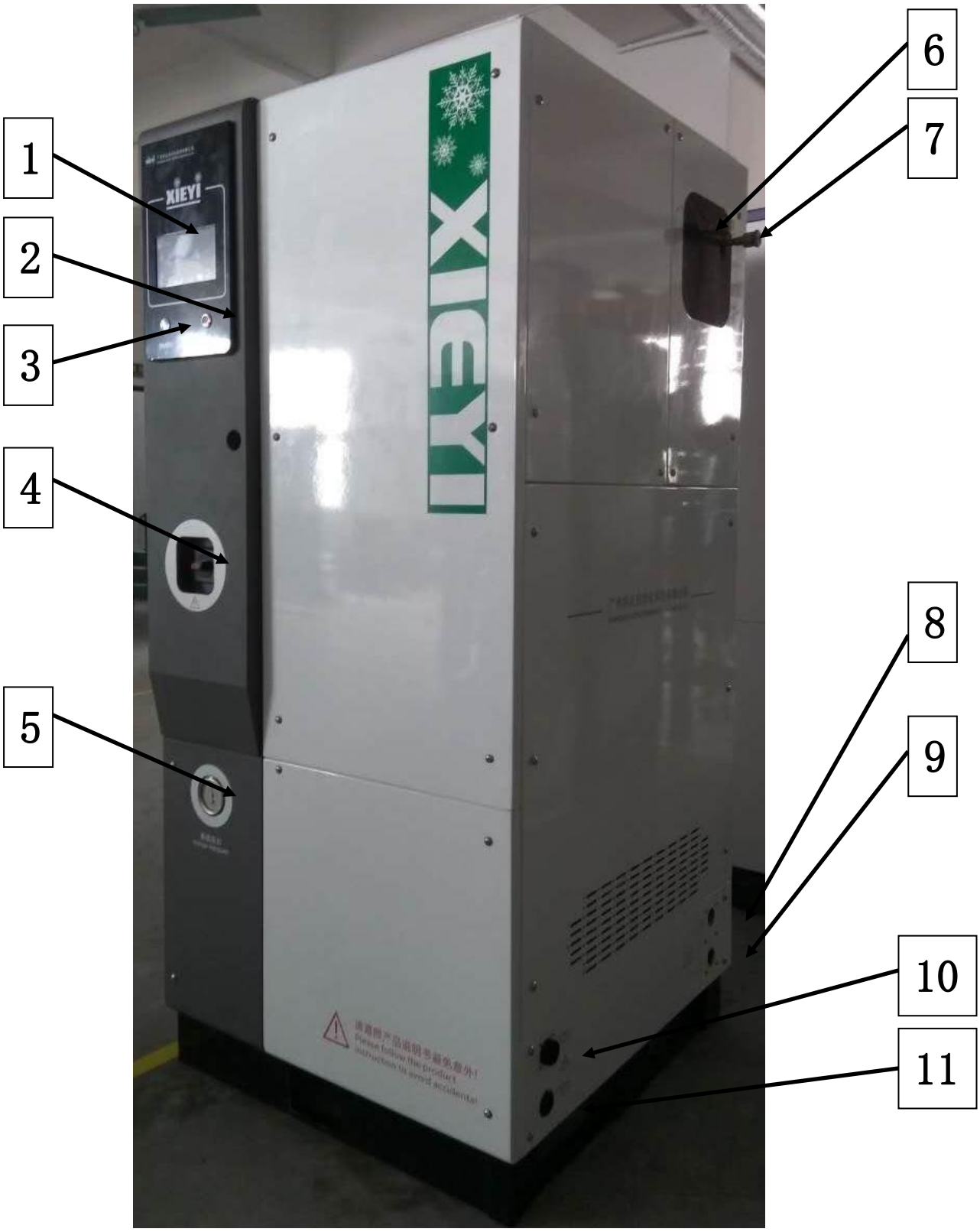


Figure 1-3. WVCP Features

1.5 The position of the isolation valve and the solenoid valve

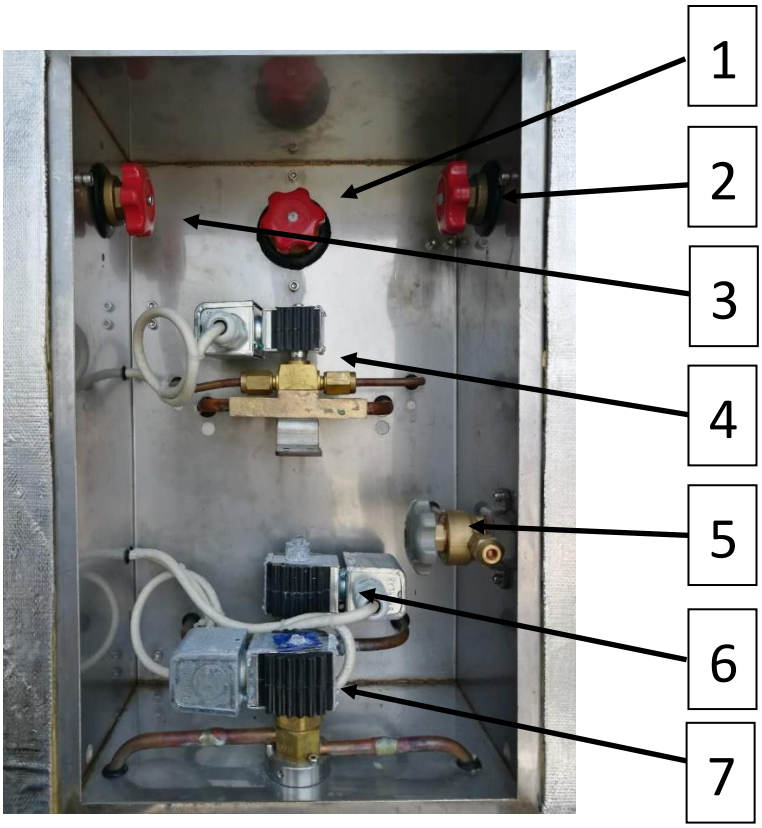


Figure 1-4. Position of isolation valve and solenoid valve in the valve box

Description:

1. The backflow isolation valve
2. Refrigeration isolation valve
3. Defrost isolation valve
4. Refrigeration solenoid valve
5. Maintenance isolation valve
6. Balance solenoid valve
7. Discharge pressure solenoid valve

1.6 The dimension data of the cooling unit

See Figure 1-5 Dimension.

Refrigeration unit	**Dimensions/** Width * depth * height (mm)	**Weight or Mass** (kg)	**Maximum sound pressure level** dB(A)
WVCP550/WVCP550D	700*750*1530	200	70
WVCP2600/WVCP2600D	935*873*1809	540	72
WVCP3000/WVCP3000D	935*873*1809	525	72
WVCP3600/WVCP3600D	935*873*1809	525	72
WVCP4200/WVCP4200D	935*873*1809	505	72
WVCP6000/WVCP6000D	1138 x 805 x 1780	740	80
The maximum sound pressure: Units were tested in a manufacturing environment while under the cooling mode and the maximum load for the above device. Measurements were made on each side of the device at distance of 1.6m and a height of 1.6m. The measured values on each side of the device do not vary significantly. However, for the different noise backgrounds when the device was placed, the measured value will change.			

Figure 1-5. Dimensions

1.7 Suggest stock spares

Description	Part number
WVCP550 Refrigerant	XY-RF-0001
WVCP2600 Refrigerant	XY-RF-0002
WVCP3000 Refrigerant	XY-RF-0003
WVCP3600 Refrigerant	XY-RF-0004
WVCP4200 Refrigerant	XY-RF-0005
WVCP6000 Refrigerant	XY-RF-0006
Duct tape for piping insulation (Armaflex elastic insulation)	XY-3001
Adhesive for piping insulation (for glue of Armaflex insulation)	XY-3002
Sheet metal used for piping insulation (foam panel, a smooth surface for insulation layer)	XY-3003
O ring seal removal tool	XY-0200
O-rings	XY-1008
sealing washer	XY-1007
Refrigeration solenoid valve XUJ copper seal washer	XY-0913
Refrigeration solenoid valve (XUJ)	XY-0912
Defrost solenoid valve (E6)	XY-0915
Buffer solenoid valve (E9)	XY-0915
Compressor oil LT32 (5L)	XY-0209
Compressor	XY-0210
Compressor exhaust valve seal gasket	XY-0213
Seal gasket of compressor suction valve	XY-0212
Dry filter (Used for WVCP2600/ WVCP3000/ WVCP3600/ WVCP4200/WVCP6000)	XY-0206
Exhaust temperature switch to 145 ℃	XY-5001
T-type thermocouple wire The cross-sectional area is 0.50 mm squared	XY-0203

2 Safety Information

Overview

This chapter describes the safety guidelines of WVCP water vapor cryopump. All personnel involved in the operation or maintenance of these products should be familiar with the safety precautions stated in this chapter.

Note: These safety recommendations are the most basic guidelines. We should also follow the national and international security regulations.

2.1 How to prevent security risk

The WVCP has been designed to conform to all known safety requirements applicable to our products. Under normal operation the WVCP presents no hazard to its operator or other personnel. Access panels require tools for their removal, thus shielding operators and other personnel working in the area of the device from the operation or possible failure of the components of the WVCP.

Only qualified service personnel are authorized to open or remove the panels and must work in accordance with the safety instructions presented in this chapter and throughout this manual. In service and repair operations, the following hazards may exist:

- Electrical shock
- Hazardous Materials
- Lifting Hazards
- Cold Surfaces
- Hot Surfaces

The information and instructions provided in this chapter and throughout this manual are intended to help service personnel work with the device in a safe, effective, and efficient manner. The emergency and safety procedures are provided to help service personnel develop safe practices and establish safe conditions for working with the WVCP.

Xieyi Automation assesses the safety of each product we manufacture. The safety issues generated during the WVCP assessment are discussed in this manual. The complete Safety Analysis is available upon request.

Only qualified personnel are permitted to transport, assemble, operate, or maintain the WVCP. Properly qualified personnel are those who have received certified training and have the appropriate qualifications for their jobs, according to local standards.

2.2 Interpretation of warnings of danger, warning and attention

Warning contents of danger, warning and caution are an integral part of this manual:

- Danger is used to indicate a hazardous situation that will occur immediately, if not avoided, will result in death or serious injury.
- Warning is used to indicate a potentially hazardous situation, if not avoided, could result in death or serious injury.
- Caution is used to indicate a potentially hazardous situation, if not avoided, could result in a minor or moderate injury.
- Caution is also used to indicate that device can be damaged if relevant guidelines or safety precautions are not followed.

Danger, Warning, and Caution alerts must be read carefully, understood thoroughly, and followed them at all times. If this device is used in a manner not specified by the manufacturer, the protective measures of the device may be failed. Pictorial hazard alerts follow the format shown in Figure 2-1.

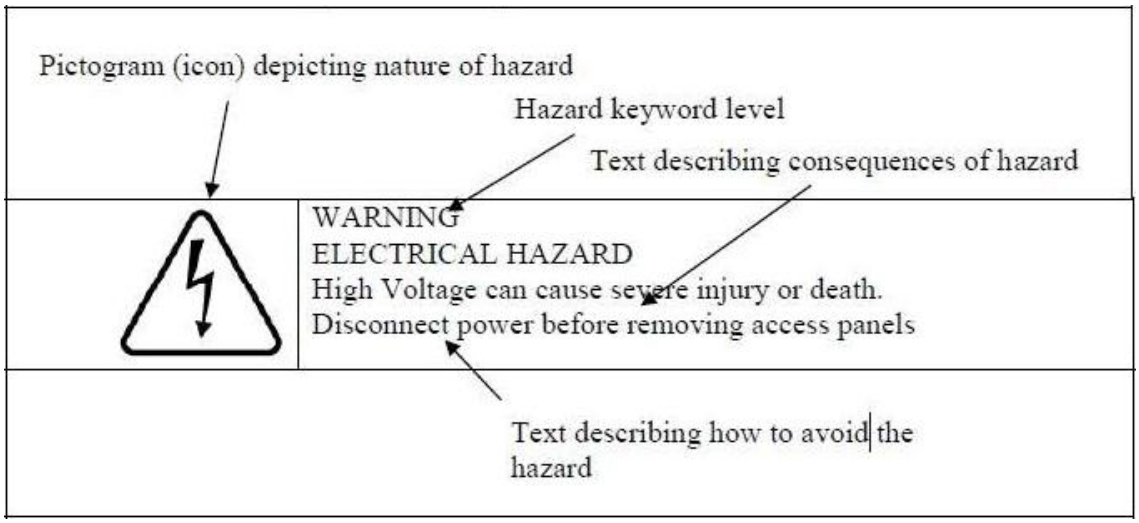


Figure 2-1. Pictorial hazard alerts

Table 2-1. Legend of warning label

Warning Label Legend	Description	Safety Warning Sign
Danger	White Triangle / Red Background	Yellow background black triangle black eWVCPlamation point
Warning	Black Triangle / Orange Background	Yellow background black triangle black eWVCPlamation point
Caution	Black Triangle / Yellow Background	Yellow background black triangle black eWVCPlamation point

This page lists the presentation graphics used on the device. Some of these graphics can be found on WVCP super cryogenic rapid cycle water vapor cryopump.

2.3 Safety training guidance

The safety information is summarized in this chapter, which is required to be taken as part of the relevant training for maintenance personnel of WVCP super cryogenic rapid circle water vapor cryopump. The training content shall ensure that the personnel responsible for maintaining the WVCP super cryogenic rapid circle water vapor cryopump can be performed safely. Therefore, the training content includes but is not limited to the following:

- Read up on applicable safety standards and procedures, such as those listed in this chapter.
- Study carefully the applicable maintenance and safety recommendations of the device provided by the supplier.
- Explain the subsystem and the purpose of its operation.
- Explain their specific tasks and responsibilities to each person (operator, maintainer, etc.) assigned to work on the rapid cycle water vapor cryopump.
- The person who should be contacted (name, location, and phone number) when the work required later goes beyond what the trainer has been trained to do and the scope of responsibility.
- Identify identified hazards associated with each job description.
- Identify abnormal operating conditions and learn how to respond appropriately.
- The functions, limitations and design features of all safety protection devices are explained.
- How to conduct functional testing (or other checks) on safety protection device in normal operation

For the safe use and maintenance of the rapid cycle vapor cryopump device, the following are also required:

- Maintenance personnel should be aware of process-related hardware interlocking operations, as well as the automated hardware operation procedures explained in this chapter.
- Do not use this device without confirming that all other connected devices are operating normally.
- During maintenance, the maintenance personnel will personally cut off the power supply and lock the power off switch.

- Do not operate the device until all protective and safety facilities are in place.
- During the maintenance of the device, the device shall be closed and locked, and shall not be operated.
- The user shall not attempt to disable, forbidden, or modify the safety interlock switch of the device.
- Only the personnel trained by Guangzhou Xieyi automation technology co., LTD can install, assemble, operate, disassemble, repair or maintain the rapid cycle water vapor cryopump.
- The user shall carefully read and understand the Material Safety Data Sheets (MSDS) provided by the manufacturer for the materials used in the device.
- All electrical operations must comply with electrical safety management procedures.

2.4 The following hazards may exist during maintenance and repair

See Figure 2-2

The left anterior strabismus The right posterior strabismus

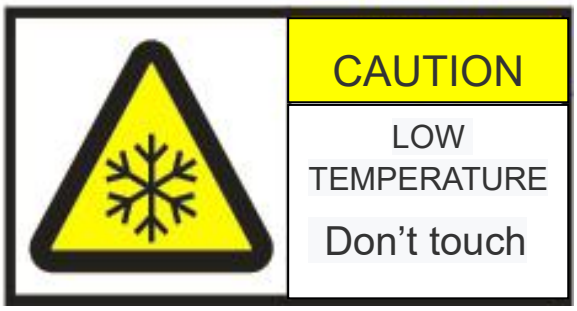
Figure 2-2. Safety Labels on the WVCP550(D)/2600(D)/3000(D)/3600(D)/4200(D)/6000(D)

1. When the system is pressurized, the valve is in the pressurized state.

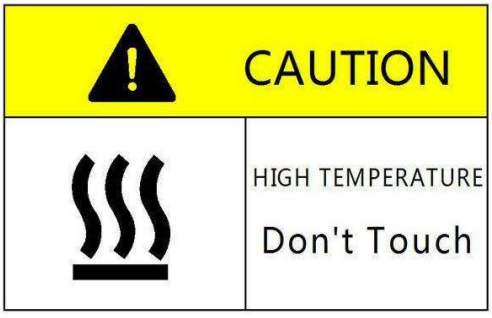
CAUTION!
When the system is pressurized, the valve is in the pressurized state.

2. The valve must remain open.

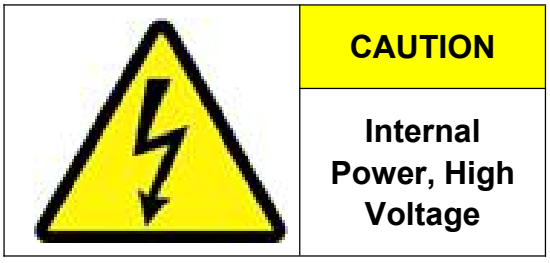
3. Extremely cold inside, contact can cause frostbite.



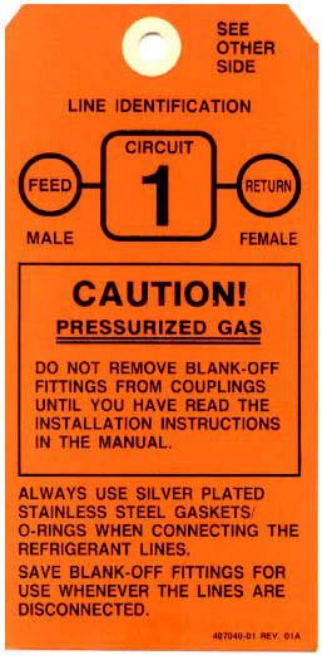
4. High temperature inside, contact can cause burns.

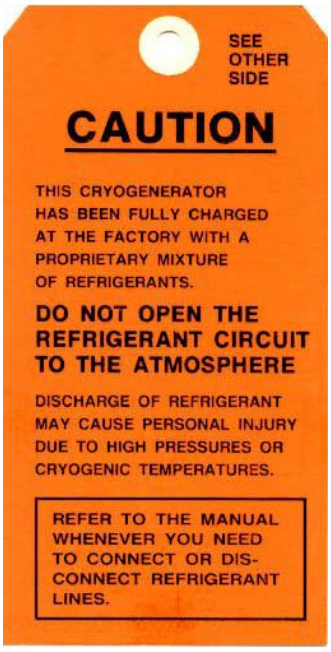


5. There's electricity inside. Be careful.

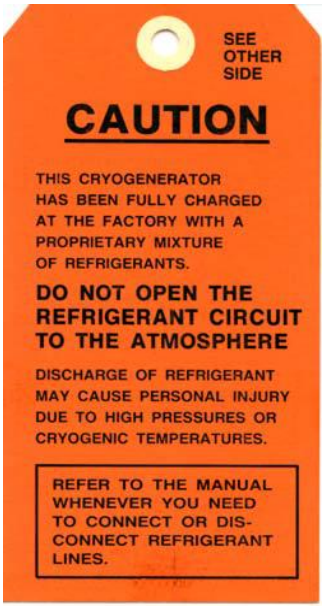


6. Pipeline identification A





7. Pipeline identification B



2.5 Lock-out and tag-out instructions

Note: the power supply chain listing is to cut off the power supply of the system to avoid the possibility personnel electrocution.

⚠Warning

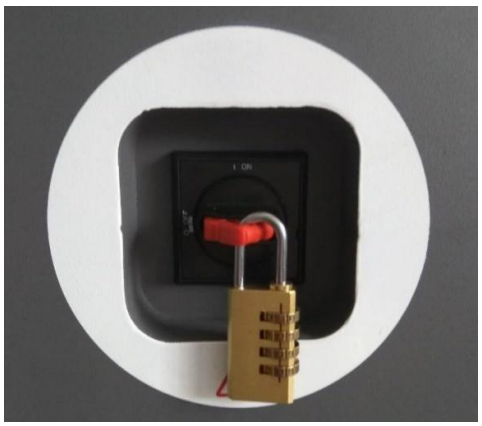
ELECTRICAL HAZARD

Contact may cause shock and death or serious injury. The line voltage is still present on the input end of the power disconnect switch after the power disconnect switch is put up.

Disconnect the power supply from the power supply to the end user.

1. According to section 7.1, if the low temperature cryopump is down and the transportation device part is described, the water vapor cryopump is shut down.
2. Switch the power OFF switch (see figure below) to the OFF location.
3. Unplug the red lock on the switch (shown below right) and hang a padlock on the opening to keep the power cut off and lock the lock.
4. Use a perfectly normal test pen or a multimeter to make sure that there is no electric potential on the secondary side of the power disconnect switch.
5. You can now safely do your homework in this area. Electrical safety management procedures must be used in electrical operation.

Unlocked(left)



Locked(right)

Figure 2-4. Power cut OFF switch in OFF position

3 Installation

Overview

This chapter provides the complete installation procedure of WVCP series super cryogenic water vapor cryopump products, including: unpacking, assembling, connecting with other device, initial debugging and initial inspection.

3.1 How to install the cryosurface

3.1.1 If the cryosurface is a coil

Need the tools and materials of following：

- Spanner wrench
- standard ¢50 mm feed-through
- high vacuum lubricant - must be low volume (as optional material, used for feed-through's O sealing ring)

The content of this section is to assume that the customer purchases a standard ¢50 mm feed-through from Guangzhou Xieyi Automation Technology co., LTD., If it is not purchased from Guangzhou Xieyi, please refer to the 3.5 depth and cold thermal bridge specifications, and then proceed with installation.

⚠CAUTION

GENARAL HAZARD

Do not use this device connected to the existing cryosurface, without first verifying that the cryosurface meet specification. The pressure of the water vapor cryopump may eWVCPeed the working pressure of the cryosurface which will damages the parts of the vacuum system and may cause minor or moderate damage. (Reservoir cryosurface is not suitable.)

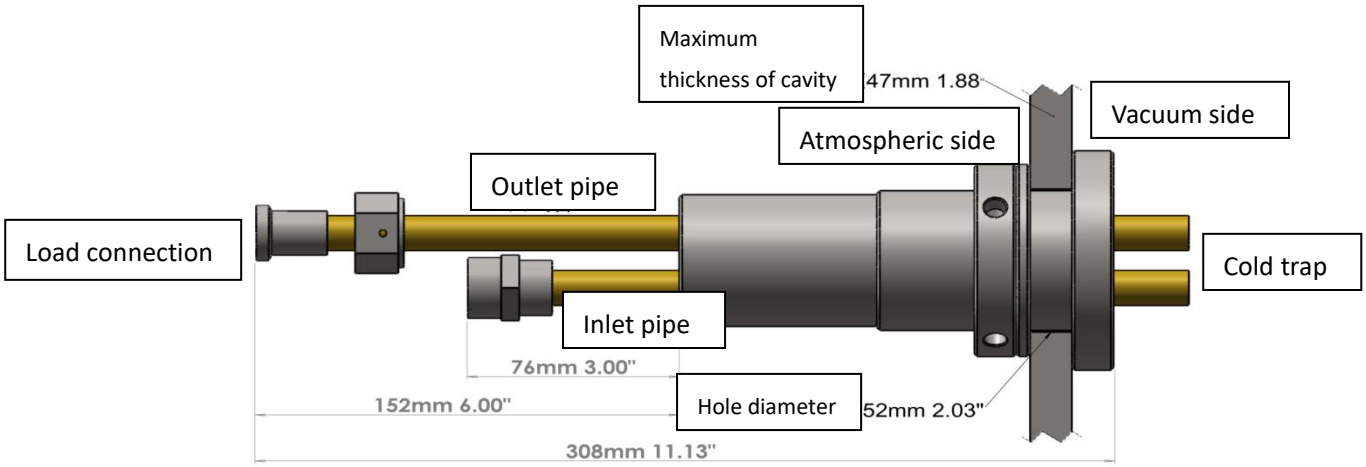
Before connecting, please confirm that all the parts meet the specifications.

3.1.1.1 Confirm that the installation hole of the feedthrough is matched

Check the wall thickness, diameter and sealing surface of the mounting hole of the feedthrough. Ensure that the mounting hole matches the cryogenic feedthrough. (see

figure 3-1 below.)

Note: The standard feedthrough is designed to be installed from the vacuum chamber. When cleaning or repairing the vacuum chamber, the cryocoil can be removed.



Note: the material is SUS304

Figure 3-1. Standard ¢50mm feedthrough

Type O sealing ring specifications: 57 mm (inner diameter) * 3 mm ¢¢type

O sealing ring material: fluorine rubber type

O sealing ring surface must be smooth, clean and no scratches or fouling

3.1.1.2 Put the cryocoil into the vacuum chamber

1. Put the feedthrough into the installation hole of the vacuum chamber. Tighten the feedthrough nut with the hand and position the cryocoil. If the cryocoil comes with fasteners, tighten the fastener.
2. Make sure no moving parts touch the cryocoil. Determine that the crypcoil will not touch any other parts of the vacuum chamber wall or vacuum chamber. The distance between the cryocoil tube and the vacuum chamber wall should be at least 16mm.
3. Screw the feedthrough nuts with a wrench. Determine that the nut has been tightened. If the nut is loose, the o-ring seal will be removed from the vacuum chamber in a vacuum.
4. If the cryocoil directly in the face of more than 50℃ heat source, you should install a radiation shielding device. This radiation shielding device is placed between the cryocoil and the heat source, and the radiation shielding device should be as close

as possible to the heat source, as far as possible from the cryocoil. When the cryocoil can maximize view the various parts of the vacuum chamber, the water molecules in vacuum chamber can be captured most effectively.

3.1.1.3 Check the vacuum chamber from leak

Use the helium leak detector to check the feedthrough port and the sealing ring that is used to install the cryocoil to ensure that the vacuum chamber is not leaking.

3.1.2 If the cryosurface is a baffle

Tools and materials needed:

- High vacuum lubricants - must have low air discharge (as optional materials for vacuum O-type seal seals)

Note: the content of this section is to assume that a cryobaffle is purchased from Guangzhou Xieyi Automation Technology co., LTD. If not, please refer to section 3.5 cryosurface and feedthrogh specifications, and then proceed with installation.

<table>
<tr><td rowspan="2">  </td><td>⚠CAUTION</td></tr>
<tr><td>GENERAL HAZARD
Do not connect the device to the existing cryosurface before determining whether the existing cryogenic interface meets the specifications. The working pressure of the cryopump may exceed the working pressure of the cryosurface, which can damage the parts of the vacuum system and may cause minor or moderate damage. (Reservoir type cryosurface is not suitable.)
Before connecting, please confirm that all the parts meet the specifications</td></tr>
</table>

3.1.2.1 Check all vacuum sealing covers

The cover must be clean, no scratches or any other defects that can cause a vacuum leak. These sealing covers should be protected at all times. If you have any contaminants, use a clean cloth to wipe with alcohol.

3.1.2.2 Fixed the cryobaffle

If the cryobaffle is a Polycold “CB” type, carefully center it between the flange boltholes to assure a good O-ring seal.

3.1.2.3 Determine that the crypbaffle is isolated from the heat source

1. Cryosurface should be kept away from any more than 50 ℃ heat radiation source.
2. Ensure that no part of the cryobaffle is in direct contact with the vacuum chamber.

3.1.2.4 Check the vacuum chamber for leaks

Use the helium leak detector to check the feedthrough port and the sealing ring that is used to install the cryobaffle to ensure that the vacuum chamber is not leaking.

3.2 How to install the refrigeration unit

3.2.1 Check the refrigeration unit

⚠CAUTION

HIGH PRESSURE BURST

If the high-pressure circuit breaks, the device can be damaged. In addition, flying objects can cause cuts and eye injuries, and can even cause death or serious injury.

Read this manual before proceeding with any operating procedures. The refrigerant circuit and the entire unit should be checked before proceeding.

3.2.1.1 Check all items received

If there is any reason to suspect that an object is damaged in transit, please inform the transport company immediately. If you have any questions about the items received, please contact Guangzhou Xieyi Automation Technology co., LTD. Spare parts are usually shipped together with the refrigeration unit.

3.2.1.2 Check the balance pressure of the refrigeration unit

Record the pressure value on the pressure gauge locate the operating panel of WVCP device.

Balance pressure of refrigeration unit: _____ psi

The balance pressure of the refrigeration unit should be within a reasonable range. (see table 3-1). If not within the reasonable scope, contact Guangzhou Xieyi Automation Technology co., LTD. for help.

Note: some refrigeration units cannot be transported with refrigerant charged in them.

If the refrigeration unit is not filled with refrigerant, it will receive a separate

package of refrigerant and a guide document.

Table 3-1. Acceptable balance pressure of refrigeration units

Refrigeration unit	Acceptable balance pressure psi
WVCP550	150-220
WVCP2600	180-220
WVCP3000	180-220
WVCP3600	180-220
WVCP4200	180-245
WVCP6000	180-245

Note:

These pressure values only apply to refrigeration units. After installing the refrigeration line and the cryosurface and opening the isolation valve, the balance pressure may be reduced by 5-10 psi.

Balance pressure refers to the pressure of the cooling unit when the refrigerating unit stops and the temperature is fully heated up. This is a balance of pressure on both ends of the compressor (suction side and outlet). In the running state (when the compressor is running normally), the unit of refrigeration will produce a pressure difference between the two ends of the compressor.

3.2.2 Locate the refrigeration unit

Tools and materials needed

- Forklift
- Two 17mm wrenches
- Phillips screwdriver

⚠WARNING

TIPOVER

If the method of promotion is inappropriate, it may cause death or serious injury. Use the forklift slot to properly lift the device.

3.2.3 Place the refrigeration unit

See figure 3-2

1. The refrigeration unit shall be installed in an environment that meets the following conditions:
   - Indoor
   - Above ground
   - A well-ventilated area
   - Room temperature is between 5 to 40 ℃
   - Relative humidity is 20-80%, no condensation

	**⚠DANGER** **HIGH PRESSURE BURST** If WVCP system storage temperature is above 5℃, could cause system balance pressure too high lead to piping and vessel rupture or burst. Flying objects can cause cuts and eye injuries, and can even cause death or serious injury. Read this manual before proceeding with any operating procedures. Do not place the unit in the region of the environmental temperature is higher than 50℃.

2. The refrigeration unit must remain upright. But the refrigeration unit can be placed at any height relative to the cryosurface. The water vapor cryopump system is insensitive to gravity.

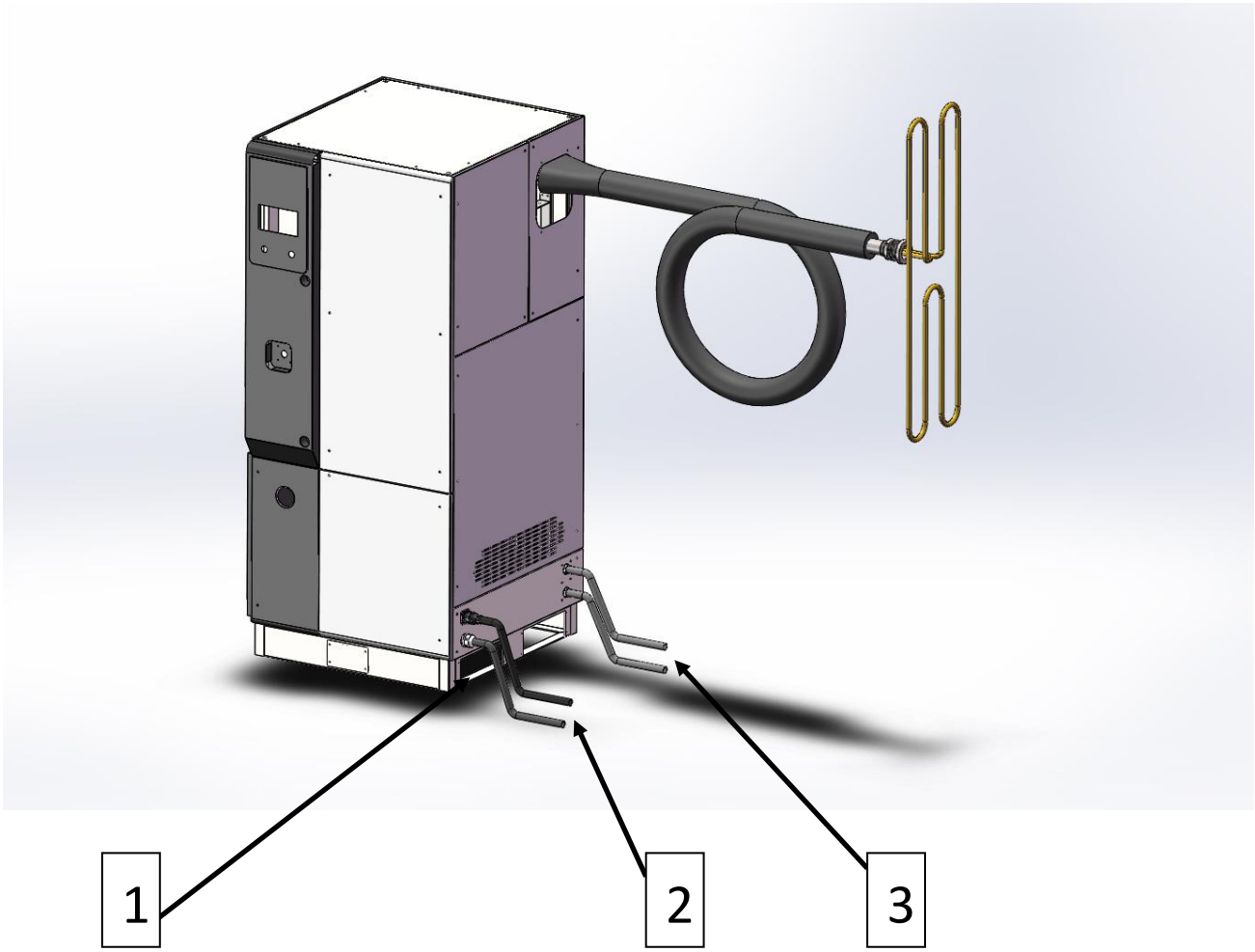


Figure 3-2. Refrigeration unit placement

1. Forklift slots
2. Electrical supply port
3. The cooling water connection

3. The minimum space requirements for inspection and maintenance are as follows (see figure 3-3):

- In front of 1000 mm
- Top, back and right of 500 mm
- The left side is 500 mm

4. Standard refrigerant tube length is about 2.4m. Its minimum bending radius is 300mm.

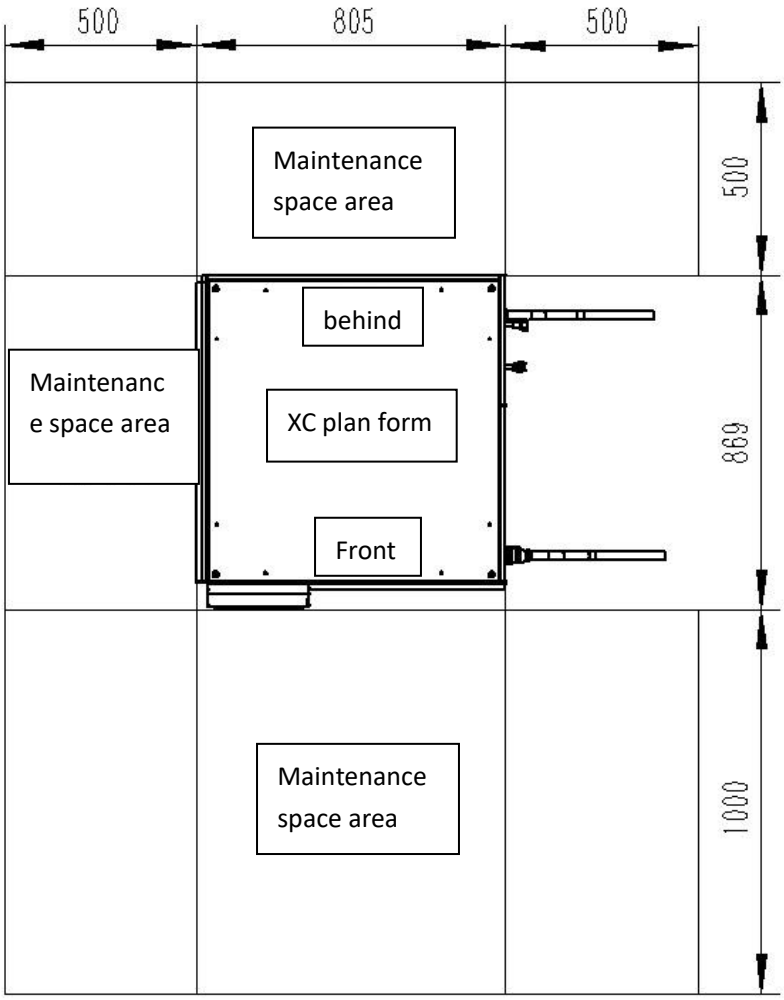


Figure 3-3. WVCP footprint

- The WVCP system needs to set aside a space of 500mm in the back, with a space of 1000mm in front. In order to be able to access the switches, setting up and safety requirements.

- If the cooling unit is installed in a narrow space, it will slow down service and maintenance. Therefore, we recommend that when installation of refrigeration unit, as long as the device conditions permit, should leave as much as possible maintenance space.

- Multiple refrigeration units can be placed side by side, but public Spaces need to be set aside for maintenance.

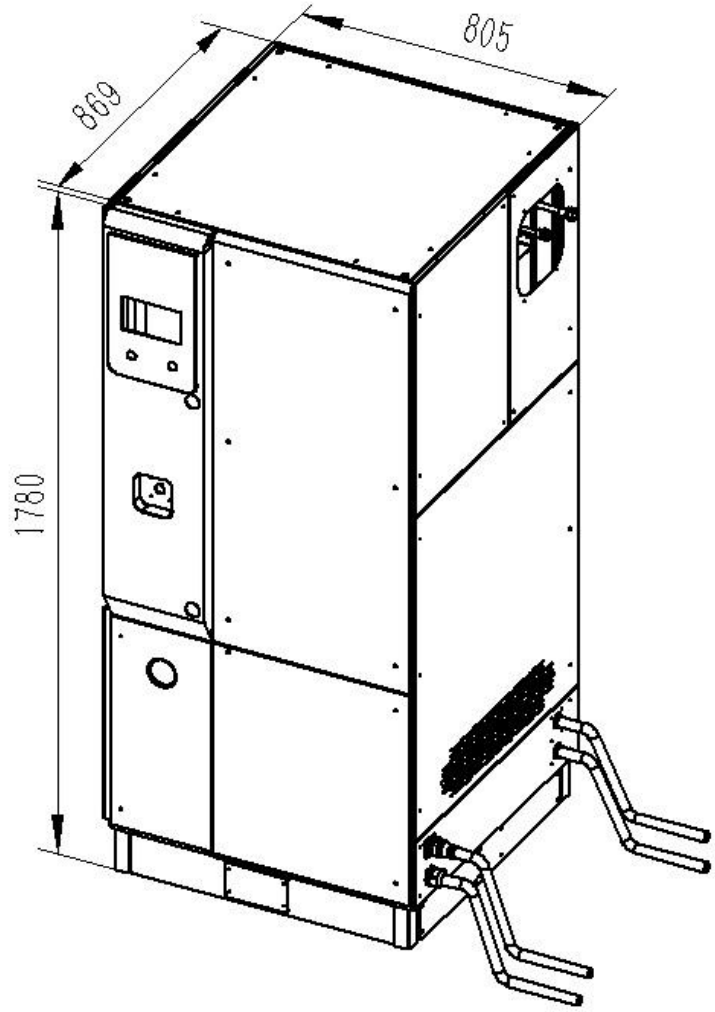


Figure 3-4. WVCP/550/2600/3000/3600/4200/6000 dimensions

Table 3-2. External dimension of each type

Refrigeration Unit	A	B	C
WVCP550/WVCP550D	600	720	1450
WVCP2600/WVCP2600D	805	869	1780
WVCP3000/WVCP3000D	805	869	1780
WVCP3600/WVCP3600D	805	869	1780
WVCP4200/WVCP4200D	805	869	1780
WVCP6000/WVCP6000D	805	1130	1780

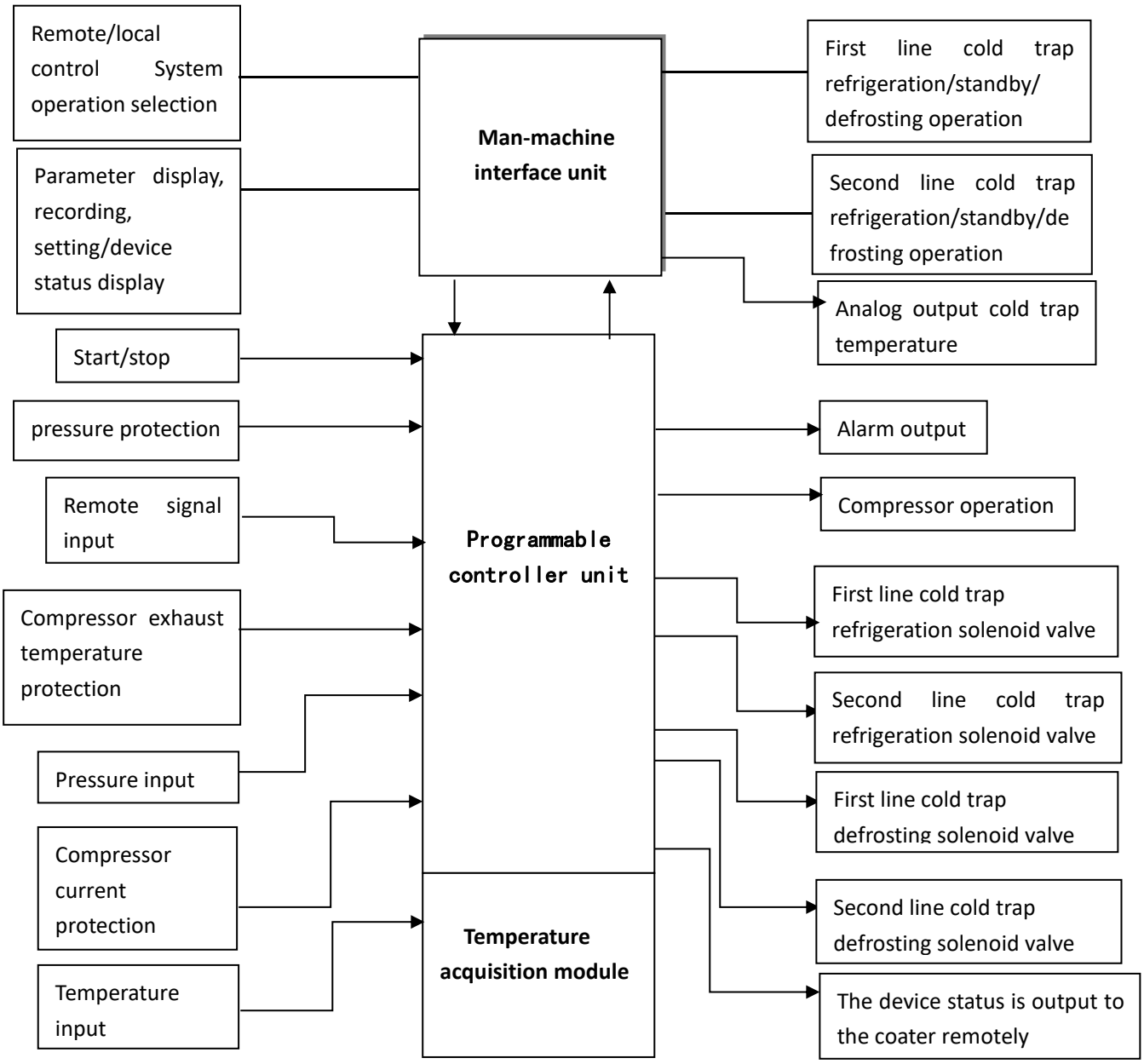


Figure 3-5. Electrical block diagram

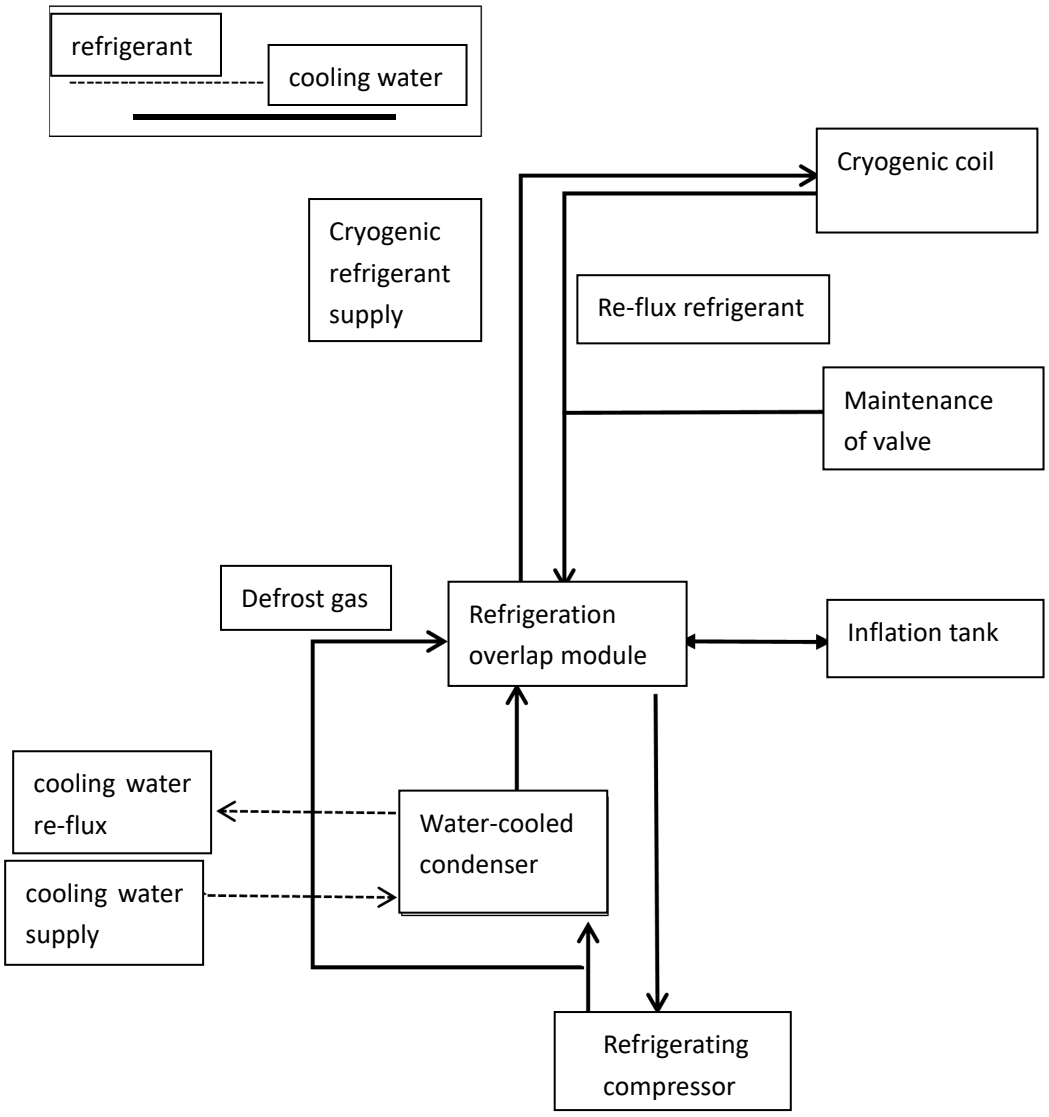


Figure 3-6. System block diagram

3.2.3.1 Remove compressor pressing nut

Remove the front panel and rear panel from the refrigeration unit. Use two 17mm ratchet wrenches to unload the compressor's compression nut (see figure 3-7). Keep these nuts, and the next time the cooling unit moves, you'll need to reinstall the nuts.

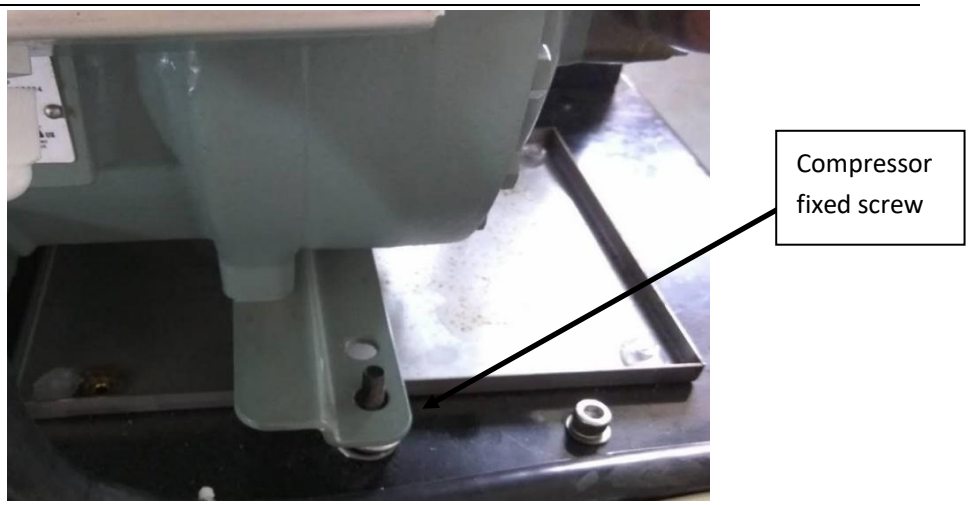


Figure 3-7. Position of compressor compression nut
Compressor compression nut (2 nuts in 4)

3.2.4 Connect the electrical power

Qualified electrical engineer, with tools and materials

	**⚠WARNING** **ELECTRICAL** Hazardous voltages exist. Failure to have a qualified electrician do all electrical work could result in death or serious injury. Make sure the electrical supply is not energized. Do not reach inside the refrigeration unit. A qualified electrician must do all electrical work. Electrical work must be completed according to local codes.

3.2.4.1 Check and protect the power supply

Check the nameplate of WVCP rapid cycle water vapor cryopump system. According to the mark on the nameplate, the power supply three-phase leakage switch and the connected power cable are selected.

Note:

1. The refrigeration unit should have a separate power supply. (see table 3-2: power supply and protection requirements.)
2. The power supply of the refrigeration unit must have good wiring.
3. The voltage between the branch and the branch must be in balance and not exceed 2 %.

Table 3-3. Power supply and protection requirements

Model	Compressor Voltage V	Voltage Range V	MCC (A)	RLA (A)	LRA (A)
WVCP550(D)-X-L	208/230	187-254	30.4	15.8	145.6
WVCP550(D)-X-H	400	342-460	13.5	7.7	51.5
WVCP2600(D)-X-L	208/230	187-254	55.5	35.6	198
WVCP2600(D)-X-H	400	342-460	27.8	17.8	77
WVCP3000(D)-X-L	208/230	187-254	62	39.7	191
WVCP3000(D)-X-H	400	342-460	31	22.1	86
WVCP3600(D)-X-L	208/230	187-254	62	39.7	191
WVCP3600(D)-X-H	400	342-460	31	22.1	86
WVCP4200(D)-X-L	208/230	187-254	62	39.7	191
WVCP4200(D)-X-H	400	342-460	31	22.1	86
WVCP6000(D)-X-L	208/230	187-254	108	90	345
WVCP6000(D)-X-H	400	342-460	54	45	173

Note: RLA is the current value of the compressor in the rated load, also known as the rated load value.

MCC is the maximum continuous running current, which is equal to or must not exceed the value when the current protection is selected.

Note: This numerical value can help the electrical engineer to determine the electrical system design.

LRA is the current of the block rotor. The current value of the compressor is used when the rotor is locked and the compressor cannot turn.

Note: The compressor has motor over-temperature protection.

3.2.4.2 Refrigeration unit connected to power supply (see figure 3-8)

⚠WARNING

ELECTRICAL HAZARD

Dangerous voltage. All electrical work must be carried out by qualified electrical engineers or risk death or serious injury accidents. Determine that the power supply has been cut off. Do not extend your hand into the refrigeration unit. All electrical work must be performed by qualified electrical engineers. Electrical work must be done in accordance with local regulations. You can only use copper wires.

1. Turn the power switch to the OFF position.
2. Unscrew the fastener and remove the high voltage box panel.
3. See table 3-3 and all local regulations to determine the appropriate type and size of wire. We need four conductors, each one of which needs the lead and the other way. You don't need a neutral line.
4. Grounding the refrigeration units according to local regulations. WVCP internal grounding bolt is located inside the high voltage box.
5. The three phase wires of the power line are connected to the terminals of L1, L2 and L3 respectively. Each terminal can choose any one of the wires to connect, and the compressor has no requirement on the phase. Tighten the cable lock to keep the wire in place.
6. Re-install the high voltage box panel. Make sure the panel and the box are sealed.

⚠CAUTION

GENERAL HAZARD

Do not open the refrigeration unit at this moment. otherwise the device will be damaged. The cooling water must be connected before the refrigeration unit is opened.

Figure 3-8. High voltage box electrical connection method

1. Amphenol joint
2. Terminals ground pile.
3. Power connection box
4. The power cord hole

Note: The power cord junction box is located on the right side of the device unit.

3.2.5 Connection cooling water

Required tools and materials:

For WVCP550(D)/WVCP2600(D)/WVCP3000(D)/3600(D)/4200(D)/6000(D) for internal diameter 20 mm standard size piping

⚠CAUTION

GENERAL HAZARD

If cooling water has not been connected, damage to the device can result.

Verify that cooling water has been connected before turning on the unit.

3.2.5.1 Ensure adequate cooling water

Measure inlet temperature. Must be between 15 to 33℃ temperature. Ensuring that the minimum velocity required to maintain the water temperature is sufficient. See table 3-3.

Note: the temperature of cooling water in summer is higher than that in winter.

The cooling water should be cleaned. If the cooling water is very dirty or has sand in it, it is recommended to filter the cooling water. Any chemical impurity in the cooling water must not corrode copper.

Table 3-4. Cooling water flow requirements

Model of refrigeration unit	water inlet temperature /℃	Minimum flow (L/min)
WVCP550	18(min)	8
	24	10
	29 (Max)	20
WVCP2600	18(min)	13
	24	20
	29 (Max)	40
WVCP3000/ WVCP 3600	18(min)	18
	24	27
	29(Max)	55
WVCP4200	18(min)	18
	24	27
	29 (Max)	55
WVCP6000	18(min)	26
	24	40
	29 (Max)	80

3.2.5.2 Connect the water supply line and the drain line to the refrigeration unit

Please use the correct pipeline, see the "required tools and materials" section at the beginning of this section. For WVCP2600/WVCP3600/4200 cooling water connection devices, there are G3/4 internal pipe threaded joints.

Connect the water supply line to the port marked with cooling water. Connect the backwater line to the port marked with cooling water. The cooling water must flow in this direction to cool the WVCP system unit. (see Figure 3-9).

3.2.5.3 estimate the correct flow rate

Ensure that the minimum flow rate is met. (see Table 3-3).

In order to determine the correct flow rate, when the refrigeration unit is in refrigeration, please check the temperature of the high-pressure refrigerant and the water outlet temperature.

Optional: pressure gauges can be installed in the cooling water supply and backwater line of refrigeration units to measure the pressure of cooling water. It is necessary to ensure that the pressure drop meets the requirements of the flow rate of the cooling water temperature.

Note: If the flowmeter of the rotor flowmeter is used, the flow resistance within the flowmeter will decrease the maximum actual flow value that can be achieved after the flowmeter is received into the pipeline.

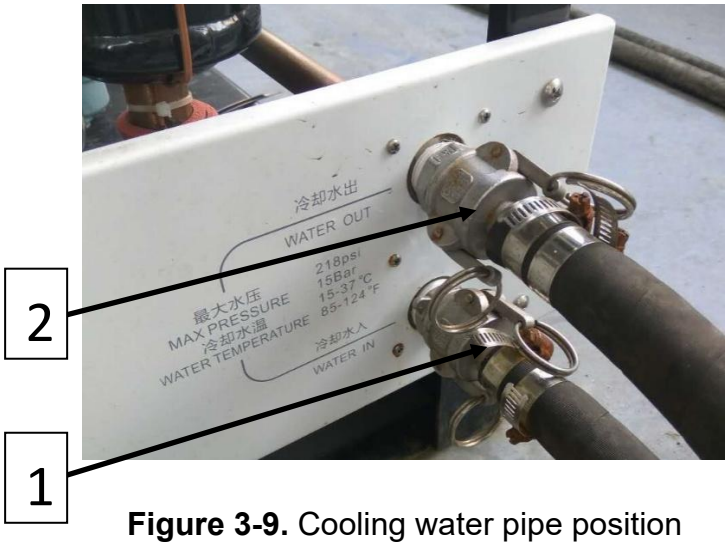


Figure 3-9. Cooling water pipe position

1. Input of cooling water 2. Cooling water reflux

3.3 How to connect the cryosurface with the refrigeration unit

⚠CAUTION

The information contained in this section is provided by engineers who have been trained and qualified for the installation of the rapid circulating water vapor cryopump. If you have not received any training in these installers, please contact the WVCP system factory or the maintenance representative in your area. If the product is not properly installed, it may result in a cold media leak or other problems that are not covered by the warranty.

3.3.1 Connect the refrigerant line

Required tools and materials:

- Stepladder
- Torque wrench (optional)
- Gas welding tool
- 5/8-inch tube expander. (welding interface)

For Parker CPI UltraSeal joint (standard accessories)：

- Silver-plated stainless steel o-type sealing ring
- 1-inch opening wrench
- 15/16-inch opening wrench

For the Swagelok VCR joint (optional accessories) :

- Silver-plated stainless steel seal gasket or non-plated nickel seal gasket
- 1-3/16-inch opening wrench
- 1-1/16-inch opening wrench

Note: this section assumes that the refrigerant line is purchased from Guangzhou Xieyi Automation Technology Co., LTD. If not, please refer to the refrigerant line specification in section 3.6 before connecting.

This section assumes that two sets of cold media circuits will be connected

simultaneously. Sometimes it may only be connected to a set of cold media. Therefore, the refrigerant mixture must be pumped back into the refrigerating unit before it is ready to connect the second set of cold media. (Because the two refrigerant circuits are both connected in the refrigeration unit.) See section 7.2 how to disassemble refrigerant line by step 1 and step 2 to learn more about the guide.

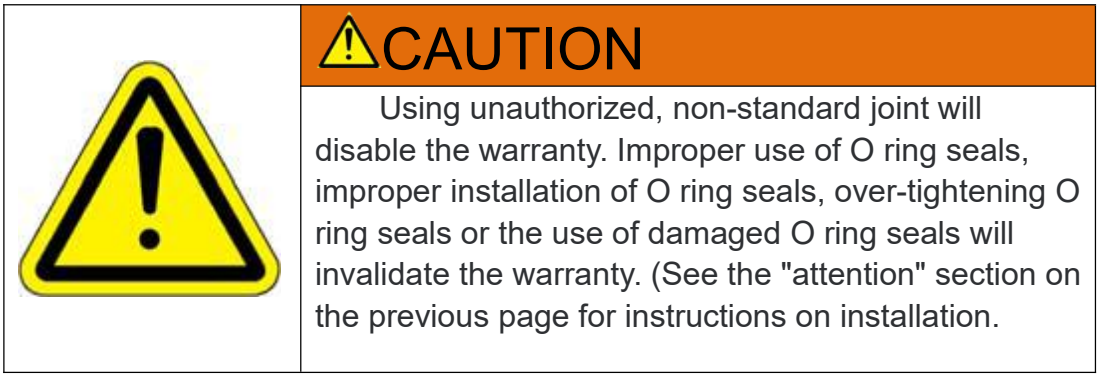
<table>
<tr><td>  </td><td>⚠CAUTION
GENERAL HAZARD
A leak point is usually a connection to an insecure connection. Internal leakage can cause damage to the device.
Use the new o-ring seal or seal washer every time you install the joint.
Do not use grease when installing joints. Lubricating oil can contaminate the system of collecting pump piping, and it will cover the leakage point during the leak detection process. At low temperature, the oil becomes brittle, resulting in leakage of the joint.
Pay attention to the protection of the joint not to allow the sealing surface to be scratched or dented.
O ring seals are used to remove O ring seals from Parker CPI UltraSeal joints. See 7.2 how to disassemble the step 4 of the cold-media section to learn more about the guide</td></tr>
</table>

3.3.1.1 Check joints

Remove any dirt or foreign material from the sealing surface. Determine that there are no scratches or dents in the sealing surface. (See figure 3-10 and figure 3-11). If the cover is damaged, please contact the WVCP factory or nearby seller.

For the welding connection, after cutting off the sealed weld before delivery, pay attention to check whether there is refrigerant blowing at the slit. If so, check the return valve, refrigeration valve and defrosting valve in the valve box to see whether they are completely closed, and make sure there is no leakage of refrigerant before operating the next step. The burr and chamfering of the cutting hole should be removed. During the operation, it is strictly prohibited to drop the cut copper slag into the connection pipe, so as to avoid the copper slag entering the system and causing system blockage.

Note: Welding interface is the standard connection mode of WVCP super cryogenic rapid cycle water vapor cryopump. It is recommended that customers choose this connection mode in preference to reduce the risk of system leakage. Parker CPI UltraSeal Joint and the Swagelok VCR Joint are selection components for customer.



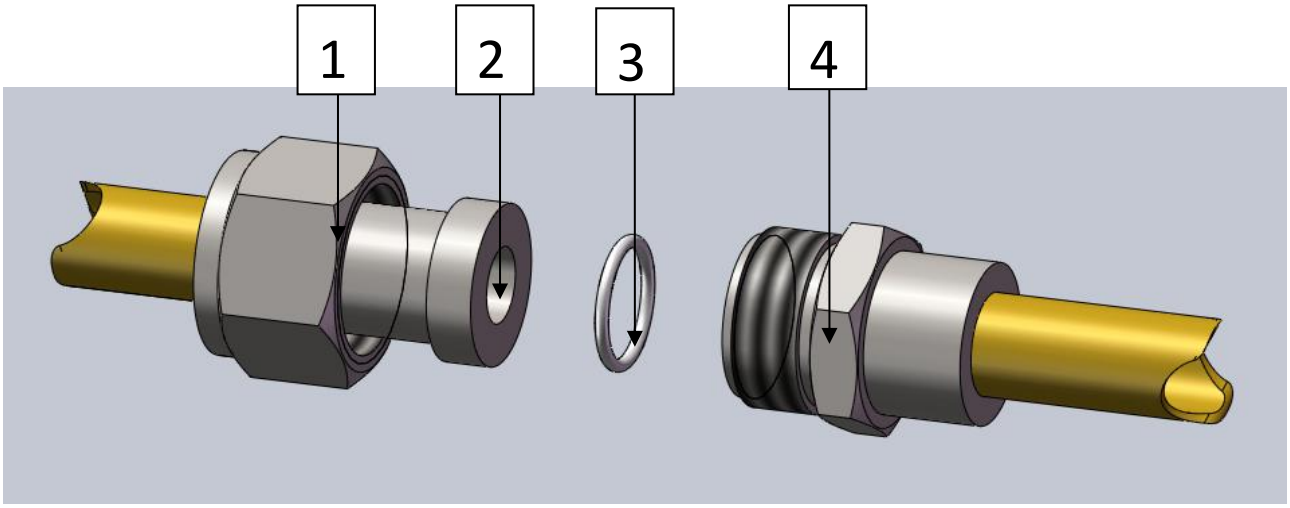


Figure 3-10. Parker CPI UltraSeal Joint (standard accessories)

1. Nut
2. Seal cartridge
3. Silver-plated stainless-steel o-type sealing ring
4. Pin end

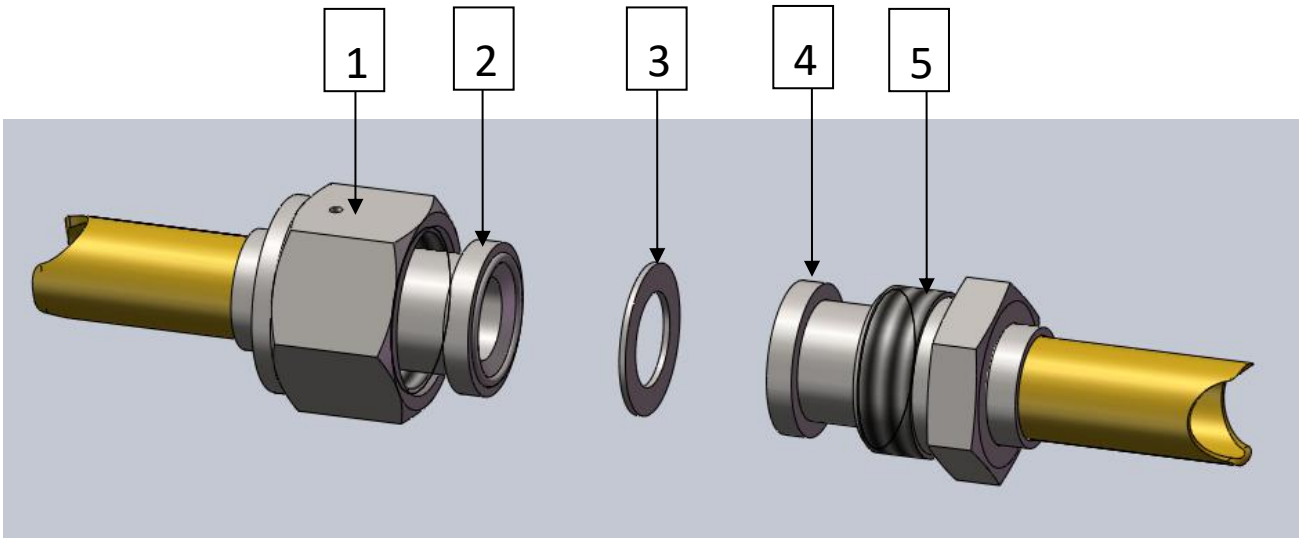


Figure 3-11. Swagelok VCR Joint (standard accessories)

1. Hexagon nut
2. Curved seal sleeve
3. Silver-plated stainless steel seal gasket or non-plated nickel seal gasket
4. Curved seal sleeve
5. Male connection

Note: In addition, welding connection is provided, which is more reliable than CPI/VCR joint in terms of leakage prevention and almost no leakage of welding joint.

3.3.2 Position the refrigerant tube

See Figure 3-12.

⚠CAUTION

Avoid leakage due to pipeline vibration. See section 3.3.2.4 to support the cold media and avoid the vibration of the pipeline.

Note: cold media tube is made of soft cooling copper tube with minimum bending radius of 300mm. Bend only once to fit the desired shape of the installation.

1. Bend the refrigerant line so that the joints reach the cooling unit (e.g., the output and return tube should have the same bending radius).

⚠CAUTION

GENERAL HAZARD

Don't repeat bent the refrigerant line many times. Do not distort the refrigerant line. Do not bend the pipeline at the end of the cold media pipe within a distance of 150 mm from the joint. Improper operation can cause damage to pipelines or device. The cold media should be operated cautiously.

2. Connect the refrigerant line connection to the cryosurface, and use the fingers to tighten the joint to the connecting line for initial positioning (See 3.2.1.2. Check the balance pressure part of the refrigeration unit).

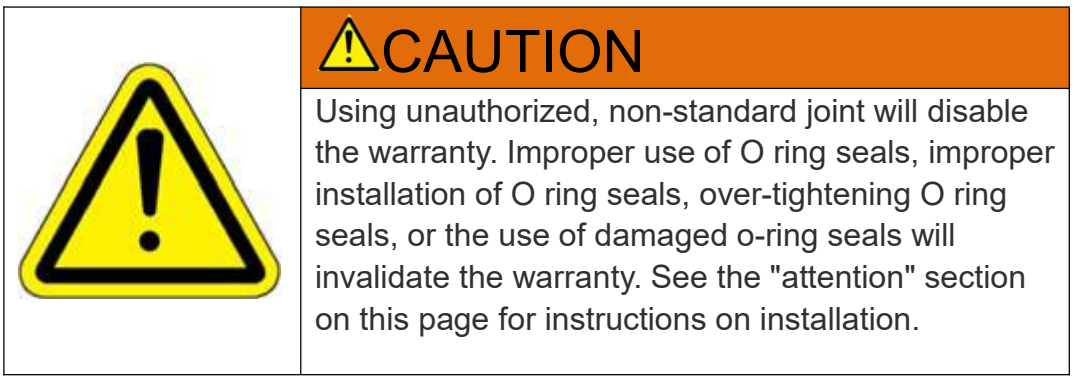
Note: For the two-channel circuit system, the top one is used for the first set of refrigeration circuits, and the following joint is used for the second circuit.

3.3.2.1 Connect the refrigerant line to the cryosurface

For Parker CPI UltraSeal joint (standard accessories)：Plug an O ring seal into the slot of the male joint. Tighten the o-ring seal and the male joint on another cover. Confirm O ring seals will not escape from the slot. Slide the nut forward and tighten the joint with your finger. Fix the male joint with a 15/16-inch wrench and tighten the nuts with a 1-inch wrench. Until the resistance suddenly increases and cannot continue fastening. In the fastening process, the metal O ring is pressed into the o-ring groove. Tighten each joint to 54-80 Nm torsion.

For the Swagelok VCR joint (optional accessories): Place a sealing gasket in the hexagon nut. Assemble the parts and tighten the joints with your fingers. Tighten each joint to 54-80 Nm with two wrenches.

Note: these accessories are connected and sealed based on mechanical displacement of threaded parts, resulting in compression of sealing surface. For users who need to determine the locking value, we provide a torque value.



⚠CAUTION

Using unauthorized, non-standard joint will disable the warranty. Improper use of O ring seals, improper installation of O ring seals, over-tightening O ring seals, or the use of damaged o-ring seals will invalidate the warranty. See the "attention" section on this page for instructions on installation.

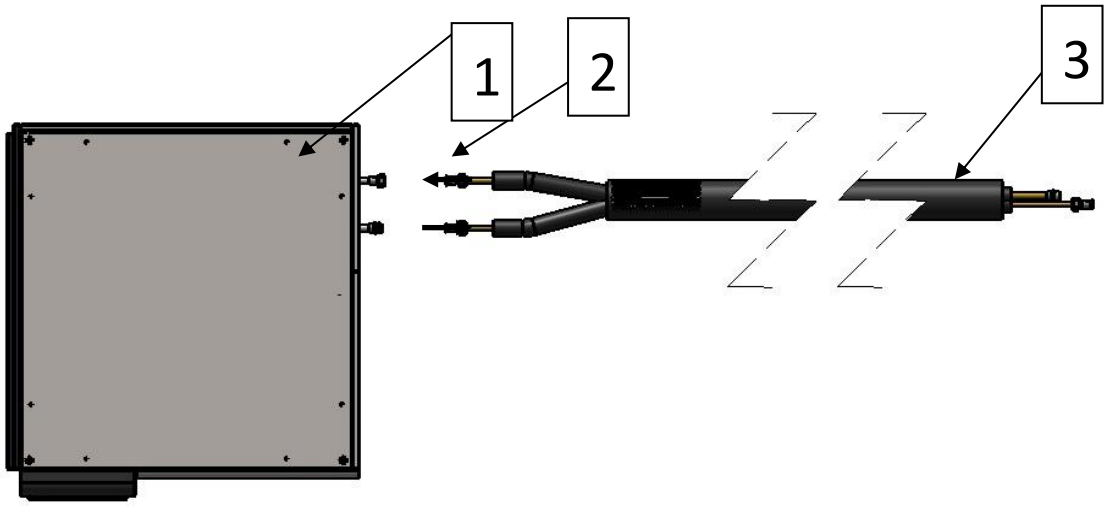


Figure 3-12. Refrigerant line connection

1. Refrigeration unit (top view)
2. The direction of the refrigerant flow
3. Refrigerant line

3.3.2.2 Determine that the isolation valve has been closed and the plug is removed

1. Remove the valve box panel of the refrigeration unit. Turn each red manual valve clockwise to ensure that it is closed. (See figure 3-13)
2. Slowly remove the plug from the joints in the refrigeration unit. You can hear a short hiss. However, if the refrigerant continues to leak out of the refrigerating unit, reload the plug immediately and confirm that the isolation valve has been closed.
3. Keep the plug for future use. After disconnecting the refrigerant tube, you need to reload the plug parts.

Note: the function of the isolation valve is to keep the refrigerant mixture in the unit of refrigeration when the refrigerating unit is transported or when the cryosurface or

refrigerant line is disconnected. These valves cannot be operated on during cryogenic temperatures.

3.3.2.3 Connect the refrigerant line to the refrigeration unit

Remove rubber o-ring seal from each joint. Check the balance pressure and install the joints follow step 3.2.1.2.

3.3.2.4 Support the cold media and avoid pipeline vibration

The pipeline is supported in the middle position of the cold media tube. If a longer cold medium is installed, the support will be set every three feet (1m). Determine that the support will not break through the stratosphere. Support should be at least 4 inches (100 mm) wide and can be worn with straps, hooks, clips or brackets.

Note: the choice of brand or type of tape, hook, clip or bracket depends on the brand or type available at the installation site. A support that is not used in direct contact with exposed pipes or joints. Don't let the line swing when applied.

It is recommended to use the whole continuous cooling copper tube from the refrigeration unit to the feedthroungh of the cryocoil. It is not recommended to use the joint in the middle of the copper piping, which is not covered by the warranty. If you have a pipeline design, there are multiple joints between refrigeration unit to the feedthroungh of the cryocoil., and it is recommended that the pipes be welded with copper instead of the joint. However, if you can't do welding, you can only use the joint of qualified Parker CPI UltraSeal or Swagelok VCR. In addition, the pipeline must be supported within 300mm on both sides of the joint.

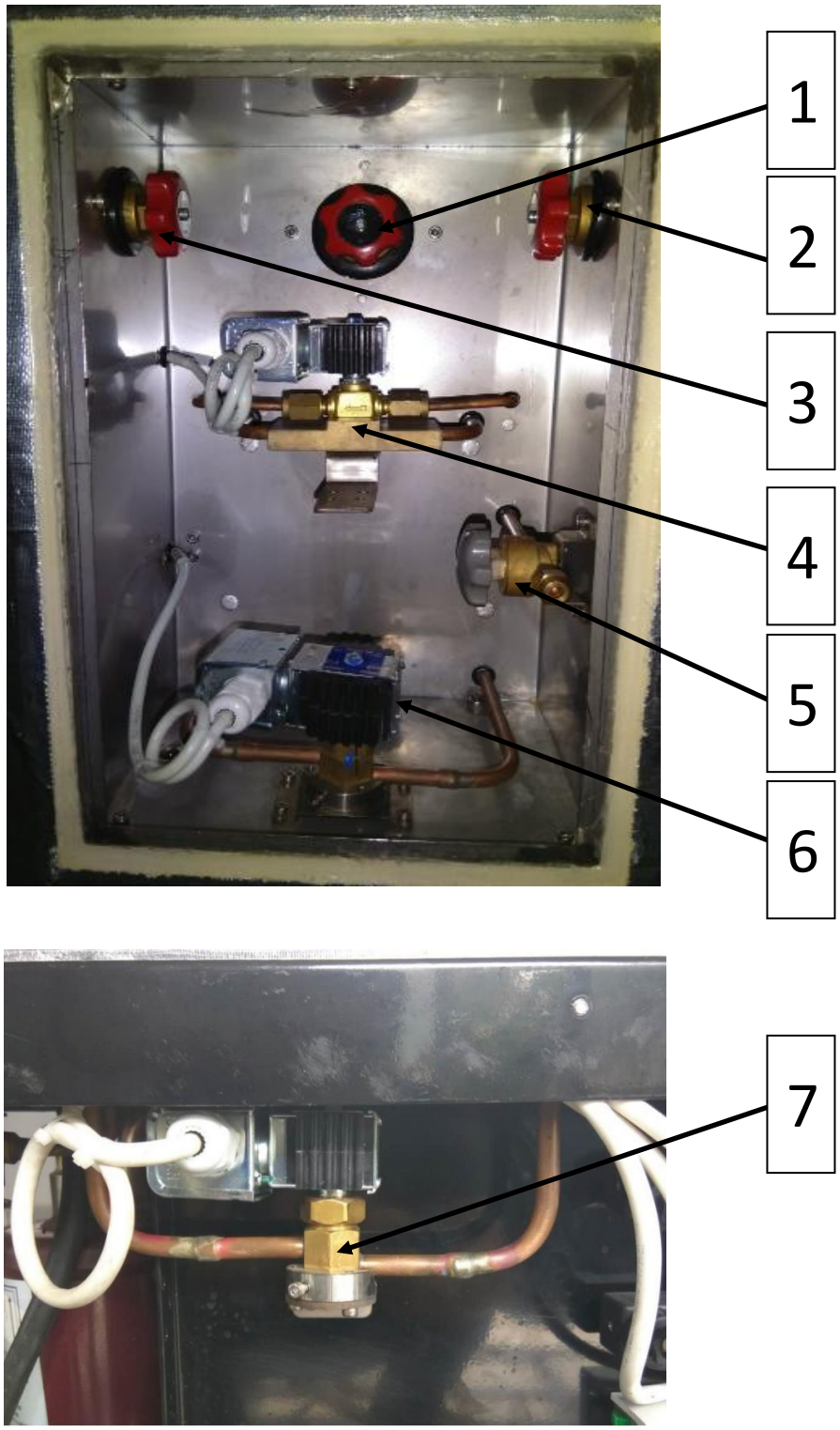


Figure 3-13. Valves position

1. Return gas hand valve
2. Refrigeration hand valve
3. Defrost hand valve
4. Refrigeration solenoid valve
5. Maintenance hand valve
6. Pressure relief solenoid valve
7. Defrosting solenoid Valve

3.3.3 The leak detection of refrigerant tube and cryosurface

Required tools and materials:

- Cylinders with R-22 or R-134a refrigerant gas
- Cylinders with dry nitrogen with pressure relief valves
- Nugget assembly with maintenance of three hoses (manifold)
- Electronic halogen leak detector
- Leakage with soapy water
- Detection mirror

Note: If you cannot obtain these materials, please contact the WVCP system vendor or a nearby vendor for additional leak detection methods.

3.3.3.1 Pressurize the refrigerant tube and cryosurface (See Figure 3-14 and Figure 3-15)

1. Make sure that the valves of the manifold table are closed. Connect the manifold suction (low pressure) hose to the service valve on the cooling unit. Open the service valve (turn 2 rounds counterclockwise).
2. The refrigerant cylinder is connected to the center hole of the manifold table. Open the manifold valve and the cooler valve to pressurize the refrigerant and cryosurface to 10-20 psi. Once the pressure is complete, close the valve and disconnect the refrigerant cylinder.
3. The nitrogen cylinder is connected to the center hole of the manifold table. Increase the pressure in the coolant and cryosurfaces to 200 psi.

⚠NOTICE

GENARAL HAZARD

Do not pressurize the refrigerant pipeline and cryosurface above the equilibrium pressure of the cooling unit. Improper pressurization can cause damage to the pipeline or device.

Make sure that the procedure in 3.3.2.1 pressurizes the refrigerant and cryosurface is carefully followed.

Note: For the WVCP550D / WVCP2600D / WVCP3000D /WVCP3600D / WVCP4200D / WVCP6000D refrigeration unit 3.3.3.1 to the refrigerant and cryogenic interface pressurized part of the operation will make two sets of refrigerant circuit are pressurized.

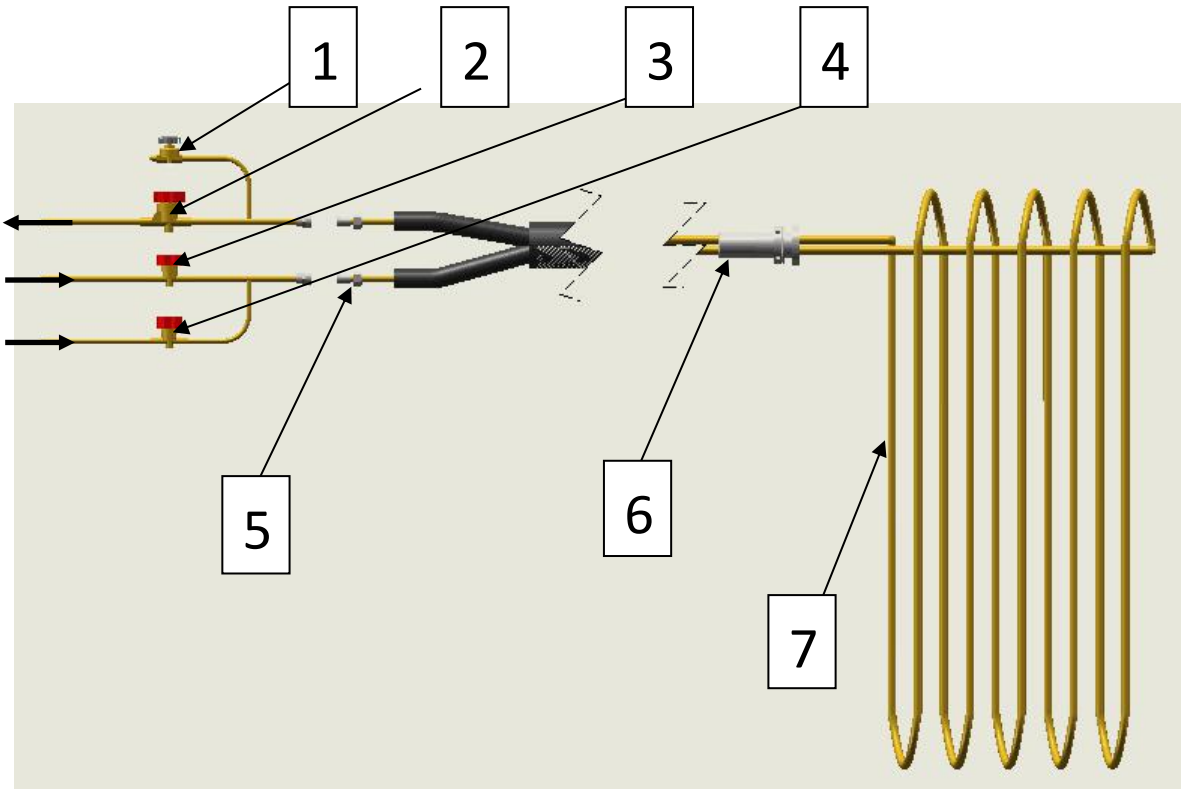


Figure 3-14. Relationship between the isolation valve and the refrigerant tube and the cryosurface (Only schematic)

1. Maintenance valve
2. Backflow valve
3. Refrigeration hand valve

4. Defrost hand valve
5. Parker/VCR/Brazing joints
6. Feedthrough
7. Cryosurface

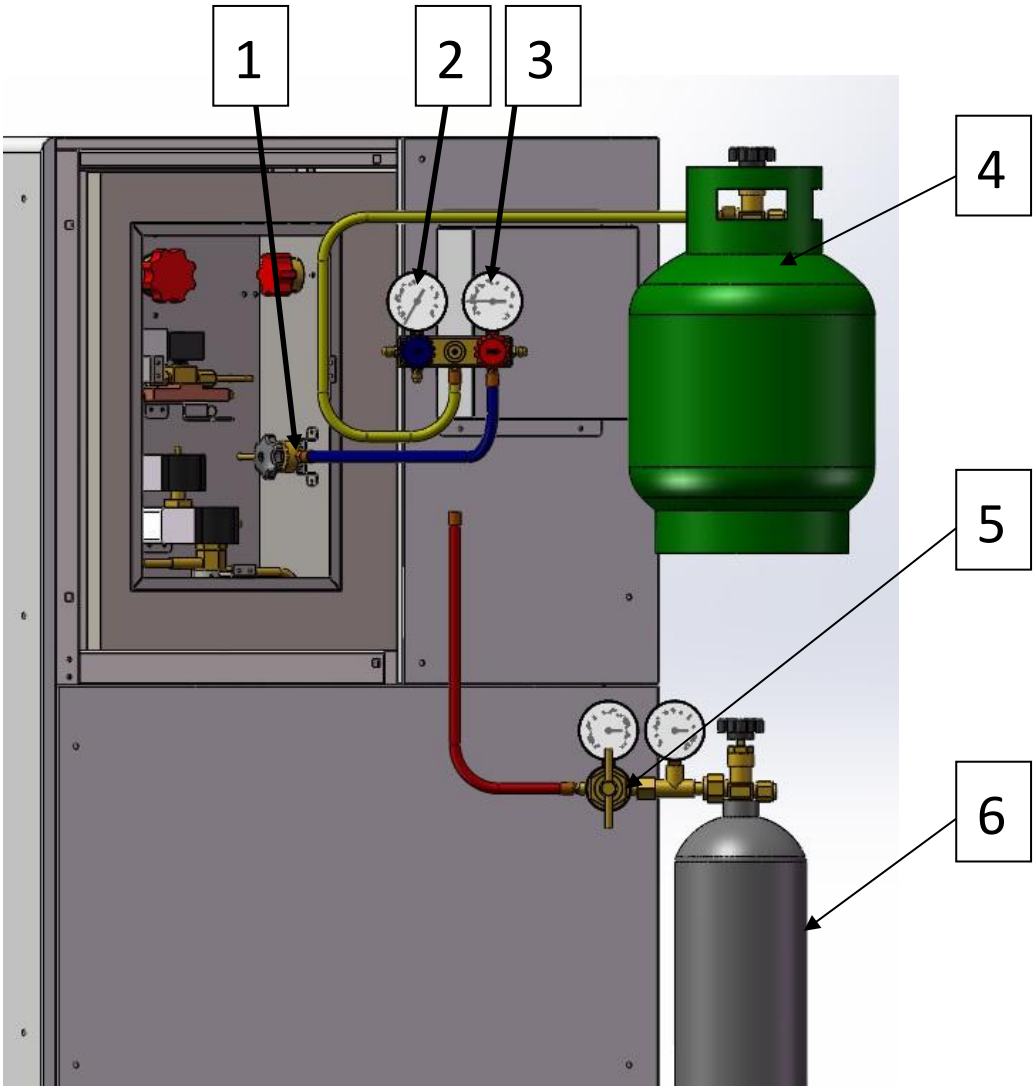


Figure 3-15. Refrigerant tube and cryosurface - leak detection fill settings

1. Maintenance valve
2. Manifold table low pressure valve
3. Manifold table high pressure valve
4. Cylinder with R-22 or R-134a
5. Nitrogen pressure reducing valve
6. A cylinder with dry nitrogen

3.3.3.2 Check the refrigerant leak

1. Use a halogen leak detector carefully check every connection made. Including the Parker CPI UltraSeal or Swagelok VCR fittings, exhaust valves, and any brazed joints. Each of the Parker and Swagelok joints has two small check holes that help to find leaks. Cover one of the holes with your fingers and place the sensor in another hole. (See Figure 3-16).
2. If no leaks are found, check the manifold pressure to ensure that the pressure is still at 200 psi. If the pressure does not change, go to 3.3.2 to empty the refrigerant tube and the cryosurface section.

Note: If a large leak occurs, the leak detector is unable to find the location of the leak, and the manifold suction valve can be opened until the pressure drops to 50 psi. This can then use the leak detector to detect the specific location of the leak.

3.3.3.3 Accurately identify and repair any leaks

⚠CAUTION

Do not add refrigerant to a leaky refrigeration unit. Before adding or recharging the refrigerant unit, be sure to pinpoint and repair any leaks.

If a leak is found with a halogen leak detector, the soap bubble is used to accurately identify the leak point.

Note: In the using a soap bubble leaking detecting, we need to avoid the artificially created bubble imitation.

If a leak is found at the Parker CPI UltraSeal or Swagelok VCR joint:

- Cover your bottom of the inspection hole with your fingers and apply leak detecting soapy water at the above inspection hole. Observe the above check holes for at least two minutes. If no foam is present, it indicates that the tightness of the joint is

within the specification.

- If the joint is still leaking, it must be reassembled. The manifold suction valve is opened to release the gas in the coolant and cryosurfaces. Then follow the guidelines in section 7.2 to remove the joint. Make sure that the sealing surface of the joint is not scratched or damaged. Reassemble the joint according to the instructions in 3.3.1 Connecting the refrigerant tube.

If a leak is found at the copper joint:

- Apply leak detecting soapy water at the junction. Use the detection mirror to observe all sides of the junction. At least observe the junction for two minutes. If there is a leak at the junction, it must be patched. The suction valve of the manifold table is opened to release the gas in the refrigerant pipeline and cryosurfaces. Follow the guidelines in the section 3.7 Copper Weld Specification to repair the leak.

If a leak is found at the exhaust valve:

- Apply soapy water at the seal packing. Observe the sealed packing for at least two minutes. If the seal of the valve is a source of leakage, turn the copper gland clockwise to tighten the packing. If the seal filler is not a source of leakage, replace the valve.

3.3.3.4 Make sure that the refrigerant pipeline and cryosurfaces are not leaking

Use a halogen leak detector to check for the repaired points of the weld. (See section 3.3.3.1 for pressurization of the refrigerant pipeline and cryosurface and section 3.3.3.2 Checking the refrigerant leak) Repeat this procedure until all leaks have been patched.

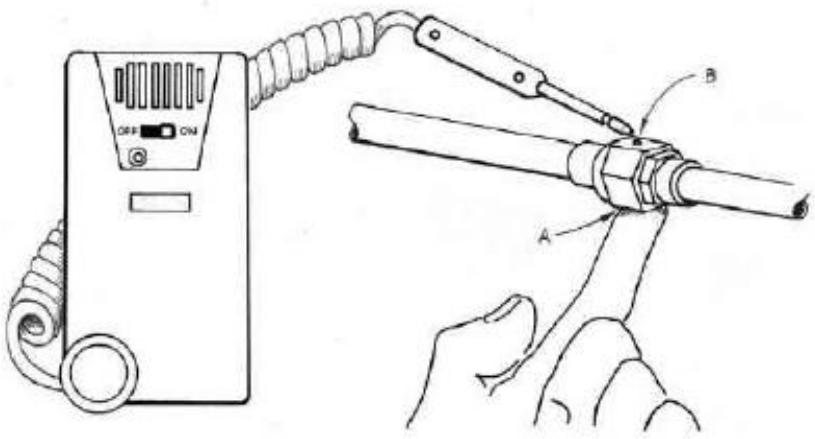


Figure 3-16. Joint - Leak Detection Method

A. Cover one hole with your fingers

B. Place the sensor at another hole

3.3.4 Vacuum the refrigerant pipeline and cryosurface

Required tools and materials:

- Vacuum pump, with 1/4-inch SAE taper connection, can be vacuumed at least to 10Pa or lower.
- Cylinder with dry nitrogen, with regulator.
- Manifold pressure gauge assembly with hose (manifold).

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be done by a qualified refrigeration engineer, otherwise it could result in death or serious injury.

Do not try to do vacuum work by your own. Please contact a qualified refrigeration engineer.

3.3.4.1 Vacuum the refrigerant pipeline and cryosurface

1. The refrigerant tube and the cryosurface are evacuated to less than 10 Pa. (See Figure 3-17)
2. Let the vacuum pump continue for 30 minutes vacuum operation.
3. Close the manifold suction valve and close the vacuum pump.

Note: The refrigerant tube and cryosurfaces should be evacuated to 10Pa within 30 minutes. If not, there may be a leak.

3.3.3.2 The second time to vacuum the refrigerant tube and cryosurface

1. Connect the nitrogen cylinders to the middle hole of the manifold table (see Figure 3-17). Pressure the refrigerant tube and cryosurface to 10-20 psi. Remove the manifold from the relief valve and open the manifold's low-pressure valve (suction valve) to drain the nitrogen in the coolant and cryosurface.
2. The refrigerant pipeline and cryogenic interfaces are evacuated to less than 10 Pa. Then let the vacuum pump continue for 30 minutes vacuum operation. When the vacuum pump is still evacuated, turn off the evacuation valve of the refrigeration unit. Stop the vacuum pump. Slowly remove the hose from the service valve.
3. Reattach the bonnet to the service valve. (See Figure 3-18).

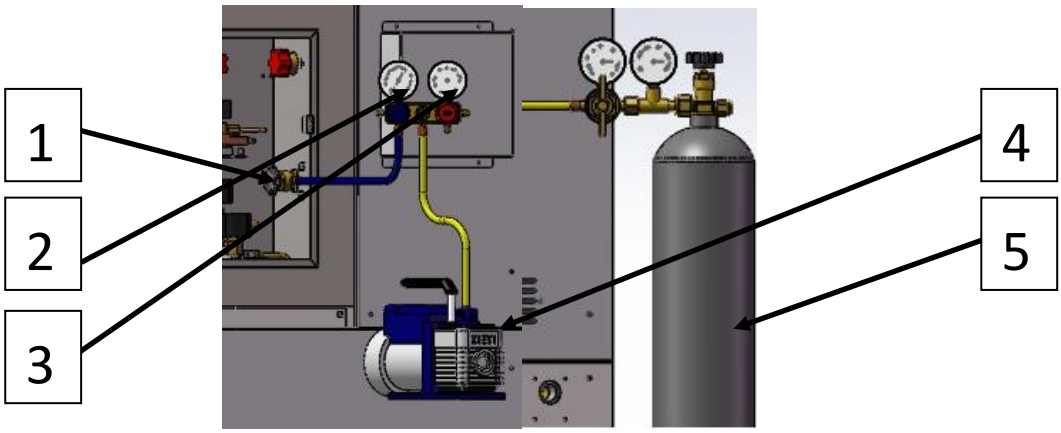


Figure 3-17. Refrigerant tube and cryosurface - Vacuum setting

1. Maintenance valve
2. Manifold low pressure valve
3. Manifold high pressure valve
4. Vacuum pump
5. A cylinder with dry nitrogen

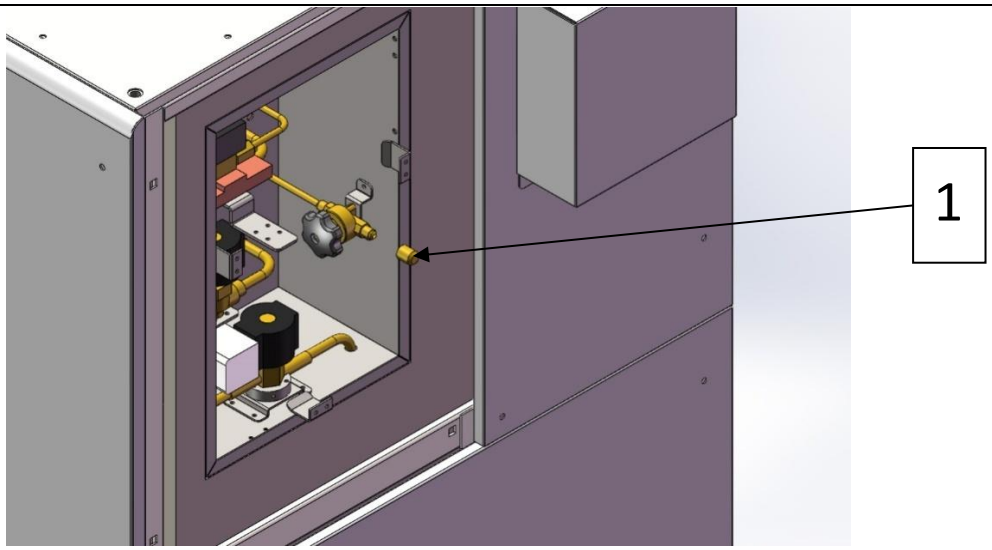


Figure 3-18. Maintenance of the valve

1.Rubber cap with rubber seal

3.4 How to prepare the cryopump before operation

3.4.1 Open the isolation valve

⚠NOTICE

GENERAL HAZARD

Do not open the isolation valve, this will cause damage to the device.

Before opening the isolation valve, make sure to follow the 3.3.2 instructions for the refrigerant and cryosurface leaks detecting and the 3.3.2 evacuation of the refrigerant and cryosurface sections.

3.4.1.1 Open the isolation valve

1. Find the red manual valves in the cooling unit valve box. (See Figure 3-20)
2. Turn each manual valve counterclockwise until it is fully open.

3.4.1.2 Record the equilibrium pressure of the cryopump

1. Wait 10 minutes for the system to reach the same pressure. As the refrigerant mixture enters the refrigerant pipeline and cryosurface, the equilibrium pressure may drop by 5-10 psi.

Figure 3-19. Balanced pressure gauge

2. The pressure displayed on the balance gauge is recorded in the blank space below, see Figure 3-26. At the same time the pressure should be recorded in the regular inspection check and maintain "check diary". This measured value will be used as a

reference for subsequent inspection.

Water vapor capture pump balance pressure: _____ psi

3.4.1.3 Remount the valve cover and the external panel

Fix the valve cover and close it. Insulation board for the sealing effect, to avoid water vapor into it.

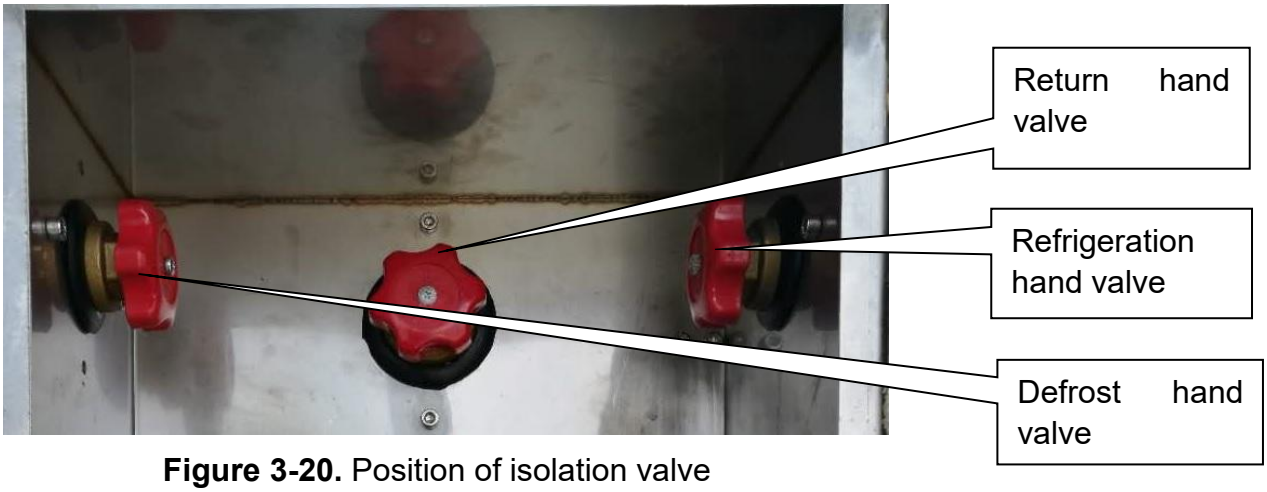


Figure 3-20. Position of isolation valve

3.4.2 Check for refrigerant leaks

Required tools and materials:

- Electronic halogen leak detector
- Cleaning rags

Accurately identify and repair any leaks.

In order to pinpoint the location of the leak, follow the guidelines in section 3.3.2 for leak detection of refrigerant tubes and cryosurfaces. If it is necessary to reassemble the joints (or repair the brazed joint), the refrigerant mixture must first be pumped back into the refrigeration unit. When doing this, follow steps 1 and 2 in see the Section 7.2 How to Disassemble the Refrigerant Tube.

Follow the guidance given in 3.3.2 for leak detection of refrigerant tubes and cryosurfaces and check the point after repairing with a leak detector.

3.4.3 Insulate exposed pipes and joints

Required tools and materials:

- Pipe with Armaflex insulation pipe
- Armaflex tape
- Armstrong 520 adhesive
- Large scissors or utility knife

If you have buy a refrigerant tube, it will be ship with the refrigeration unit.

If exposed tubes and fittings have good insulation, they will remain dry. Intruding moisture will add heat load to the cryopump and may cause corrosion or leakage.

3.4.3.1 Insulate the exposed piping between the refrigeration unit and the insulation of the refrigerant tube

(See Figure 3-21, Figure 3-22, Figure 3-23, Figure 3-24)

1. Cut a number of insulation pipe, the length equal to the gap between the refrigeration unit and the refrigerant pipe insulation part. Cut each of the insulation tubes longitudinally.

2. Put a small diameter insulation pipe around each exposed pipe. Apply adhesive to the longitudinal cut of the insulation tube. Closure of the pipe cut to form a hermetic seal.

3. Insulate the smaller diameter insulation pipe with larger insulation pipe. Seal with adhesive on the cut point of large longitudinal insulation pipe. (Inside and outside the insulation of pipe sealing should be staggered, do not overlap.)

4. The insulation board should be cut into the same length with insulation pipe. The plate wrapped in insulation pipe, only a pack, the two sides of the plate should be overlapped 50-75 cm. Apply adhesive to the outermost end of the overlap in the range of 25-40 cm to secure it.

5. Seal both ends of the insulation board with tape. Fix the plate to the insulation of the refrigerant tube and to the panel of the cooling unit. Make the tape outward to tape the insulation board to the panel.

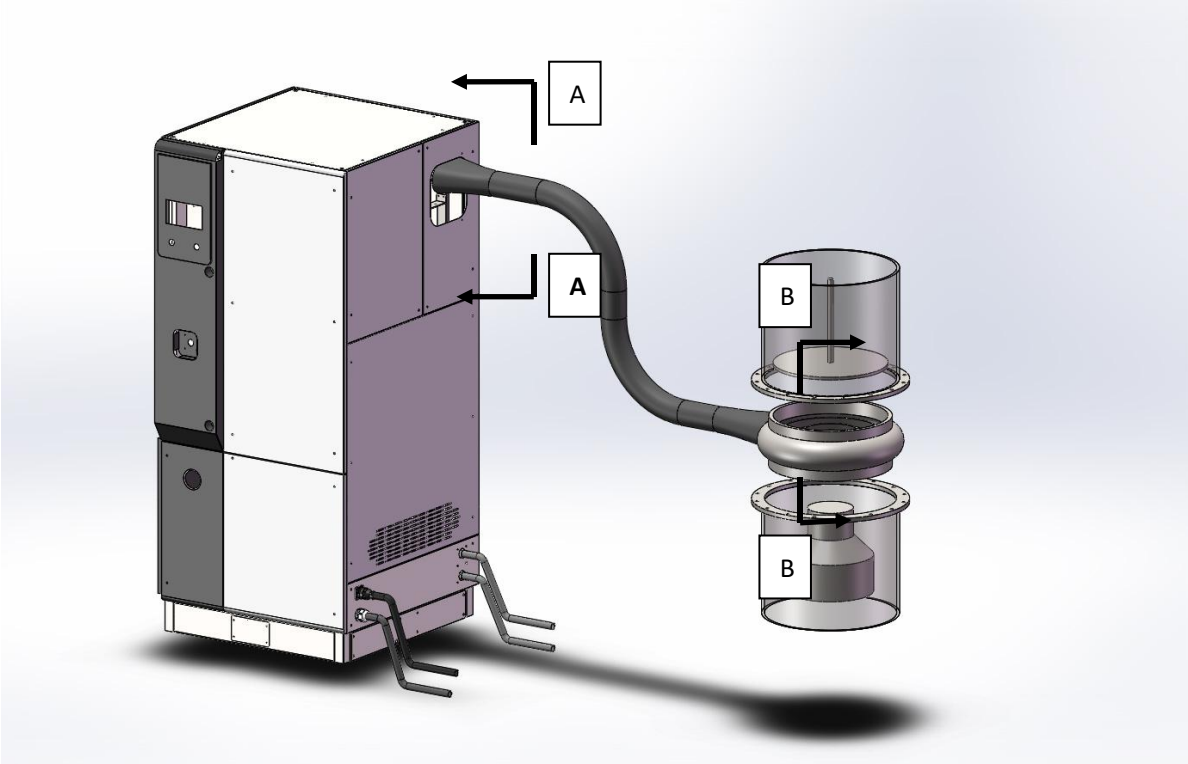


Figure 3-21.

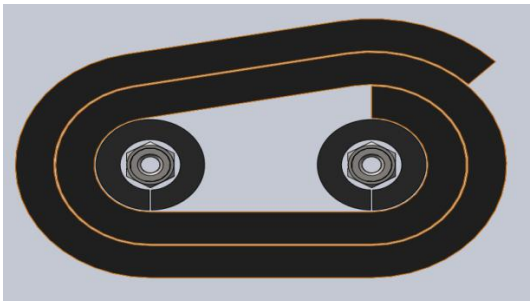


Figure 3-22. A-A B-B

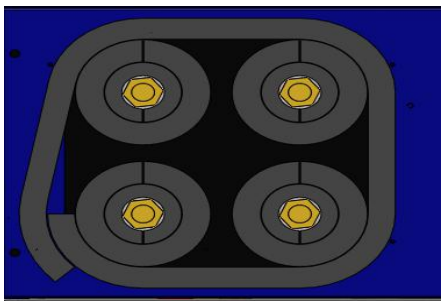


Figure 3-23. A-A B-B

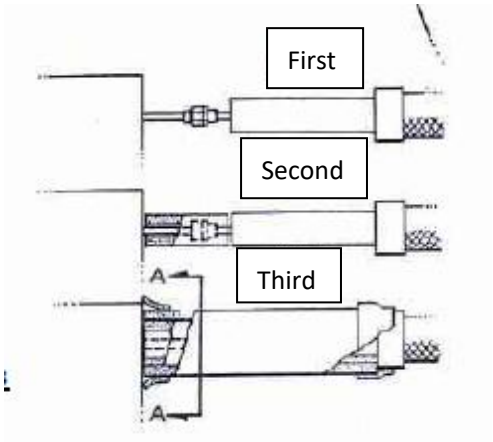


Figure 3-24. Insulation method of refrigerant pipe two joints

3.4.3.2 To insulate the exposed pipe between the heat-insulated part of the refrigerant pipe and the part of the feedthrough

⚠NOTICE

GENERAL HAZARD

Armaflex tape in cryogenic joint threads or Armstrong 520 adhesive is very difficult to remove. If these materials are not tightened when the cryogenic joint nut is tightened, it will cause it to stick and will cause damage to the device.

Do not place Armaflex tape or Armstrong 520 adhesive in the threads of the cryogenic joint.

1. The insulation board is enclosed between the refrigerant pipe which thermal insulation treated beforehand, and the feedthrough. Insulate the exposed pipe sections with a layer of insulation board, and apply adhesive in the range of 25-40 cm within the last lap edge of the plate to hold it in place.
2. Seal both ends of the plate with tape. The plate is fixed to the refrigerant tube insulation part and the feedthrough. Make the tape outward to tape the insulation board to the panel.

3.4.4 Start the water vapor cryopump and test it

3.4.4.1 The vacuum chamber is evacuated to below 6 Pa while the vapor cryopump is in standby.

1. Turn on the cooling water and determine the minimum flow required to maintain the

water temperature, see section 3.2.5 Connecting the Cooling Water Section.

2. Turn on the water vapor cryopump main power and make sure the power switch is on the ON position. Refer to Figure 3-25.

3. Press the Start / Stop button to start the water vapor cryopump (see Figure 3-26). The water vapor cryopump turns into the state of local control standby.

Figure 3-25. Power switch

Figure 3-26. Start / stop switch

4. Start the system, standby for 30 minutes to cool the heat exchange part.

Note: For WVCP550D / WVCP2600D / WVCP3000D /WVCP3600D / WVCP4200D / WVCP6000D, both two refrigerant circuits are in standby mode.

	**⚠NOTICE** **THERE IS EXTREME TEMPERATURE** Do not reach into the compressor compartment while the cooling unit is operating. Compressor heads and high-pressure lines can be very hot and exposure to these hot surfaces can result in minor or moderate injury. Do not touch the compressor head and high-pressure pipeline.

	**⚠DANGER** **ELECTRIC** Do not reach into the compressor compartment while the cooling unit is operating. In the compressor electrical box has dangerous voltage. All electrical work must be performed by a qualified engineer, as this may result in death or serious injury. Do not reach into the interior of the cooling unit. All electrical work must be performed by a qualified electrician.

5. Listen to sound of the compressor. Compressor should be continuous operation, will not be suspended or shut down.

6. Remove the rear lower panel of the cooling unit. Locate the oil level sight glass of the compressor (Figure 3-27). After the compressor has been running for at least 60 minutes, the oil level should indicate 1/3 to 1/2 (best 1/3).

7. Record oil level of the compressor after the compressor has been running for at least 60 minutes.

8. Check flow direction of the cooling water. (See Figure 3-28.) If the flow direction is wrong, shut down the cooling unit and connect the cooling water pipe to the correct port.

9. Record the following pressure and temperature:

Table 3-4. Pressure and temperature in standby mode

Parameter Name	The following specifications acceptable range					The following specifications of the measured value				
	WVCP550	WVCP2600	WVCP3000/3600	WVCP4200	WVCP6000	WVCP550	WVCP2600	WVCP3000/3600	WVCP4200	WVCP6000
Inlet Pressure	3-30 psi	3-30 psi	3-30 psi	5-30 psi	5-30 psi	____ psi	____ psi	____ psi	____ psi	____ psi
Exhaust Pressure	110-230 psi	110-230 psi	110-230 psi	110-230 psi	110-230 psi	____ psi	____ psi	____ psi	____ psi	____ psi
Exhaust Gas Temperature	80-120 ℃	80-120 ℃	80-120 ℃	80-120 ℃	80-120 ℃	____℃	____℃	____℃	____℃	____℃
Condensation Temperature	18-33℃	18-33℃	18-33℃	18-33℃	18-33℃	____℃	____℃	____℃	____℃	____℃

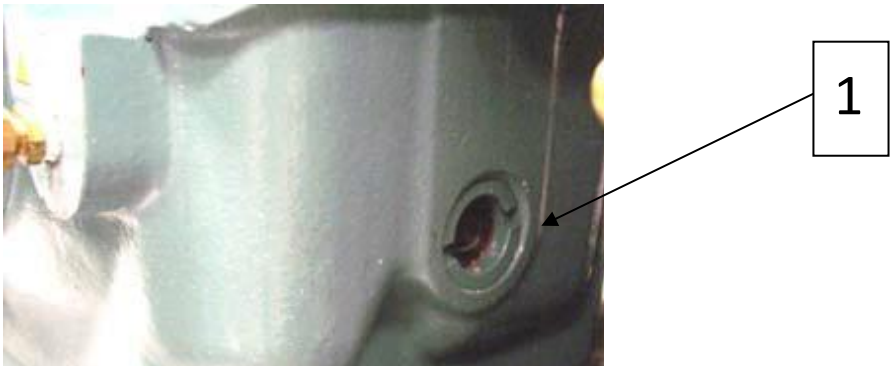


Figure 3-27. The sight glass of Compressor

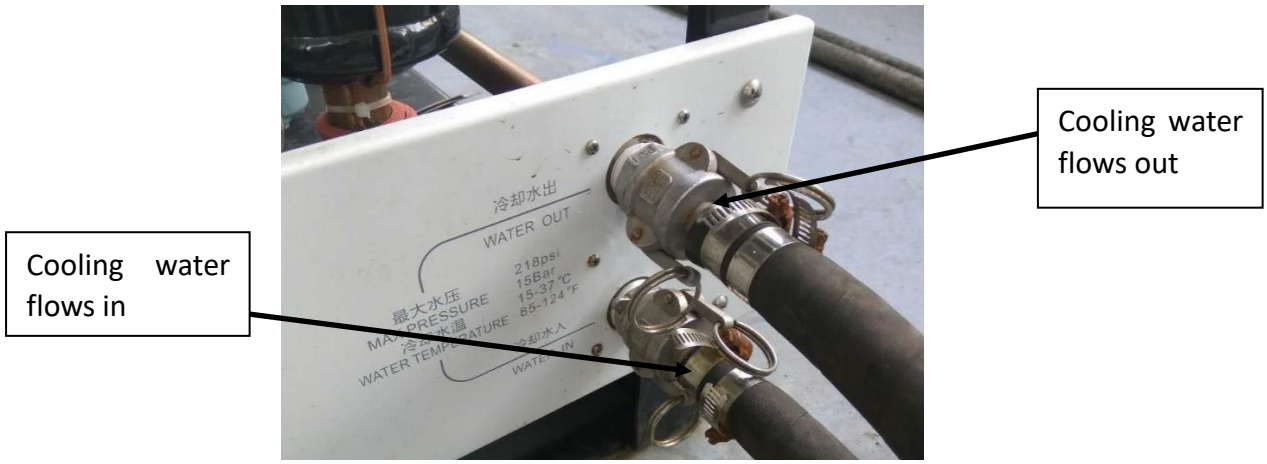


Figure 3-28. Check the cooling water flow direction

Note: The temperature of the flowing out water should be higher than the temperature of the flowing in water.

3.4.4.2 Assess the performance of the water vapor cryopump in cooling state

1. Vacuum the vacuum chamber where the cryosurface is located to at least 6pa.

2. Select COOL and wait for 30 minutes.

Note: For WVCP550D / WVCP2600D / WVCP3000D /WVCP3600D / WVCP4200D / WVCP6000D, COOL (Cooling) operation is selected for both two refrigerant circuits.

3. Check the cooling water outlet temperature, drain (OUT) water temperature should be 22-38 ℃. Otherwise, the cooling water flow should be adjusted so that to make the water outlet temperature within the above range.

4. If there is any ice or water on the refrigerant circuits, shut off the refrigeration unit

and remove the ice or water. Follow the guidance in Section 3.4.3 in Insulating pipes and fittings exposed, plus a layer of insulation. From Step 1, reassess the Assess performance of the water vapor cryopump.

5. Record the following pressures and temperatures:

Table 3-5. Pressure and Temperature in Refrigerated State

Parameter Name	The following specifications acceptable range					The following specifications of the measured value				
	WVCP550	WVCP2600	WVCP3000/ 3600	WVCP4200	WVCP6000	WVCP550	WVCP2600	WVCP3000/ 3600	WVCP4200	WVCP6000
Inlet Pressure	15-55 psi	15-55 psi	15-55 psi	15-55 psi	15-55 psi	____ psi	____ psi	____ psi	____ psi	____ psi
Exhaust Pressure	130-370 psi	130-370 psi	130-370 psi	130-370 psi	130-390 psi	____ psi	____ psi	____ psi	____ psi	____ psi
Exhaust Gas Temperature	80-125 ℃	80-125 ℃	80-125 ℃	80-125 ℃	80-125 ℃	____℃	____℃	____℃	____℃	____℃
Condensation Temperature	18-33℃	18-33℃	18-33℃	18-33℃	18-33℃	____℃	____℃	____℃	____℃	____℃
Coil Input	See Table 3-6	See Table 3-6	See Table 3-6	See Table 3-6	See Table 3-6	____℃	____℃	____℃	____℃	____℃
Coil Reflow	See Table 3-6	See Table 3-6	See Table 3-6	See Table 3-6	See Table 3-6	____℃	____℃	____℃	____℃	____℃

Note: The WVCP550D/WVCP2600D//WVCP3000D/WVCP3600D/WVCP4200D/WVCP6000D should also record the following temperatures

Coil2 Input	See Table 3-6	See Table 3-6	See Table 3-6	See Table 3-6	See Table 3-6	____ ℃	____ ℃	____ ℃	____ ℃	____ ℃
Coil2 Backflow	See Table 3-6	See Table 3-6	See Table 3-6	See Table 3-6	See Table 3-6	____ ℃	____ ℃	____ ℃	____ ℃	____ ℃

Table 3-6. The temperature of the cryosurface is reached at the required vapor pressure

Vapor pressure			Trapped water vapor 90% of cases cold trap temperature
Torr (Care)	Pascal (L Pascal)	Mbar	℃
5×10^0	7×10^2	7×10^0	–25.4
2×10^0	3×10^2	3×10^2	–34.4

1×10^{0}	1×10^{0}	1×10^{0}	–40.8
5×10^{-1}	7×10^{1}	7×10^{-1}	–46.8
2×10^{-1}	3×10^{1}	3×10^{-1}	–54.3
1×10^{-1}	1×10^{-1}	1×10^{-1}	–59.7
5×10^{-2}	7×10^{0}	7×10^{-2}	–64.8
2×10^{-2}	3×10^{0}	3×10^{-2}	–71.2
1×10^{-2}	1×10^{0}	1×10^{-2}	–75.8
5×10^{-3}	7×10^{-1}	7×10^{-3}	–80.1
2×10^{-3}	3×10^{-1}	3×10^{-3}	–85.6
1×10^{-3}	1×10^{-1}	1×10^{-3}	–89.6
5×10^{-4}	7×10^{-2}	7×10^{-4}	–93.4
2×10^{-4}	3×10^{-2}	3×10^{-4}	–98.2
1×10^{-4}	1×10^{-2}	1×10^{-4}	–101.6
5×10^{-5}	7×10^{-3}	7×10^{-5}	–104.9
2×10^{-5}	3×10^{-3}	3×10^{-3}	–109.1
1×10^{-5}	1×10^{-3}	1×10^{-5}	–112.2
5×10^{-6}	7×10^{-4}	7×10^{-6}	–115.1
2×10^{-6}	3×10^{-4}	3×10^{-4}	–118.1
1×10^{-6}	1×10^{-4}	1×10^{-6}	–121.5
5×10^{-7}	7×10^{-5}	7×10^{-7}	–124.1
2×10^{-7}	3×10^{-5}	3×10^{-7}	–127.5
1×10^{-7}	1×10^{-5}	1×10^{-7}	–129.9
5×10^{-8}	7×10^{-6}	7×10^{-6}	–132.2
2×10^{-8}	3×10^{-6}	3×10^{-8}	–135.2
1×10^{-8}	1×10^{-6}	1×10^{-8}	–137.3

5×10^{-9}	7×10^{-7}	7×10^{-9}	–139.5
2×10^{-9}	3×10^{-7}	3×10^{-9}	–142.1
1×10^{-9}	1×10^{-7}	1×10^{-9}	–144.1
5×10^{-7}	7×10^{-5}	7×10^{-7}	–124.1
Note: The measured value is the average temperature of the cryocoil. The difference between cryocoil outlet temperature and the average must be less than 10 ℃.			

3.4.4.3 Assess the performance of the water vapor cryopump in defrost state

1. Select DEFROST operation.

Note: For WVCP550D/WVCP2600D//WVCP3000D/WVCP3600D/WVCP4200D/WVCP6000D: DEFROST is selected for both two sets of refrigerant circuits.

2. Record the cryosurface defrosting time. When the defrost operation is completed, the text display shows defrost is completed and the cooling unit automatically switches to STANDBY.

Defrost actually takes time: _____ minutes (should be less than 4 minutes).

3. Open the vacuum chamber, the cryosurface should be dry, the temperature should be room temperature or a little higher.

⚠NOTICE

THERE IS EXTREME TEMPERATURE

Certain parts of the cryosurface may be hot, and touching hot surfaces can cause minor or moderate damage.

Do not touch the cryosurface.

3.4.4.4 Determine the water vapor cryopump in normal operation state

Recheck all measurements to determine that the vapor cryopump is operating within the required range of values. Record all measurements in the "Exam Diary" (in the Periodic Inspection and Maintenance section). These measurements will serve as a reference for later examinations.

3.4.4.5 Re-install the refrigeration unit panel

3.5. Cryosurface and the feedthrough specifications

⚠NOTICE

GENERAL HAZARD

Prior to connection to the refrigeration unit, there must be no oil or moisture above the pipeline, the cryosurface, and the feedthrough. Failure to follow this rule may result in device damage.

Before connecting pipes, the cryosurface, and the feedthrough to the refrigeration unit, make sure there is no oil or moisture on the pipe, the cryosurface, and the feedthrough.

3.5.1 If the cryosurface is a cryocoil

Note: This section assumes that cryocoils are used to trap water vapor in the vacuum chamber.

3.5.1.1 Choose the installation location

Cryocoil installation site must meet the following requirements:

- Evaporation (sediment source) will not deposit on the surface of the cryocoil.
- Cryocoils are positioned so that they are optimal (unobstructed) for each surface that is most likely to emit water vapor.
- Cryocoils do not face (or can block) heat sources that exceed 50 ° C.
- Cryocoils are not damaged by moving objects.
- Cryocoils can be supported so that they do not absorb large amounts of heat from the vacuum chamber.

If a vacuum insulated feedthrough is used, the installation site for this unit must

meet the following requirements: When the cryocoil is defrosted, there is no water in the unit.

Table 3-7. Cryocoil size specifications

Refrigeration unit	Total surface area m²	Pipe diameter Inch (mm)	Pipe length m
WVCP550	0.32	4/8 (12.7)	8
WVCP2600	1.5	5/8 (16)	30
WVCP3000	1.7	5/8 (16)	34
WVCP3600	2	5/8 (16)	40
WVCP4200	2.4	5/8 (16)	48
WVCP6000	4	5/8 (16)	80

Note:
For WVCP550D/WVCP2600D/WVCP3000D/WVCP3600D /WVCP4200D/WVCP6000D, the total surface area must be divided between the two cryocoils.
Larger cryocoils get faster extraction rates and can be used in some industries. However, if the thermal load is too high, the efficiency of the vapor trapping will be reduced and the protection will shut off the pump.

3.5.1.2 Cryocoil and feedthrough design should meet the conditions

⚠NOTICE

GENERAL HAZARD

Cryocoils and feedthrough must be designed to withstand a working pressure of 450 psi. Cryocoils and feedthrough are part of the water vapor capture pump refrigerant circuit. Failure to comply with the above specifications may result in device damage. Do not use reservoir-type or bulk cryocoils. Do not use large diameter pipes.

1. Cryocoil must be a continuous circuit (pipe).

- Do not set branch circuit in the circuit, otherwise it will cause unbalanced distribution of refrigerant mixture, thus reducing the performance of water vapor cryopump.
- Do not add fins or panels to the circuit. The increase in mass will increase the cooling and defrosting time of the cryocoil and will increase the temperature of the cryocoil.

2. Cryocoil must be stainless steel or cooling grade brass.

- Stainless steel pipe is more durable, less chemical reaction, the minimum wall thickness of 0.5 mm.
- The cooling grade copper tube is easy to process, the minimum tube wall thickness is 0.8 mm.

3. Based on the pipe diameter and length, the cryocoil must have an appropriate surface area corresponding to it. See Table 3-7.

4. Feedthrough must be thermally isolated, the best use of vacuum insulated feedthrough.

5. If the user provides a feedthrough, the joints will be shipped with the unit. The horizontal offset between the two fittings connected to the refrigerant line is 76 mm. (See Figure 3-1)

⚠CAUTION

Using an unauthorized, non-standard joints will void the warranty.
In the joints improper use of O-ring, Incorrect installation of O-ring, Over-tighten O-ring or use damaged O-ring, Will void the warranty.

6. It is best to connect the vacuum chamber pipes are taken by way of welding or brazing. If you cannot take the welding method, you can use one of the following joints to connect. These joints have been verified and the effect is reliable. Other types of joints may leak.

- Parker CPI Sealed Joint with Silver-plated Stainless-Steel O-ring.
- Swagelok VCR joint with silver-plated stainless-steel ferrules or uncoated nickel ferrules.

7. Cryocoil support fixing must allow coil cooling and defrosting hot and cold

contraction and expansion. The support fixture shall not add more heat load to the water vapor cryopump. Suitable support fasteners may be made of stainless-steel rods or pipes. Plastic support brackets are also suitable for specific applications.

3.5.1.3 Making cryocoils (and feedthrough)

The use of pipe bending machine or reel making machine, smooth and wrinkled pipe. Follow the guidelines in Section 3.7 Brazing Welding Specifications. Make sure the pipe is clean, free of corrosion, flux and oxidized deposits (both inside and outside the pipe).

3.5.1.4 Perform a 450-psi compression test on the cryocoil

This test must be carried out before connecting the cryocoil to the refrigeration unit.

3.5.1.5 Check the cryocoil for leaks

If there is a helium mass spectrometer for leak detector, please use it.

⚠NOTICE

GENERAL HAZARD

There must be no oil and moisture on the pipe before connecting to the refrigeration unit. Failure to follow this rule may result in device damage.
Before connecting the piping to the refrigeration unit, make sure that there is no oil and moisture on the piping.

3.5.2 If the cryosurface is a cryobaffle(cold trap)

Note: This section assumes that a refrigerant circuit is used to control the diffusion pump oil back into the chamber. Oil refluxing is a process that moving hot vapors condenses on cryogenic surfaces, thus it will contaminate the system. When using a vacuum pump, the pump oil heats up and moves in the opposite direction to the pump suction, causing the system to condense and contaminate the system.

3.5.2.1 Choose a reasonable installation location

- Blocking isolation must be performed between cryogenic traps and heat sources above 50 ° C.
- Cryogenic traps must not be in direct contact with the vacuum chamber.

3.5.2.2 Design cryogenic traps (and feedthroung) all need to comply with the following requirements

⚠NOTICE

GENERAL HAZARD

Cryocoils, cryogenic traps and feedthroung must be designed to withstand a working pressure of 450 psi. Cryocoils, cryogenic traps, and feedthroung are part of the vapor capture pump refrigerant circuit. Failure to comply with the above specifications may result in device damage.

Do not use a reservoir-type or bulk cryogenic trap.

Do not use large diameter pipes.

1. The cryogenic trap must be a continuous circuit (tube). Brazed the fins of baffle to the tube.

- For information on the dimensions and other aspects of cryogenic traps, please contact GUANGZHOU XIEYI AUTOMATION TECHNOLOGY CO.LTD 020－82351819
- Do not set branches in the circuit, otherwise it will cause unbalanced distribution of refrigerant mixture, thus reducing the performance of cryopump.

2. Cryogenic traps should be made of refrigeration-grade copper tubes with OFHC (Oxygen Free High Capacity) copper fins.

- The minimum pipe wall thickness of the cooling grade copper pipe must be 0.8mm.
- Cryogenic traps can be nickel-plated.

3. Cryogenic feedthrough must be thermally isolated, it is best to use vacuum insulated cryogenic feedthrough.

Note: If the cryogenic feedthrough does not have enough insulation：

- The additional heat load applied at the cryogenic feedthrough can drastically reduce the performance of the cryopump.
- Rubber seals (O-rings) may be hardened at low temperatures and create a vacuum leak.
- Frosting may occur on the outer surface of the vacuum chamber.

Note: If the user is provided with a feedthrough, the couplings will be shipped with the unit. The horizontal offset between the two couplings connected to the refrigerant line is 76 mm. (See Figure 3-1.)

3.5.2.3 Making cryogenic traps (and feedthrough)

- Use a pipe bender or a mandrel to make the pipe smooth without wrinkling.
- Follow the guidelines in section 3.7 Brazing specifications.
- Make sure the pipe is clean, free of corrosion, flux and oxidized deposits (inside and outside the pipe).

3.5.2.4 450 psi pressure test on cryogenic traps

This test must be performed before connecting the cryogenic trap to the refrigeration unit.

3.5.2.5 Check the cryogenic trap for leaks

If a helium mass spectrometer is available, please use it for leak detection.

<table>
<tr><td>  </td><td>⚠NOTE
GENERAL DANGER
There must be no oil and moisture on the pipe before connecting to the refrigeration unit. Failure to follow this rule may result in device damage.
Before connecting the piping to the refrigeration unit, make sure that there is no oil and moisture on the piping.</td></tr>
</table>

3.6 Specification of refrigerant connection pipe

Tools and materials needed:

- Pipe insulation materials for cryogenic temperature level
- Stripping pliers
- Soft state refrigeration grade copper pipe with wall thickness of at least 0.8mm

Output pipe: 10mm outside diameter copper pipe

Return line: 12.7mm outside diameter copper pipe

Parker CPI UltraSeal or VCR fittings (mating fittings are provided to connect the refrigerant tubes to the refrigeration unit).

1/2 "Parker CPI UltraSeal fitting with silver-plated stainless-steel O-ring.

5/8-inch VCR joint with silver-plated stainless-steel ferrules or uncoated nickel ferrules.

For brazing: See section 3.7 Brazing Specifications.

3.6.1. How to make refrigerant connection pipe

⚠NOTICE

GENERAL HAZARD

The refrigerant connection must be designed to withstand a working pressure of 450 psi. The refrigerant connection pipe is part of the cryopump's refrigerant circuit. Improper design or operation may cause damage to the device.

Correct design and manufacture of refrigerant connection pipe.

Note: The closer the refrigeration unit is to the cryosuface, is the better. The longer the refrigerant tube, the more the temperature rises before the refrigerant reaches the cryosurface.

Note: If the cryosurface is not removable form, the refrigerant pipe and the cryogenic

interface should be welded together by brazing. If detachable, use Parker CPI UltraSeal or Swagelok VCR joints. These joints have been verified for many years; the performance is stable. Other types of fittings may leak.

CAUTION

Using an unauthorized, non-standard fitting will void the warranty.
In the joints improper use of O-ring, Incorrect installation of O-ring, Over-tighten O-ring or use damaged O-ring, Will void the warranty.

3.6.1.1. Preparation of refrigerant connection pipe

- Follow the guidelines for brazing section 3.7.
- Make sure the pipe is clean, free of corrosion, flux and oxidized deposits (inside and outside the pipe).

3.6.1.2. Perform a 450-psi pressure test on the refrigerant connection

This test must be performed before connecting the cryogenic interface to the refrigeration unit.

3.6.1.3. Check refrigerant outlet pipe and return pipe for leaks

If helium mass spectrometer is available, please use it for leak detection.

3.6.1.4. The output and return pipe insulation treatment

In the output and return pipe wrapped at least 40mm thick insulation layer. Insulation must be airtight, otherwise the refrigerant tube will gather moisture. If not completely sealed or airtight, the water vapor in the air will gather some in the insulation surface.

⚠NOTICE

GENERAL HAZARD

Before connecting to the refrigeration unit, there should be no oil or moisture inside the pipe. Failure to follow this rule may result in device damage. Before connecting the piping to the refrigartion unit, make sure there is no oil and moisture in the piping.

3.7 Copper brazing specifications

Tools and materials needed:

- Sandpaper or wire brush or steel wool
- Dry nitrogen with pressure relief valve
- Oxygen - acetylene torch or air - acetylene torch (propane temperature is not enough)
- For copper-to-copper joints: Harris Dynaflow or Harris 0 # equivalent alloy electrode
- For the connection between copper and stainless steel or between copper and brass: Harris Safety-Silv 56 or equivalent electrode
- Harris Stay-Silv Black flux or equivalent flux

1. Thoroughly clean all joints of bare metal.

2. During brazing, the pipe must be purged of dry nitrogen until the pipe and joint have cooled to a temperature of at least 200 ° C. This avoids internal scaling or oxidation.

3. When the braze joint is still hot, wipe off excess flux with a damp rag.

4. Carefully inspect each joint to verify that the brazing alloy flow is normal. Both surfaces to be joined are covered by the electrode alloy.

5. Carefully check all joints for leaks.

3.8 How to install remote control device

This device is a standard remote-control device for water vapor capture pump.

This device sends and receives control signals to the refrigeration unit via the remote joint and to receive status signals from the refrigeration unit.

3.8.1 Connect the remote control to the remote joint

Tools and materials needed:

- Joint plug (shipped with the refrigeration unit)
- Remote joint pins (shipped with the refrigeration unit)
- Heat shrinkable insulated tube
- Multi-core cable with 18 AWG core (0.75 mm² cross-sectional area)
- Stripper
- 60/40 tin - lead resin core solder
- Iron
- Switch, the minimum capacity of 1 amp
- DC24V indicator (Note 1)

Note: Function indicators may be required on the remote console

3.8.1.1 Check the remote-control diagram

Be sure to install the system ON / OFF switch or functions indicator for remote control. All circuits connected to the remote joint are DC24V. (See Figure 8-5 or Figure 8-11)

3.8.1.2 Assemble the joint plug (see Figure 3-29)

⚠CAUTION

ELECTRICAL HAZARD

Contact may cause electric shock and cause death or serious injury. Make sure the ON / OFF switch and the power disconnect switch are OFF.

1. Strip part of the cable jacket and peel off no more than 13 mm in length. Cable sheathing is the outermost layer of insulated cable. After removing the cable sheath, peel 4 mm long inner insulation from the 18 AWG core. Each pin is soldered with a pre-tin coated core wire. Do not insert the core wire into the hole in the rear of each pin.

2. The heat-shrinkable insulated tube is cut to a length of 13 mm. Each core is covered with a 13mm long insulated tube. Clamp the cable jacket over the cable jacket.

3. Plug each pin into the back of the joint and into place.

4. The 13mm long insulating sleeve is not insulated core and welded joints. Use the air heater to shrink the insulation tube in place. Fix the cable clamp (connect and fix with screws) on the joint. Fasten the cable clamp on the cable jacket.

3.8.1.3 Connect the wires to the remote control, see Figure 3-29, Figure 3-30 in this chapter

	**⚠NOTE** **GENERAL DANGER** Make sure the wiring configuration will not cause cooling and defrosting operation at the same time, otherwise it may cause device damage. It is recommended to use the three-position switch.

	**⚠NOTE** **GENERAL DANGER** Make sure the cable configuration does not turn the cooling unit on for cooling or defrosting operation, otherwise the unit may be damaged. Three switches should be in the middle position, so that the cooling unit to boot standby. (If REMOTE is selected, the on-site operation function will not be available.)

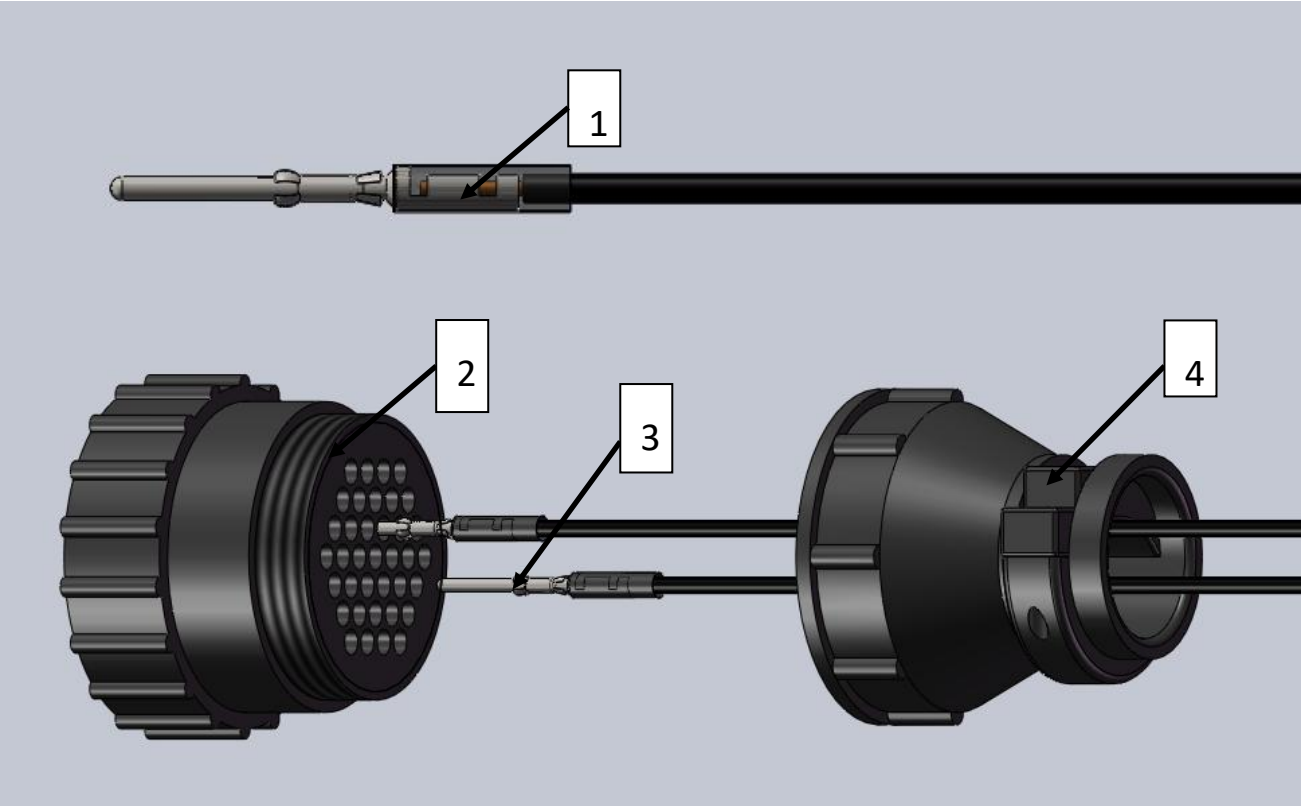


Figure 3-29. Remote Joint Assembly

1. Crimp to the pin on the core
2. Joint terminal
3. Inserting pin
4. Cable clamp

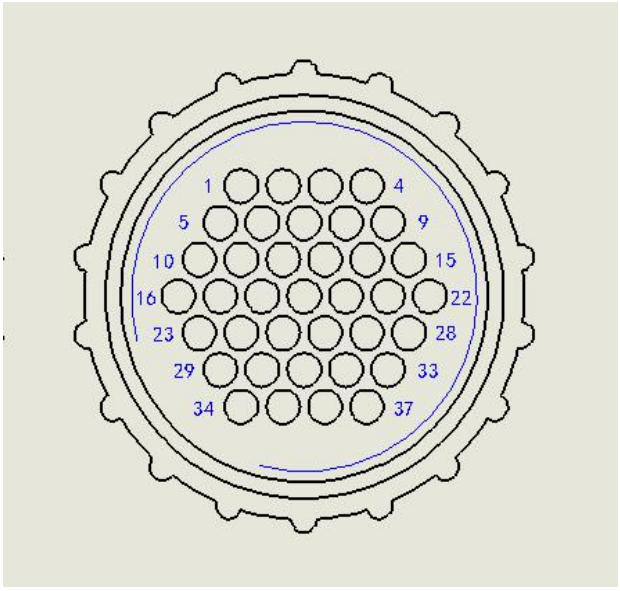


Figure 3-30. Terminal of the remote joint plug

Table 3-8. Remote Joint Wiring Worksheet

Name	Wiring function	Pin number
System Control	Start the system	1
		2
	The system is normal	3
	System power indicator	4
	Common	5
	Ground terminal	6
Coil1 Control	Indication remote	10
	Refrigeration operation	11
	Defrost operation	12
	Indicates defrosting is complete	13
	Indicates defrosting is in progress	14
Coil2 Control	Indication remote	18
	Refrigeration operation	19
	Defrost operation	20
	Indicates defrosting is complete	21
	Indicates defrosting is in progress	22
Optional	Setpoint relay A is indicated	26
		27
Coil 1 Input Temperature -2V- + 2V output -2- + 2V corresponds to -200 ° C - + 200 ° C	Analog 0V	28
	Analog 0M	29
	Analog # 1 - shield	30
Optional	Set point relay B is indicated	31
		32
Coil 2 Input Temperature -2V- + 2V output -2V - +2 V corresponds to -200 ℃ - +200 ℃	Analog 0V	33
	Analog 0M	34
	Simulation # 2 - Shielding	35
Coil 1 Input Temperature Converted to 0-10V Output0-10 corresponds to -200 ℃ - +200 ℃	Analog 0V	28
	Analog 0M	29
	Analog # 1 - shield	30
Coil 2 Input Temperature Converted to 0-10V output 0-10 corresponds to -200 ℃ - +200 ℃	Analog 0V	33
	Analog 0M	34
	Simulation # 2 - Shielding	35

Note: The following temperature is converted to analog output as an option

3.8.1.4 Insert the remote plug into the remote outlet of the refrigeration unit and select REMOTE

Note: If the refrigerant circuit is in local operation, its remote power cannot be used (including the remote ON / OFF switch of the cooling unit).

3.8.1.5 Make sure the remote control operates the unit normally

Use the remote control to perform the following tests:

1. Select STANDBY and start the cooling unit. The compressor of the refrigeration unit should be running and the refrigeration unit text should display standby. Cryogenic temperature began to decrease. Wait 30 minutes.
2. The cryosurface in the vacuum chamber, which at least 6Pa.
3. Switch to COOL (cooling). The cooling unit text shows the cooling status. COIL input (coil outlet) temperature should start to go lower.
4. Switch to DEFROST. The text of the cooling unit shows the defrost status. After the defrosting is completed, the cooling unit text shows defrost completion and standby.
5. Open the vacuum chamber. The cryosurface should be dry and its temperature should be room temperature or higher.

⚠NOTE

THERE IS EXTREME TEMPERATURE
Parts of the cryosurface may be hot and contact with hot surfaces may cause minor or moderate damage. Do not touch the cryogenic interface.

Note: The second refrigerant circuit must also be tested on the model of WVCP550D/WVCP2600D/WVCP3000D/3600D/4200D/WVCP6000D.

3.8.2 Temperature indication

3.8.2.1 WVCP system temperature point instructions

Exhaust gas temperature：

This thermocouple is located in the compressor compartment of the refrigeration unit, on the compressor exhaust high pressure line. Used to monitor the condition of the compressor.

Condensation temperature：

This thermocouple is located in the compressor compartment below the refrigeration unit, on the refrigerant circuit near the condenser exit. Used to monitor the efficiency of the system cooling water.

Refrigerant output:

This thermocouple is located inside the insulation foam of the cooling unit at a specific location on the output line of the refrigerant circuit. This thermocouple is used for troubleshooting and troubleshooting if the vapor capture pump is not capable of pumping steam.

Refrigerant backflow:

This thermocouple is located in the insulation foam of the cooling unit at a specific location on the return line of the refrigerant circuit. This thermocouple is used for troubleshooting and troubleshooting if the vapor capture pump is not capable of pumping steam.

Cryogenic temperature：

This thermocouple is located in the insulation foam of the cooling unit at the last screen in the WVCP Inner Piping. This thermocouple temperature is used to determine when to transition from STANDBY to COOL operation.

Note: For the WVCP550D/WVCP2600D/WVCP3000D/WVCP3600D/WVCP4200D/WVCP6000D, the second refrigerant circuit has another thermocouple.

2 # refrigerant output:

This thermocouple is located inside the insulation foam of the cooling unit at a specific location on the output line of the refrigerant circuit. This thermocouple is used for troubleshooting and troubleshooting if the vapor capture pump is not capable of pumping steam.

2 # refrigerant backflow:

This thermocouple is located in the insulation foam of the cooling unit at a specific location on the return line of the refrigerant circuit. This thermocouple is used for troubleshooting and troubleshooting if the vapor capture pump is not capable of pumping steam.

Note: Only when the refrigerant flows through the cryogenic interface (ie the cooling unit is in the cooling or defrosting state), Coil inlet, coil outlet, output and reflow thermocouples provide meaningful information.

3.8.3.2 Use analog output

The analog signal is converted to an electrical signal for display by a thermometer. This circuit is sensitive to external interference into the output signal, which should be shielded and grounded from an external source of interference. Therefore, the following precautions should be followed.

- The connecting cable must be shorter than 30 meters.
- The connection cable must be shielded: Only one end of the shield is grounded.

Grounding is done at the cooling unit. Use the pins specified on the remote joint for cable shield connection.

- The shielded connection cable must be separated from the remote cable bundle. However, you can route alongside the remote cable bundle.
- Do not ground any thermometer analog outputs. The external device must have a differential input isolate the connections.

3.8.3 Signal exchange through RS485 communication

3.8.3.1 The device supports Modbus communication protocol. In the communication protocol, the device is located at the slave station and the initial address of the slave station is 1. The address of the slave station can be set through the touch screen. The station address and other communication parameters are shown in Table 3-9。

Table 3-9. Modbus communication protocol

The serial number	communication parameter	The set value	Remarks
1	Mode	1	
2	Slave Address	Can be changed by touch screen	The default is 1
3	Baud Rate	Can be changed by touch screen	The default is 9600
4	Odd-even Check	Can be changed by touch screen	The default is 0
5	Additional Character Delay	0	
6	MaxIO	128	
7	MaxAI	32	
8	MaxHol	100	
9	the start addresses of the hold register area	&VB1000	
10	Communication Line Interface	3(A+)、8(B-)	

3.8.3.2 Through the communication function, the operation data of WVCP device can be monitored remotely. The specific function corresponding to communication address parameters are shown in Table 3-10.

Table 3-10. The communication address parameters of operation status of WVCP device

The serial number	Modbus Address	Address	Function	Variable parameter	Read and Write	Instructions
1	4X00003	02H	Cryogenic Temperature	16 bits signed	Read	
2	4X00004	03H	First Line Return Temperature	16 bits signed	Read	
3	4X00005	04H	First Line Return Temperature	16 bits signed	Read	
4	4X00006	05H	Exhaust Temperature	16 bits signed	Read	
5	4X00007	06H	First Line Input Temperature	16 bits signed	Read	
6	4X00008	07H	Second Line Return Temperature	16 bits signed	Read	Single without
7	4X00009	08H	Second Line Input Temperature	16 bits signed	Read	Single without

3.8.3.3 Through the communication function, the input and output state of WVCP can be monitored remotely. The specific function corresponding to address parameters are shown in Table 3-11.

Table 3-11. The communication address parameters of Input/output status of WVCP device

The serial number	Modbus Address	Address	Function	Variable parameter	Read and Write	Instructions
1	4X00012	OBH	Input Point state	16 bits signed	Read	Bit0: start switch
						Bit1: overpressure protection
						Bit2: compressor overcurrent protection
						Bit3: exhaust temperature 150℃ protection
						Bit4: low voltage switch protection
						Bit5: high voltage switch protection
						Bit6: the first device switches to remote/local
						Bit7: the second device switches to remote/local
						Bit8: start the device in remote state
						Bit9: compressor temperature switch
						Bit10: remote 1st refrigeration signal input
						Bit11: remote 1st defrosting signal input
						Bit12: remote 2nd refrigeration signal input
						Bit13: remote 2nd defrosting signal input

						Bit14: spare
The serial number	Modbus Address	Address	Function	Variable parameter	Read and Write	Instructions
2	4X00013	OCH	Spare			
3	4X00014	ODH	Output Point state	16 bits signed	Read	Bit0: alarm output
						Bit1: pressure relief solenoid valve
						Bit2: spare
						Bit3: compressor contactor
						Bit4: the 1st remote/local
						Bit5: standby complete output
						Bit6: spare
						Bit7: solenoid valve for refrigeration
						Bit8: defrosting solenoid valve
						Bit9: defrosting complete signal output
						Bit10: 2nd refrigeration solenoid valve
						Bit11: 2nd defrosting solenoid valve
						Bit12: the 2nd defrosting output is completed
						Bit13: 2nd remote/local
						Bit14: spare
4	4X00015	OEH	Spare			

3.8.3.4 Through the communication function, the alarm information of WVCP device can be viewed remotely, and the WVCP device can be reset through the remote reset point. See Table 3-12 for the specific function point.

Table 3-12. The communication address parameters of alarm information of WVCP device

The serial number	Modbus Address	Address	Function	Variable parameter	Read and Write	Instructions
1	4X00016	OFH	Alarm register	16 bits signed	Read	Bit0: overpressure switch alarm
						Bit1: compressor overcurrent alarm
						Bit2: exhaust temperature switch alarm
						Bit3: low suction pressure alarm
						Bit4: high exhaust pressure alarm
						Bit5: high exhaust temperature alarm
						Bit6: high condensation water temperature alarm
						Bit7: alarm for system temperature higher than 40℃
						Bit8: alarm for system temperature higher than 50℃
						Bit9: excessive exhaust temperature alarm
						Bit10: low water temperature alarm
						Bit11: compressor temperature switch
						Bit12: oil pressure alarm

2	4X00017	10H	Spare		Read	
3	4X00018	11H	Spare		Read	
The serial number	Modbus Address	Address	Function	Variable parameter	Read and Write	Instructions
4	4X00019	12H	Spare		Read	
5	4X00020	13H	Spare		Read	
6	4X00021	14H	Spare		Read	
7	4X00022	15H	Spare		Read	

3.8.3.5 Through the communication function, the write date function of WVCP device can be viewed remotely. See Table 3-13 for the specific function point.

Table 3-13. The communication address parameters of write data function of WVCP device

The serial number	Modbus Address	Address	Function	Variable Parameter	Read and Write	Instructions
1	4X00031	1EH	Remote control signal	16 bits signed	Write	Bit0: remote start device Bit1: 1st remote switching Bit2:1st refrigeration start Bit3:1st defrosting start Bit4:2nd refrigeration start Bit5:2nd defrost start Bit6: 2nd remote switching Bit7: communication data write confirmation Bit8: reset alarm Bit9: spare Bit10: spare
2	4X00032	1FH	1st defrosting completion temperature	16 bits signed	Write	
3	4X00033	20H	2nd defrosting completion temperature	16 bits signed	Write	
4	4X00034	21H	Reset 1# refrigeration completion temperature	16 bits signed	Write	
5	4X00035	22H	1# refrigeration completion	16 bits signed	Write	

			temperature			
The serial number	Modbus Address	Address	Function	Variable parameter	Read and Write	Instructions
6	4X00036	23H	Spare	16 bits signed	Write	
7	4X00037	24H	Spare		Write	
8	4X00038	25H	Spare		Write	
9	4X00039	26H	Spare		Write	
10	4X00040	27H	Spare		Write	

4 Man-machine interface and operation

Overview

This chapter provides a complete man-machine interface and operating instructions for WVCP products.

4.1 Operation Panel

See Figure 4-1

Figure 4-1. Operation Panel

1. Man-machine interface LCD screen.
2. Compressor start/stop button (button with ring green compressor running indicator).
3. System failure alarm.

4.1.1 Before starting the machine, it is necessary to check whether there is an alarm information in the alarm information bar of the man-machine interface and whether the alarm indicator light on the operation panel is lit. If yes, you can click the reset button on the screen to reset until the alarm information is eliminated

and the alarm indicator is off.

4.1.2 After confirmation, press the start switch. If the device is in the local state, after several seconds' delay, the sound of compressor start will be heard, and the indicator light of start switch will be turned green. If the device is in the remote state, it needs to click the start switch through the remote line or communication function. After a delay of a few seconds, the compressor will be turned on and the device will start standby operation.

4.2 Main Interface

See Figure 4-2

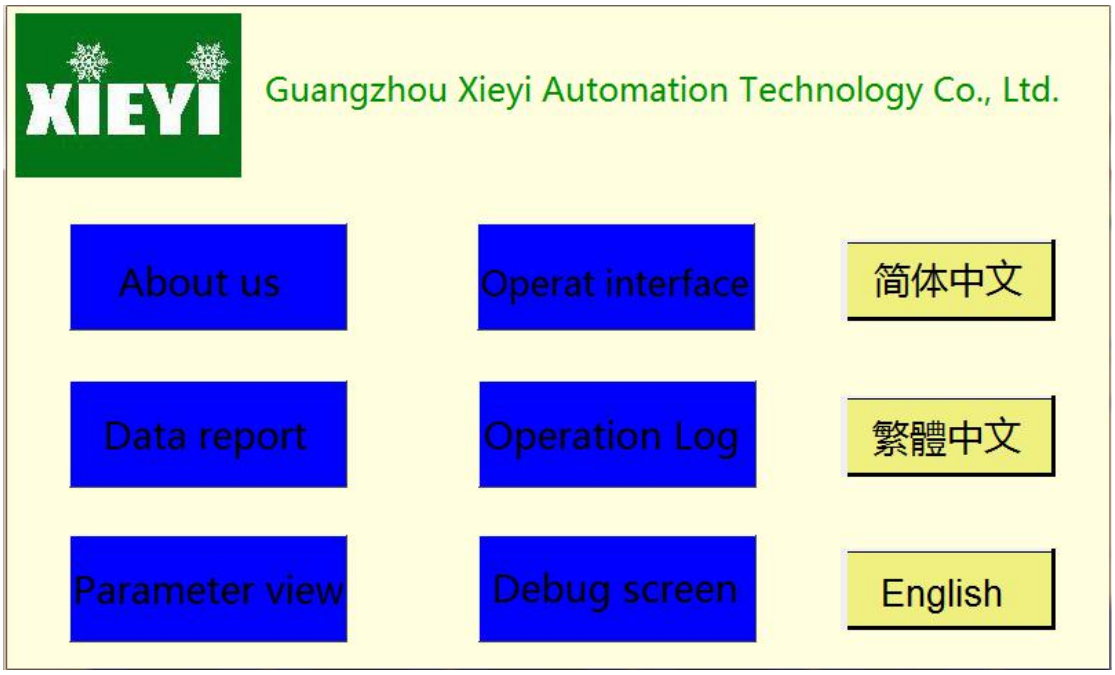
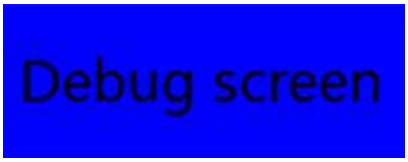
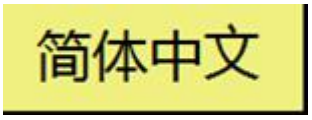


Figure 4-2. Main Interface

4.2.1 Through this interface, you can enter each function interface that needs to be operated, and see table 4-1 for the functions of the keys.

Table 4-1. Key Interface Key Functions

button	Features	use
About us	About Us	Press to enter the "About Us" interface
Operat interface	Operation Interface	Press to enter the "operator interface" interface
Data report	Data Report	Press to enter the "data report" interface

	Operation Log	Press to enter the " Operation Log " interface
	Parameter View	Press to enter the " Parameter View " interface
	Debug Screen	Press to enter the "Debug Screen" interface
	Simplified Chinese	Press to enter the Simplified Chinese Mode
	Traditional Chinese	Press to enter the Traditional Chinese Mode
	English	Press to enter the English Mode

4.3 Operation Interface

See figure 4-3 dual-way touch screen interface and figure 4-4 single-way touch screen interface.

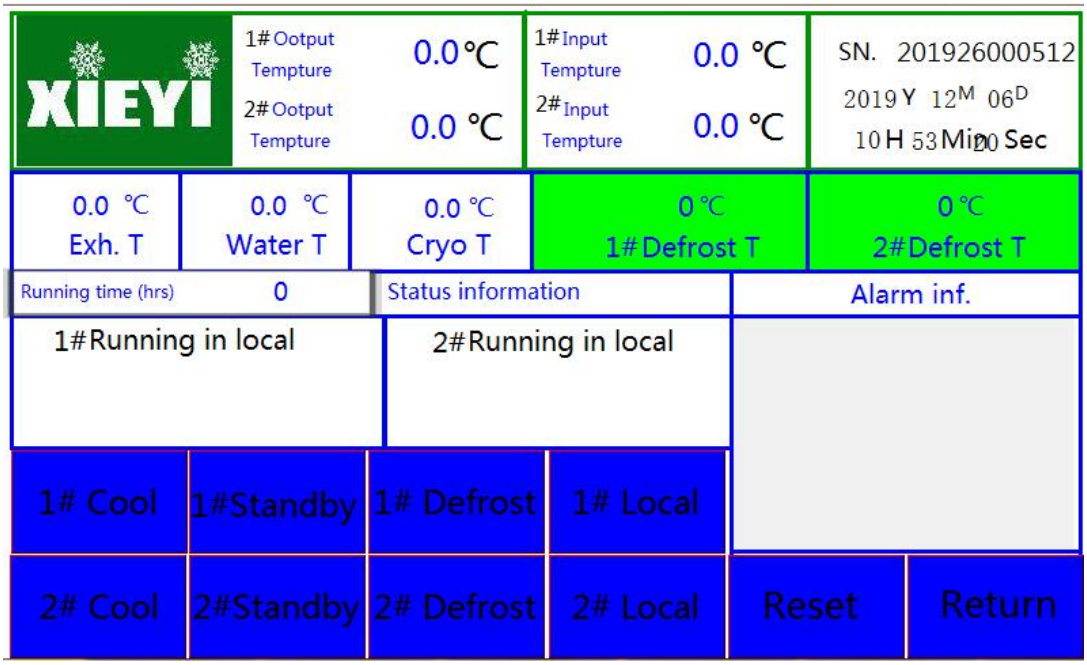


Figure 4-3. Dual-way touch screen interface

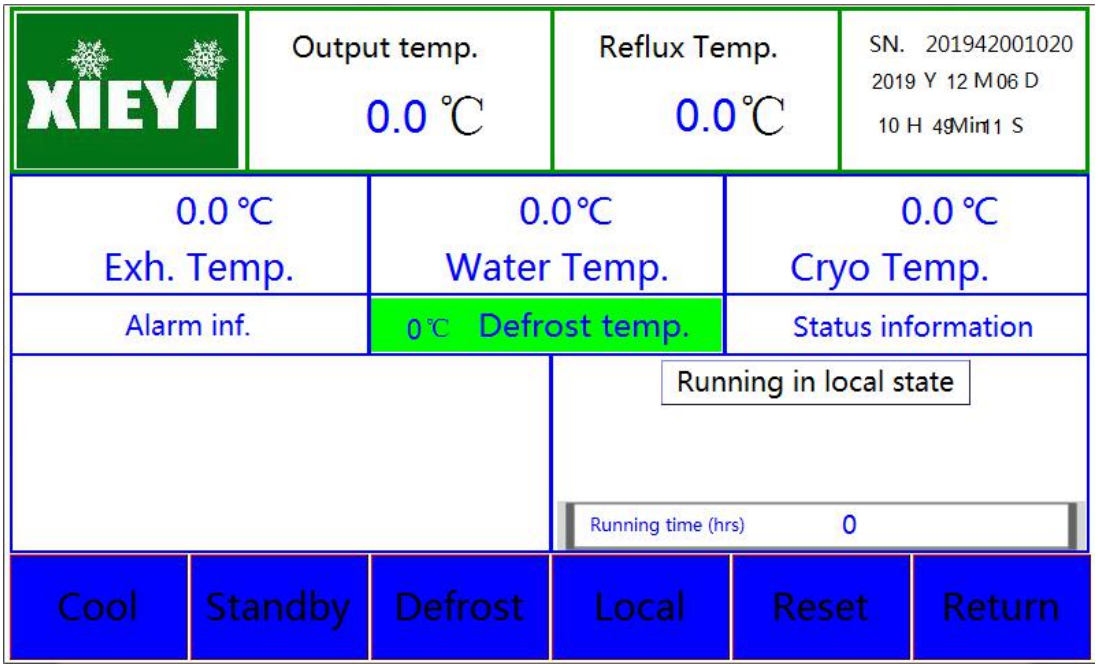


Figure 4-4. Single-way touch screen interface

4.3.1 This interface is the main operation interface, which mainly includes the operation data monitoring area, device status information area, alarm information display area and operation area.

4.3.2 The operation data monitoring area shows the main operation parameters of the device, such as exhaust temperature, cooling water temperature, cryogenic temperature and reflux temperature, as well as the factory information and current time of the device.

4.3.3 The device status information display area mainly displays the current operation state of the device, such as the remote/local state of the device, standby state, refrigeration state, defrosting state, standby state and defrosting state. The device will be displayed in the status information display area according to the current actual state, so as to know the current operation state of the device.

4.3.4 Alarm information. When the device has a fault alarm, the reason for the alarm will be displayed in this area, so that the operator can check and confirm the fault accordingly.

4.3.5 Defrost temperature setting, by pressing the button of Defrost, will pop up the setting defrost temperature keyboard, by entering the required temperature to set the defrost temperature.

4.3.6 Operation area, this area is the main operation area, can switch remote, refrigeration, defrosting, standby operation, and reset the alarm information. Detailed instructions for the operation are shown in table 4-2.

Table 4-2. Operation interface key functions

Button	Features	use
Cool	Refrigeration	After pressing the corresponding cryogenic interface circuit into the cooling mode, the button becomes green
Standby	Standby	After pressing the corresponding cryogenic interface circuit into standby mode, the button turns green
Defrost	Defrosting	After pressing the corresponding cryogenic interface circuit into the defrost mode, the button turns green

	Local/remote control	After pressing the WVCP system switches between remote mode and remote control, the remote mode button turns green and changes from "local" to "remote"
	Reset	Reset the WVCP system alarm
	return	Press to return to the main interface

4.4 Introduction to our interface

Figure 4-5. About us interface

Note: Press the "Return" button to return to the main interface.

4.5 Data Report

See Figure 4-6

Note: This interface allows you to view the device running history data.

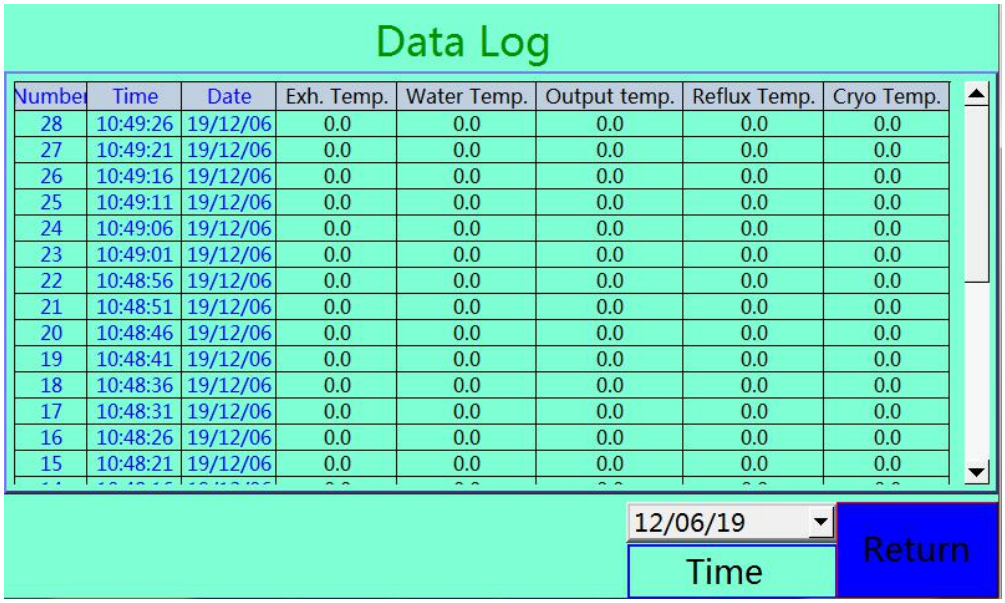


Figure 4-6. Data Report Interface

Note: Press the "Return" button to return to the main interface, Press time selection can choose to view a day's data records.

4.6 Operation Log

See Figure 4-7

Note: This interface allows you to view the device running history data.

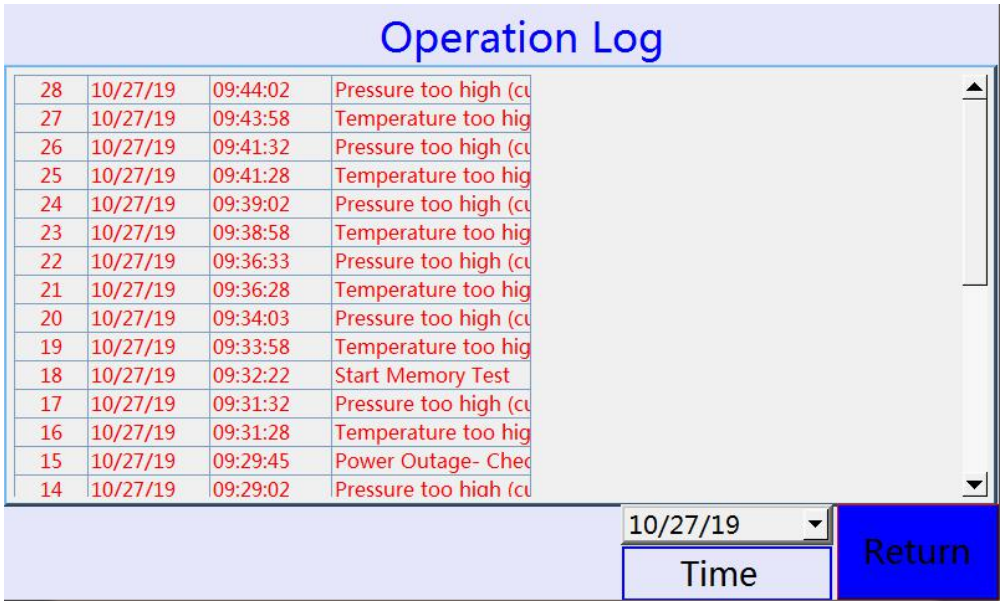


Figure 4-7. Run the recording interface

Note: Press the "Return" button to return to the main interface.

4.7 Parameter View

See Figure 4-8

Note: this interface can view the operating parameters of the device.

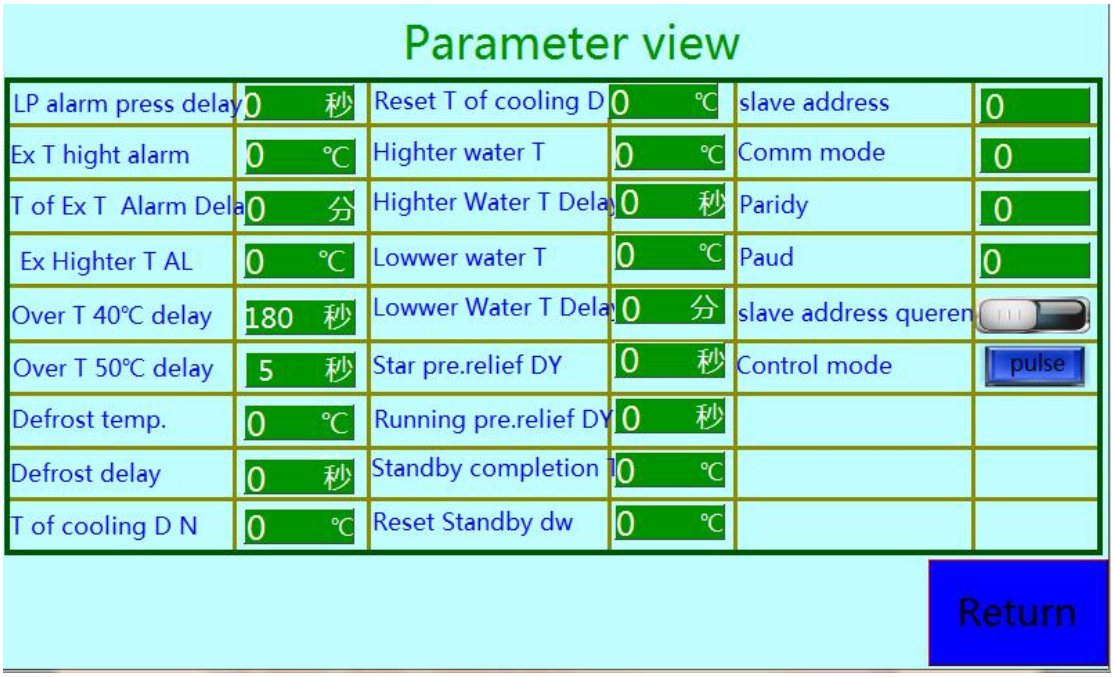


Figure 4-8. Run parameters view

4.8 Debug screen interface instructions

See Figure 4-9

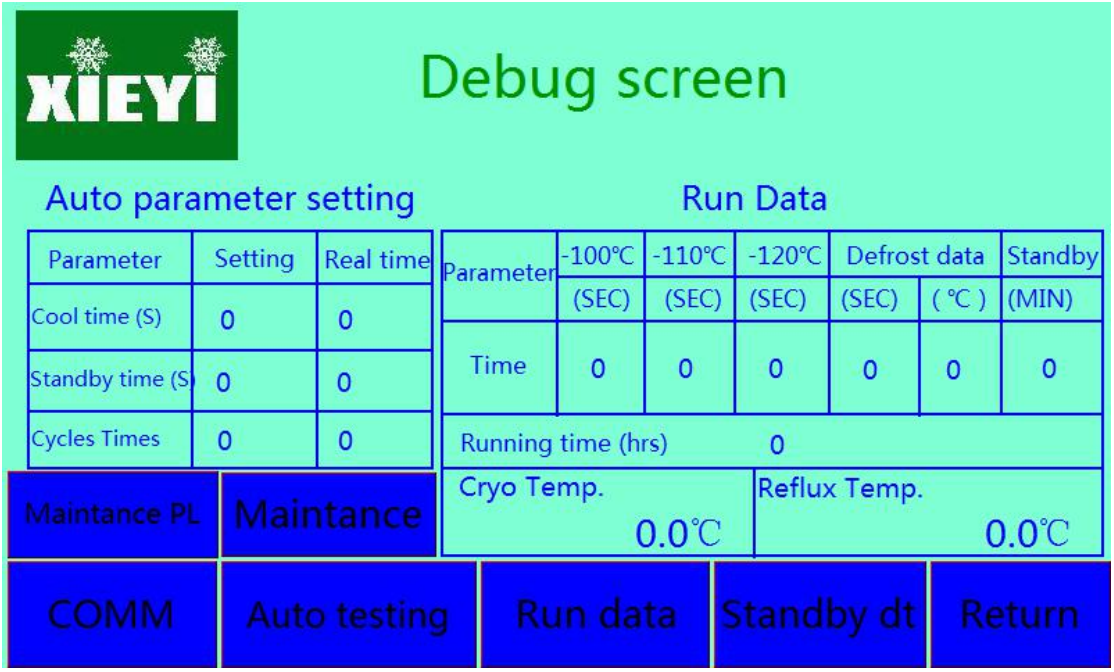


Figure 4-9. Debug screen

Note:

1. Through this interface, the performance of the device can be tested.
2. Press the "auto testing" button to start testing according to the parameters in "auto parameter setting". The device starts the cycle automatically, and automatically switches to refrigeration after the standby "standby time". After the refrigeration "cooling time", it switches to defrosting. After the defrosting, it turns to standby and runs until the cycle times are completed.
3. Press the "run data" button to enter the "run data", you can check the running data monitored in the run all the way diagram, including the time to -100℃, -110℃, -120℃, defrosting time and the condensation temperature of the time.
4. Press the "standby data" button to enter the "standby data", and you can check the running data of WVCP when standby is completed.
5. Press the "Maintenance PL" button to enter the "maintenance interface", you can enter the maintenance interface to operate the device manually.
6. Press the "Return" button to enter the main screen.

4.8.1 Run date record screen

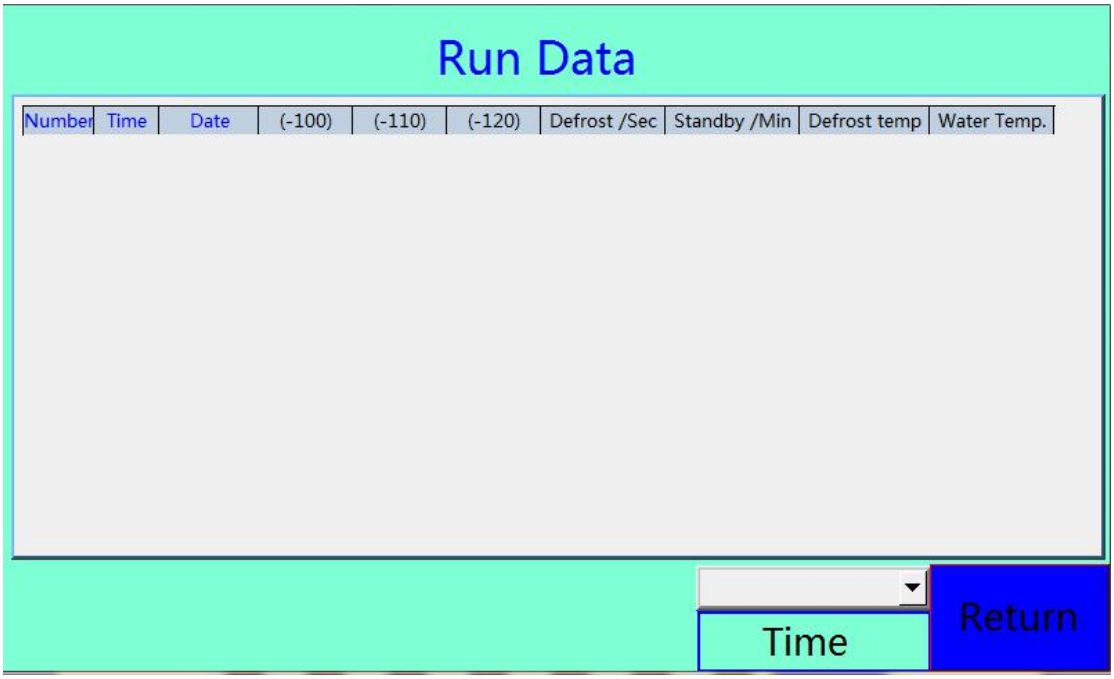


Figure 4-10. Run data record screen

Note:

1. Through this interface, you can check the standby time of defrosting for each refrigeration of WVCP.
2. The previous running record can be retrieved by clicking the time selection. Press the "Return" button to enter the main operation screen.

4.8.2 Standby date record screen

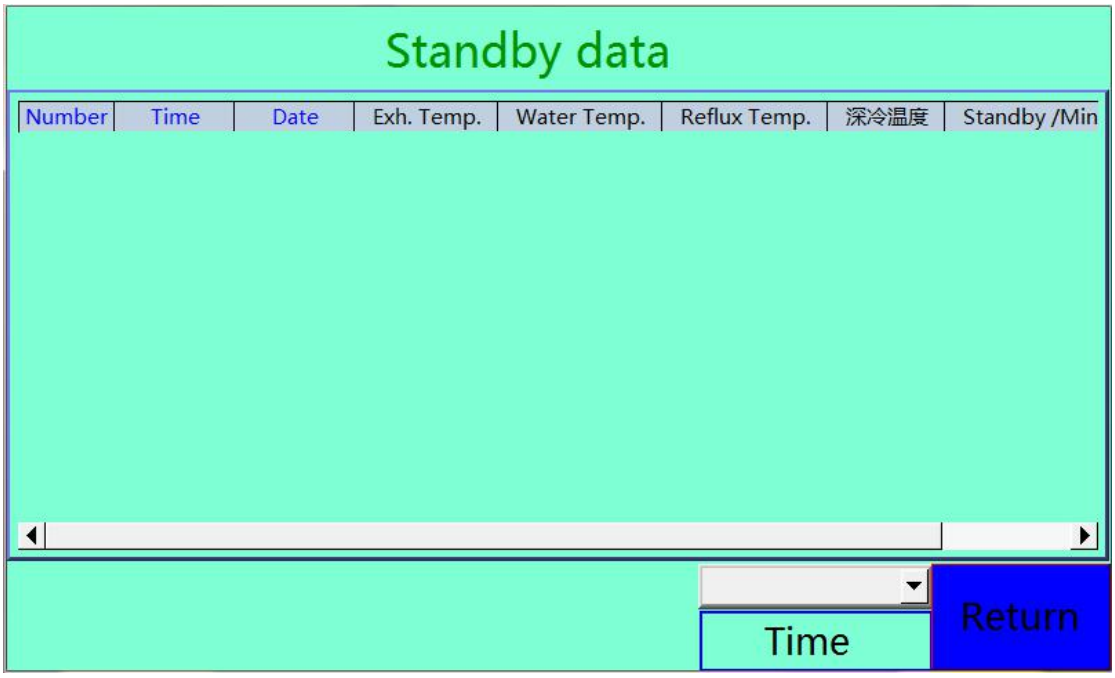


Figure 4-11. Standby data record screen

Note:

1. Through this interface, you can check the standby time of defrosting for each refrigeration of WVCP.
2. The previous running record can be retrieved by clicking the time selection. Press the "Return" button to enter the main operation screen.

4.8.3 Maintenance screen

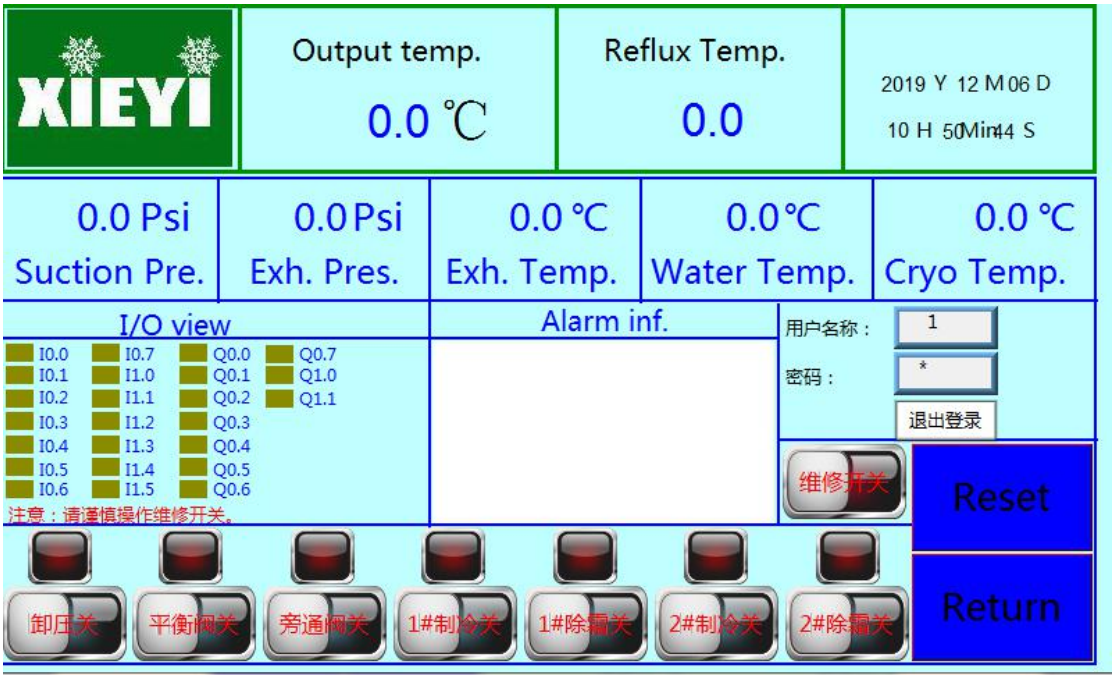


Figure 4-12. Maintenance screen

4.9 Man-machine interface content instructions

Table 4-4. Instruction of man-machine interface content

Content	Display status	Instruction
Alarm information	No alarm when the content is blank	WVCP system alarm information display
Cryogenic temperature	Temperature value	WVCP system in the standby state of the minimum temperature
1# Output temperature	Temperature value	WVCP system 1# pass cryosurface pipeline input temperature
1# Reflow temperature	Temperature value	WVCP system 1# pass cryosurface pipeline output temperature
2# Output temperature	Temperature value	WVCP system 2# pass cryosurface pipeline input temperature
2# Reflow temperature	Temperature value	WVCP system 2# pass cryosurface pipeline output temperature
Exhaust gas temperature	Temperature value	WVCP system compressor exhaust line temperature
Cold water temperature	Temperature value	WVCP system High pressure line refrigerant after condensation temperature
serial number	XXXX	Device file information, manufacturer 's definition

4.10 Man - machine interface alarm content description

Table 4-5. Instruction of man-machine interface alarm

Content	Set value	Description
Low suction pressure alarm	2psi	When the system suction pressure is less than 2psi when the system stops and shows low inspiratory pressure alarm information
Excessive exhaust pressure alarm	385psi	When the system exhaust pressure is greater than 385psi when the system stops and shows the exhaust pressure high alarm information
System overpressure switch alarm	390	When the system exhaust pressure is greater than 390psi if the exhaust pressure is too high alarm failure, the system shutdown and display system overpressure switch alarm information
Excessive exhaust temperature alarm	135℃	When the exhaust temperature is higher than 135 ° C for more than 40 minutes, the system is shut down and the exhaust temperature is too high.
Exhaust temperature switch alarm	145℃	When the exhaust temperature sensor fails, and the temperature is higher than 145 ℃ will trigger the exhaust temperature switch, the system shut down and display the exhaust temperature switch alarm information
Compressor overcurrent alarm *	Greater than FR1 setting	When the compressor running current is greater than the FR1 set value when the system stops and shows the compressor over-current alarm
Cooling water temperature is too high alarm	38℃	When the cooling temperature is higher than 38 ° C for more than 15 seconds, the system is stopped and the cooling water temperature is high.

*** Note: Compressor over-current alarm FR1 set-point (see Table 4-6)**

Table 4-6. FR1 Settings

model	Voltage(V)	FR1 current setting（A）
WVCP550	208/230	50
	400	27
WVCP2600	208/230	50
	400	27
WVCP3000	208/230	62
	400	30
WVCP3600	208/230	62
	400	30
WVCP4200	208/230	62
	400	30
WVCP6000	208/230	100
	400	45

4.11 Operation of the water vapor capture pump in standby, cooling and defrosting conditions

The water vapor capture pump can be operated in three different modes: standby, cooling and defrosting.

Operation of water vapor capture pump in standby mode

When the cooling unit is in the standby mode, the cooling and defrosting solenoid valves are closed. The refrigeration unit circulates and cools the refrigerant mixture in the "WVCP inner pipe". When the cooling unit is operated in this mode, the temperature of the refrigerant is the lowest, so the heat load is minimum.

Operation of water vapor capture pump in cooling mode

When the cooling unit is in cooling mode, the cooling solenoid valve opens and the defrost solenoid valve closes. The low temperature refrigerant is sucked into the output line. The low temperature refrigerant cools the cryosurface and returns through the return pipe. The refrigerant then passes through the "WVCP inner pipe" to the suction end of the compressor.

Operation of water vapor capture pump in defrost mode

When the cooling unit is in the defrosting state, the refrigeration solenoid valve closes and the defrost solenoid valve opens. The high temperature refrigerant in the "WVCP inner pipe" is sucked into the output line. High temperature refrigerant will make the cryosurface temperature rise, and then return through the return pipe. When the cryosurface defrosting is complete, the cooling unit will automatically switch to standby mode.

4.11.1 WVCP550D / 2600D / 3000D / 3600D / 4200D / 6000D Precautions

The function of WVCP550D /2600D /3000D /3600D /4200D /6000D and WVCP550/2600/3000/3600/4200/6000 are the same. However, the former refrigerant is assigned to two separate sets of output and return pipes, which can operate simultaneously for both cryosurfaces.

When a set of circuits is defrosted and another set of circuits is being cooled, the temperature of the circuit in the cooling operation is increased by about 20 ° C. Therefore, it is necessary to coordinate the choice of defrost time in order to meet the process requirements. If the second set of circuits contains a cryosurface, and the use of diffusion pump, there is no such problem. However, if the cooling of the two sets of circuits is a cryocoil, a set of circuits should be evaluated for defrosting while the other circuit is cooling at the same time, which will affect the coating process.

If the two sets of refrigerant circuit at the same time the mode of operation is different, the following modes of operation will occur:

Standby and cooling

If a circuit is standby and another set of circuits is cooled, the temperature of the cryosurface that is cooled at this time, will be cooler by a few degrees than the two cryosufaces are cooled at the same time (two sets of circuits cooling at the same time) This is because only a set of circuit cooling, the system's total heat load is lower. However, when a set of circuits is not used and only use another set of circuits, it is impossible to achieve 100% of the cooling capacity in a set of circuits.

Defrost and cooling

If a cryogenic interface is defrosted when another cryogenic interface is cooled, the temperature of the cryosuface will rise by about 20 ° C. This is because the refrigerant from the two cryosurfaces will converge in the common return pipe. If the above temperature cause problems, please contact Guangzhou Xieyi Automation Technology Co., Ltd. 020-82351819 for relevant assessment.

Defrost and standby

If a set of circuit defrost and another set of circuit standby, then the cryosurface defrosting speed will be s little faster, than the two cryosurface defrost at the same time the time.

4.12 How to use water vapor capture pumps

4.12.1 If the cryosurface is a coil

Select Standby to make the refrigeration unit pre-cooled.

When the cooling unit is in the standby state, the refrigerant mixture and the "WVCP inner pipe are cooled. If the refrigeration unit is turned off for more than 12 hours before starting, it takes 40 minutes to complete the pre-cooling session.

The internal temperature of the cooling unit can be monitored by the cryogenic temperature of the display panel. When the cryogenic temperature below -140 °C the machine can go to the cooling state. Because at this time the cooling unit heat load is small, it is safe. Turn to cooling state for the refrigeration unit.

Note: The WVCP system can be in standby mode for a long time.

Select COOL to capture the water vapor in the vacuum chamber where the cryocoil is located.

Once the pre-cooling is complete, the cooling unit can turn to the cooling operation at any time (after the vacuum chamber is in vacuum), most of the control will turn to the cooling operation when the high vacuum valve is opened. Within 60 seconds, the cryocoil will begin to trap moisture.

The time point at which the steam trapping pump is turned to the cooling can be tested to determine the shortest evacuation time of the vacuum chamber. Normally the faster the cooling unit is turned to the cooling, the shorter the evacuation time of the vacuum chamber. However, if the cryocoil traps too much water, the surface temperature of the cryocoil will rise and limit the ultimate moisture vapor pressure temperature which can be achieved eventually (see Table 3-6).

Select DEFROST to remove the trapped water from the cryocoil

The defrost operation allows the cryocoil to be ready again before the next vacuum cycle begins. Defrosting is performed so that the temperature of the vacuum chamber reaches the atmospheric pressure before the temperature of the cryocoil

rises to the ambient temperature. General defrosting operations will end in 3 minutes or less. When the temperature of the return refrigerant reaches 0 °C, the cooling unit stops the defrosting operation. This will ensure that there is no water vapor condensation in the air on the cryocoil.

After the defrosting is complete, the cooling unit will automatically turn into standby mode. Before selecting the cooling operation, keep the cooling unit at least 5 minutes in standby mode.

Note: In order to shorten the defrost cycle, you can adjust the defrost temperature (adjust the range to -30 ° C- + 20 ° C). Adjust the temperature need to make sure when vacuum chamber fills the atmosphere, the cold coil does not produce water or does not affect the next pumping time and product quality.

⚠CAUTION

GENERAL HAZARD

If a large amount of water is trapped in the vacuum cycle, the liquid or ice may drip on the cryocoil during defrosting. This may cause minor or moderate damage.

It may be necessary to prepare a water tray or similar device to avoid the accumulation of liquid water in places where you do not want to gather.

⚠CAUTION

GENERAL HAZARD

For WVCP550D/WVCP2600D/WVCP3000D/WVCP360 0D/WVCP4200D/WVCP60 00Dusers: When a set of circuits is defrosted and another set of circuits is being cooled, it should be noted that the temperature of the coil being cooled will rise by 20 °C. The temperature required for the affected process should be checked to confirm that the above temperature rise does not affect the process. If the rising temperature is unacceptable, wait until the process is completed after the defrost operation. Two sets of circuits can be defrosted at the same time.

4.12.2 If the cryosurface is a cryobaffle

Cooling the cryobaffle:

1. Vacuum chamber where the cryogenic cold trap is located is at least 6Pa.
2. Start the cooling unit and select the cooling operation. The general cryobaffle takes more than 60 minutes to be cooled down.
3. Start the high vacuum pump.

Defrosting the cryobaffle:

If the cryogenic cold trap traps too much moisture, the surface temperature of the cryogenic cold trap will rise and will limit the final number of the water vapor partial pressure temperature. It is recommended to carry out natural backwashing and defrosting so that the cryogenic cold trap is ready for the next cycle to capture water vapor and oil vapor. The defrosting interval may take 8 hours or more, depending on the amount of water collected, the temperature of the low temperature surface, and the degree of vacuum.

1. Turn off the high vacuum valve to keep the vacuum pump high
2. Turn off the cooling unit or select the standby mode

⚠CAUTION

GENERAL HAZARD

If the cryogenic cold trap is used to prevent oil return, if the defrosting operation is selected, the high vacuum pump may be damaged or the oil quality may be deteriorated.

When the cryogenic cold trap is used to prevent oli return, do not choose the defrosting operation.

Note: Refueling is a process in which hot steam moves and condenses on a low temperature surface, thus contaminating the system. When using a vacuum pump, the pump oil will heat and move in the opposite direction to the pump suction direction, causing the system to condense and pollute the system.

5 Regular inspection and maintenance

Overview

This chapter provides maintenance plans and procedures for WVCP products.

5.1 Record the temperature and pressure monthly

All measurements are recorded in Table 5-1. If the measured value is not within range, see Chapter 7, Troubleshooting and Repairing Partial Analysis.

In standby mode:

Choose local and standby. Start the cooling unit and wait for 60 minutes. Record inlet pressure and exhaust pressure, exhaust temperature and condensation temperature and cryogenic temperature.

Note: For WVCP550D/2600D/3000D/3600D/4200D/6000D, for the two sets of refrigerant pipelines are selected standby operation.

In cooling mode:

Vacuum where the cryogenic interface is located, at least 6Pa. Choose to cool and wait for 30 minutes. Record the output temperature and return temperature.

Note: For the WVCP550D/2600D/3000D/3600D/4200D/6000D, for the two sets of refrigerant pipelines are selected cooling. Also record the 2 # input temperature and 2 # reflow temperature.

Check the cooling water outlet temperature. The temperature range should be in the range of 22-38 °C. If not, adjust the water flow to make the cooling water outlet temperature is within the above range.

Table 5-1. WVCP Check Data Record Table date:

Refrigeration unit serial number:		First run the data reference benchmark	The degree of change that is acceptable on the basis of the reference	Check the running data
Standby 60 minutes later	Inlet pressure	Psi	If you keep between 3 and 30 psi, you can accept a change of ± 5 psi	
	Exhaust pressure	Psi	Acceptable variation ± 10%.	
	Exhaust gas temperature	°C	Such as at 125 ° C, subject to variable ± 10%	
	Condensation temperature	°C	If the range is within ± 10% of the range of 16 ° C to 33 ° C,	
After cooling for 30 minutes	1 # Output temperature 1 # Reflow temperature	°C	Steady (depending on load). See table 3-6	
	2 # output temperature 2 # Reflow temperature	°C		
After the refrigeration cycle	Is there any extra noise?	no	no	
	Is there any ice or water on the cooling line?	no	no	
After recovering the equilibrium pressure	Is there any water in the valve box?	no	no	
Restore balance pressure	time	Min	Acceptable ± 5Min change	
Restore balance pressure	Balance pressure value	Psi	Acceptable ± 10 changes	
Note: Record the reference value and copy the table multiple copies. If you re-fill the water vapor capture pump system in the future (or add "refrigerant supplements"), you need to re-establish a new reference.				

5.2 Check the water vapor trapping pump every six months

All measurements are recorded in Table 5-1. If the measured value is not within the allowable range, see Chapter 7, Troubleshooting and Repair.

Noise level or new noise

Listen to the sound emitted by the cooling unit. If you hear any new noise, you should determine the source location. If the noise is due to pipe vibration and encountered anything, you can gently remove the pipe to avoid unnecessary wear and tear.

If the noise comes from the compressor, check the compressor oil level - see section 3.4.4 Evaluating the water vapor trapping pump section. Contact your local sales representative or WVCP vendor service department for advice.

Refrigerant tube

Before the completion of the refrigeration cycle, check the refrigerant tube to see if there is no ice or water. If there is water of ice, which should be removed. In accordance with section 3.4.3 on the exposed pipes and joints in the insulation treatment part of the guide, plus a layer of insulation layer.

So that the cooling unit to restore balance pressure. Open the upper right side panel of the front of the cooling unit. Remove the valve cover. If there is water in the valve box, it should be removed.

Make sure that each gasket is in its slot. Install the valve compartment cover. The gasket should be sealed to block the entry of water vapor.

Reinstall the outside of the valve compartment of the cooling unit.

Balance pressure

In the standby state to activate the cooling unit to restore the balance pressure function. Restore the balance pressure (about 10-15Min) after 5 minutes to record the exhaust pressure value from the text showing. If the pressure drops and the last recorded value eWVCPeeds 15 psi, the water vapor capture pump may leak.

⚠ CAUTION

GENERAL HAZARD

When need to restore the balance pressure, WVCP system cryosurface must be in a vacuum state (vacuum less than 6Pa) to activate the function, Otherwise the WVCP system may meet the need to restore the balance pressure for too long or even restore the balance pressure failure, causing damage to the WVCP system.

Prohibited WVCP system in the cold trap in a non-vacuum state (vacuum greater than 6Pa) activation to restore the balance pressure function.

⚠WARNING

GENERAL HAZARD

All refrigeration operations must be performed by a qualified refrigeration engineer, which could result in death or serious injury.

If you need to repair the water vapor capture pump, please contact a qualified refrigeration engineer.

6 Troubleshooting and repair

Overview

Only qualified personnel who have been trained can troubleshoot this product. Guangzhou Xieyi Automation Technology Co., LTD. Provides training in troubleshooting and maintenance of this product.

6.1 If the system leaks

1. Locate the leak point.
2. Determine the cause of the leak.

⚠Warning

If there is a repeat leak or you have not been trained, please stop and contact the factory or qualified maintenance representative to repair the leak.

If you are qualified for maintenance:

3. Refrigerant can be discharged from the system only after the system has been shut down for at least 24 hours or activated to restore balance pressure.
4. Adopt environmental protection methods to drain and refill the cold media from the system, and comply with local regulations.

Repair the leak.

5. Leak detection after repairing.
6. Keep the WVCP system and the cold well pipeline at the pressure of 250 psi, the holding time is about 24 hours, every 2 hours record pressure number, only after confirm the pressure has no change, then we can go to the next step.
7. Use a heating lamp to bake oil separator and dry strainer and at the same time vacuum the system at least 12 hours to remove moisture.(for the filter drier heated, the highest temperature should not eWVCPeed 80 ° C, in order to avoid the internal damage.)
8. Replace refrigerant with the original WVCP series refrigerant, which is authorized by Guangzhou Xieyi Automation Technology Co., LTD., to replace the cold medium as the refilling medium. Using unrecognized refrigerant will disable the warranty and damage the system.

⚠CAUTION

GENARAL HAZARD

Refrigerant not come from Guangzhou Xieyi Automation Technology Co., LTD. May cause damage to the system or unstable system conditions, and disable the device warranty.

It is forbidden to use refrigerant not come from Guangzhou Xieyi Automation Technology Co., LTD

6.2 If the system performance goes down

1. Check the balance pressure.

2. Check whether the discharge pressure solenoid valve is closed.

At least 60 minutes after the system stabilizes, find the position of the discharge pressure solenoid valve. Do you find frost on this line or valve? If the frost is found, the solenoid may not be closed. A pressure gauge can also be connected to the expansion tank to measure pressure, and its pressure is not more than 10psi compared with the suction pressure of the compressor. If the pressure difference exceeds this limit, it indicates that the discharge pressure solenoid valve is not in close place.

3. Conduct vacuum check of compressor

Let the system run for at least 60 minutes in standby mode, and the suction pressure of the compressor can be detected by the manifold meter on the compressor suction valve. Make the air suction valve stem of the compressor forward. Observe the pressure gauge on the manifold dial. Compressor stops when pressure is -15In.Hg. The pressure will slowly rise, but it should be maintained at least 1 minute under this pressure condition. If not, apply more torque to the suction stem to ensure that it is tightly closed. Repeat the vacuum check, then stop the compressor and check the rising speed of the pressure again. If the pressure continues to rise, contact the factory for more guidance. You may need to replace the compressor valve plate or replace the compressor.

4. Check whether the pipeline or cryocoil has abnormal curl

Check the coolant tube and the cryocoil to ensure that all the pipes have no indentation or kinks.

5. Check if the insulation is appropriate

Check for refrigerant pipeline. Determine the insulation of the pipeline in good condition. If you use a vacuum sandwich insulation line, check if there is frost on these pipes. If there is frost on the outside, it indicates that the pipe may have a knot phenomenon or vacuum insulation has been damaged.

6. Check the voltage at the cooled solenoid valve

To operate the system in cooling mode. If a tick is heard, the solenoid coil of the valve is activated. Measure the voltage of the solenoid valve. The voltage shall be within the limits specified in the electrical installation section.

7. Check the cooling water and confirm that its flow rate is adequate and the temperature is appropriate.

(see section of 3.2.5 connect cooling water.)

8. Check whether the compressor oil contains acid. If you find acid in the oil, contact the factory and get a rework instruction.

9. Check if there is too much oil in the refrigeration valve.

Check the oil in the refrigerating valve, remove the refrigeration solenoid valve, open the refrigeration manual valve for 15 seconds, and check the condition of the refrigeration solenoid valve interface for oil. If you find eWVCPess oil, please contact the factory.

6.3 How to deal with water vapor capture pump failure

When the cooling unit alarm light is on, enter the man-machine interface to view the alarm information. See figure 6-1. Then find the corresponding troubleshooting section below.

⚠CAUTION

After the fault investigation is clear and troubleshooting, the system should be reset to restart.

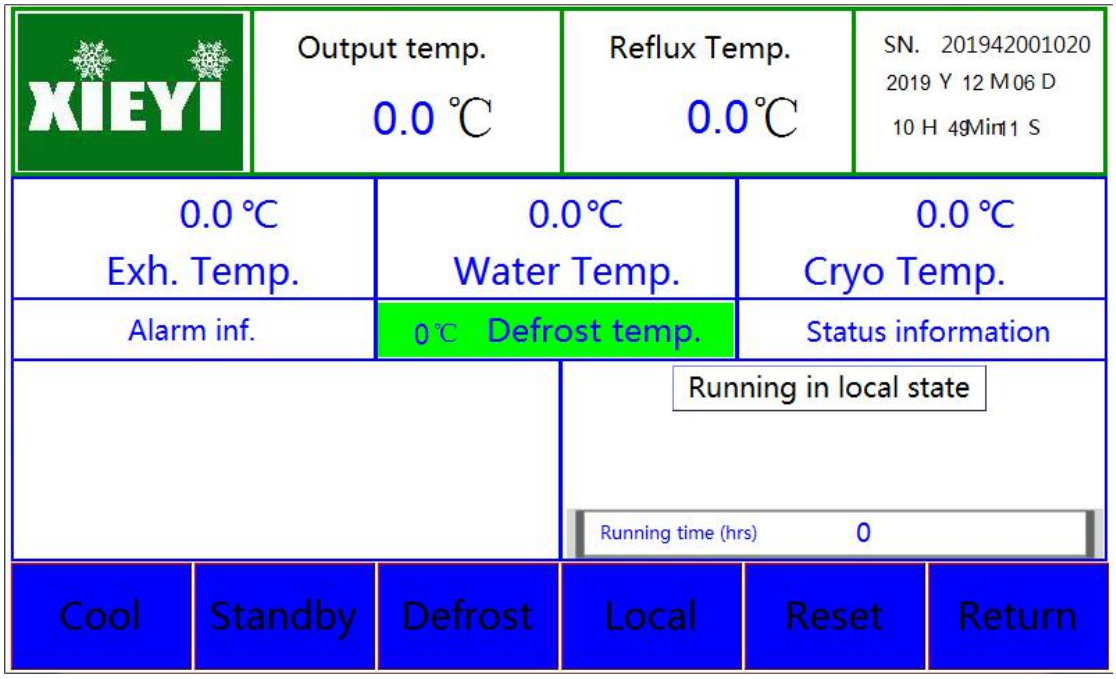


Figure 6-1. Operation interface

6.3.1 Low suction pressure alarm

When the WVCP system runs, the system controller collects data through the suction pressure sensor. System suction pressure alarm is set to 2 psi. This

setting can ensure the positive pressure is maintained at the suction end of the compressor. If the water vapor cryopump is leaking, the system will be shut down, ensure the moisture in the air cannot pollute the refrigerant pipeline system.

Note: if you have checked the water vapor cryopump before, please refer to table 5-1 for more accurate data reference.

Problem	Cause	Solution
Cryopump stop running Alarm indicator man-machine interface display inlet pressure low alarm information	Cooling water overcooling the system	Record the condensation temperature. Stop the system and press the RESET button. Select the local state STANDBY. Restart the system. In standby mode, the temperature of condensation temperature is monitored for 30 minutes. The temperature should be within the scope of the 16-33 ° C. If not in this range, ensure that the cooling water meets the requirements of section 3.2.5 connecting parts of the cooling water.
	Refrigeration unit shutdown: from refrigeration to standby power off in a few minutes. The system is undergoing a lightweight shutdown. When the high-pressure refrigerant pipe temperature is less than 16 ° C when turned off.	By lowering the flow rate or increasing the temperature of the cooling water, the condensation temperature increases.
	The water vapor cryopump is leaking	Make the water vapor cryopump to restore balance pressure, capture records balance pressure gauge's number, compared with the standard balance pressure value (or) compared with standard value when device installation, if lower than the standard 20 psi, please contact the authorized service agent or WVCP for guidance.
	The suction pressure alarm is set at 2psi	Gas pressure sensor readings appear error, use a good manifold gauge access compressor suction side to measure inlet pressure whether real value get to alarm value, if the judge is due to the device measuring error prompted a alarm device downtime, please call authorized service agent or WVCP manufacturers, in order to obtain guidance.

Note: ** no load means no external heat load or no heat (watt). The maximum rated load can be defined as the case when the operating power of the system is limited to a light thermal load (light load is 1/2 or 1/3 of the maximum load).

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be completed by qualified refrigeration engineers, otherwise fatal or serious injuries will result.

If you need to fix water vapor cryopump, please contact qualified refrigeration engineer.

6.3.2 High exhaust pressure alarm

During the WVCP system operation, the system controller collects data through the exhaust pressure sensor. The system exhaust pressure alarm is set to 380 psi. These set values ensure that the compressor and other components can operate under rated work pressure.

In WVCP system running, the exhaust pressure of pressure switch manually reset device value: 390 Psi, this value can be in the compressor and other components to ensure that the running under the rated pressure, when the system controller of the exhaust pressure sensor data failure, pressure switch will be used as the final pressure protection.

6.3.2.1 Pressure setting of pressure switch for manual reset device of exhaust pressure: 390 Psi

For WVCP550/2600/3000/3600/4200 specifications, the operation pressure of pressure switch for the manual reset device of exhaust pressure is set at 390Psi;

For WVCP6000, the operation pressure of pressure switch for the manual reset device of exhaust pressure is set at 400Psi.

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be completed by qualified refrigeration engineers, otherwise fatal or serious injuries will result. If the pump needs repairing, please contact qualified refrigeration engineer.

Note: WVCP2600/3600/4200 USES a pressure switch with a manual reset device. When the high-pressure alarm needs to be opened, the lower panel on the right side of the unit should be opened, and the green reset button on the pressure switch is manually pushed to remove the alarm.

Problem	Cause	Solution
Steam cryopump stop running alarm indicator man-machine interface display high exhaust pressure alarm information	Excessive heat overload come from the cryosurface	Enter refrigeration mode. Monitor the discharge pressure for 30 minutes. If high exhaust pressure will cause the system downtime, should check whether the following content: ● Cryocoil is from the vacuum chamber wall should be at least 16mm. ● Cryosurface can't directly to more than 50 ° C heat source. ● Please confirm whether the size specification is within the specified range for the newly installed cryosurface. ● The vacuum chamber must be evacuated during refrigeration. If the above is normal, be sure to stay in standby mode for at least 5 minutes after defrost, before turn to refrigeration.
	After defrosting the cryosurface, the refrigeration mode is directly switched from standby mode to refrigeration mode	After the defrosting is completed, the system should remain in standby for at least 5 minutes.

	High - pressure alarm occurs when defrost occurs, or high - pressure alarm occurs when the defrost turns to standby.	Before the refrigerating condition turns to the defrosting, make sure the exhaust pressure drops below 300 psi and then defrost.
	The frost action cannot stop the system load too much	Check whether the temperature of the COIL input temperature reaches the temperature of the defrosting finish, and the temperature is still rising. If it keeps rising, it may be the fault of the solenoid valve jam or the control circuit of the solenoid valve fault.

Cryopump stop running alarm indicator man-machine interface display high exhaust pressure alarm information	Refrigerant in the cryopump is too much, the capture is not correct	Make the cryopump to restore balance, records balance pressure gauge number, compared with the standard model balance pressure value, if higher than the standard 20 psi, please contact the authorized service agent or WVCP for guidance.
	The compressor discharge valve is not fully open. This valve may not be fully open after the system is filled with refrigerant.	Check the valve and open it.
	The exhaust setting value of the high-pressure manual reset pressure switch is incorrect	High pressure manual reset pressure switch sets the alarm value of 390psi.
	High pressure manual reset pressure switch cable loose contact	Visual inspection of all system cables. Tighten when necessary.
	High pressure sensing detection error, the high-pressure alarm set point is 380 psi	High pressure sensor appear error, use an accurate manifold pressure gauge access compressor exhaust side to measure exhaust pressure's real value whether get to the alarm value, if the judge is due to the sensor error prompted an alarm, please call authorized service agent or WVCP manufacturers, in order to obtain guidance.

6.3.2.4 Reset the pressure switch after failure

Note: see the following figure (figure. 6-2 to figure. 6-3) to determine the location of the system's pressure switch. Push the green reset button to reset the switch.

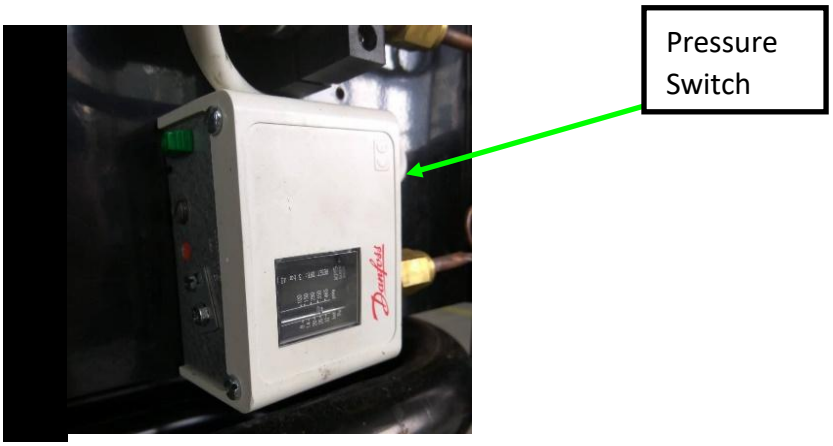


Figure 6-2. Pressure switch

Figure 6-3. Pressure switch location

6.3.3 High exhaust temperature alarm

During the operation of WVCP system, the system controller gathers data through the exhaust temperature thermocouple sensor. System exhaust temperature alarm set at 135 ° C and 145 ° C two analog logic setting values for protection. These set values ensure that the compressor and other components can operate under reasonable operating conditions. When the system detects that the exhaust temperature of 135 °C, PLC start a timer, if the exhaust temperature of greater than 135 °C more than 40 minutes, PLC will shut down the system and alarm, text display shows the exhaust over temperature alarm information.

If the system exhaust temperature sensor detect failure, exhaust temperature reaches 145 ° C, exhaust temperature constant temperature switch open, then the system downtime, alarm indicator light and text display shows the exhaust over temperature alarm information.

Note: if you have checked the water vapor cryopump before, please refer to table 5-1 for more accurate data reference.

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be completed by qualified refrigeration engineers, or risk death or serious injury accidents. If the pump needs repairing, please contact qualified refrigeration engineer.

Problem	Cause	Solution
Pump stop running, alarm indicator man-machine interface displays high exhaust temperature alarm information	The cooling water is not enough	To shut down the system and press the reset button, select local control and STANDBY (STANDBY). The temperature and condensation temperature of the high-pressure pipeline are monitored for 90 minutes. ● Exhaust temperature shall not exceed 135 ° C and should remain stable after 45 minutes. ● Condensation temperature should be between 15 to 33 ° C. If the temperature is more than 38 ° C, see section 3.2.5 connection part of cooling water. If cooling temperature is lower than 38 °C system downtime, temperature sensing system is likely to be failed.
	Cryosurface's heat load is too large	Turn to refrigeration mode. Monitor the temperature of the high-pressure line for 30 minutes. If the system is shut down due to excessive exhaust temperature, check the following items: ● The distance of cryosurface from the vacuum chamber wall should be at least 16mm. ● Cryosurface does not directly heat source for more than 50 ° C ● The dimensions of the cryosurface are within the standard range. ● The vacuum chamber must be evacuated during refrigeration.
	The exhaust temperature thermostat switch and cable are not strong enough to be connected or damaged.	Call the authorized maintenance agent or WVCP for guidance
	The internal valve slice of the compressor is not sealed well.	Call the authorized maintenance agent or WVCP for guidance.

6.3.4 High temperature alarm for cooling water

During the operation of WVCP system, the system controller collects data through the cooling temperature thermocouple sensor. When the system detects the cooling temperature of 38 ° C, timing starts, if the cooling temperature >or= 38 ° C for more than 10 seconds, system will breakdown, alarm indicator and text display shows condensing over temperature alarm information.

Note: if you have checked the water vapor cryopump before, please refer to table 5-1 for more accurate data reference.

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be completed by qualified refrigeration engineers, or risk death or serious injury accidents.

If the cryopump needs repairing, please contact qualified refrigeration engineer.

Problem	Cause	Solution
Steam cryopump stop running alarm indicator man-machine interface display high condensation temperature alarm information	Cooling water flow direction is not correct.	Stop the system and press the reset button. Select local control and STANDBY (STANDBY). Start the system. Use one hand to hold the cooling water supply line (IN) and hold the discharge tube (OUT) with the other hand. The temperature of the discharge tube should be higher than that of the water supply line. If not, make the system stop. Connect the water supply and discharge pipe to the correct port.
	Insufficient cooling water flow	Monitor the cooling water temperature for 30 minutes. Temperature should be between 15 to 33 ° C if not, please see 3.2.5 connection part of cooling water. Determine whether the system is stopped only under the following conditions: ● When the water vapor cryopump is under high heat load. ● The condensing temperature is near the upper limit of the alarm temperature range. ● If so, it can increase the cooling capacity of the system by increasing the flow rate of the cooling water or lowering the cooling water temperature.
	High pressure refrigerant pipe thermocouple wire connection is not tightened, or break.	Tighten or maintain the junction of thermocouple lines.

6.3.5 Low temperature alarm for cooling water

During the operation of WVCP system, the system controller collects data through the cooling temperature thermocouple sensor. When the system detects the cooling temperature of 13 ° C, timing starts, if the cooling temperature ＜or= 13 ° C for more than 10 seconds, system will breakdown, the alarm indicator light is on, and the touch screen displays the alarm information of low cooling water temperature.

Note: if you have checked the water vapor cryopump before, please refer to table 5-1 for more accurate data reference.

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be completed by qualified refrigeration engineers, or risk death or serious injury accidents.

If the cryopump needs repairing, please contact qualified refrigeration engineer.

Problem	Cause	Solution
System breakdown, the alarm indicator light is on, and the touch screen displays the alarm information of low cooling water temperature.	Cooling water temperature is too low	Stop the system and press the reset button. Select local control and STANDBY, then start the system. It can be solved by turning up the cooling water temperature. If it is solved unconditionally, the condensation temperature can be increased by turning down the inlet or return

		water valve to reduce the water flow.

6.3.6 Compressor overflow alarm

When WVCP system is running, electronic hot thermal relay detects the compressor current is greater than the set value, thermal relay output signal to the system controller system downtime, alarm indicator light text display shows compressor over-current alarm information.

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be completed by qualified refrigeration engineers, or risk death or serious injury accidents. If the pump needs repairing, please contact qualified refrigeration engineer.

⚠WARNING

ELECTRIC SHOCK

All electrical work must be carried out by qualified electrical engineers or risk death or serious injury accidents. All electrical work must be performed by qualified electrical engineers.

Problem	Cause	Solution
Cryopump stop running. Alarm indicator text display. Compressor over current alarm information	There are too many refrigerants in the water vapor cryopump. Refrigerant filling is not correct.	Make the pump to restore balance, capture records balance pressure gauge number, compared with the standard model balance pressure value, if higher than the standard 20 psi, please contact the authorized service agent or WVCP for guidance.
	Cryosurfaces are subjected to excessive heat overload.	Enter the refrigeration mode. Monitor the discharge pressure for 30 minutes. If the discharge pressure is high, the system will be shut down, and the following items should be checked: ● The distance of cryosurface from the vacuum chamber wall should be at least 16mm. ● Cryosurface does not directly heat source for more than 50 ° C ● The dimensions of the cryosurface are within the standard range. ● The vacuum chamber must be evacuated during refrigeration. If the above is normal, be sure to stay in standby mode for at least 5 minutes after defrost (turn to refrigeration).
	The frost action cannot stop the system over load	Check whether the temperature of the COIL input temperature reaches the end temperature of defrost. If it keeps rising, it may be the fault of the solenoid valve card or the control circuit of the solenoid valve.
	Compressor motor broken	Please check whether the compressor motor is normal. If not, contact WVCP manufacturer.
	The power cord of the compressor is not fastened or broken	Tighten or repair the connection of the power cord.
	The thermoelectric repeater is damaged	lease check whether the compressor motor is normal. If not, contact WVCP manufacturer.

6.3.7 System temperature above 40℃ (or 50℃)

During the WVCP system is running, the system controller will collect the cryogenic temperature and BP temperature by thermocouple. When the system detects the cryogenic temperature and BP temperature of 40℃, timing starts, if the cryogenic temperature and BP temperature >or= 40℃ for more than 3 minutes, system will breakdown, the alarm indicator light is on, and the touch screen displays the alarm information that the system temperature is higher than 40℃.

When the system detects the cryogenic temperature and BP temperature of 50℃, timing starts, if the cryogenic temperature and BP temperature >or= 50℃ for more than 5 seconds, system will breakdown, the alarm indicator light is on, and the touch screen displays the alarm information of the system temperature is higher than 50℃.

Note: If the cryopump has been checked before, please refer to Table 5-1 for more accurate data reference.

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be completed by qualified refrigeration engineers, or risk death or serious injury accidents.

If the cryopump needs repairing, please contact qualified refrigeration engineer.

Problem	Cause	Solution
System breakdown, the alarm indicator light is on, and the touch screen displays the alarm information of the system temperature higher than 40℃ (or 50℃)	Balance solenoid valve failure	Stop the system and press the reset button. Select local control and STANDBY, then start the system. Open the valve box and check whether the balance solenoid valve has power in the coil. During normal system operation, the coil has no power. At the same time, under the premise of ensuring safety, check the temperature before and after the balance solenoid valve, there is no temperature difference before and after the balance valve under normal circumstances. If the balance valve is always closed, the temperature difference will be large, then replace the balance valve.
	Refrigeration solenoid valve and defrost solenoid valve have opened for a long time at the same time	Check the state of refrigeration solenoid valve and defrosting solenoid valve to see whether they are open, if check the circuit system to see if it is normal, check whether both ends of the solenoid valve have been open. If solenoid valve problem, please contact WVCP manufacturer for repair.

6.3.8 Compressor oil pressure protection

For the WVCP6000 system, a pressure detection device is installed at the outlet of oil pressure pump of the system to detect the discharge pressure of the oil pump. The system requires the oil pressure difference between the pump pressure and the suction pressure. When the pressure difference is less than 20psi, the start time delay will occur. After a delay of 5 seconds, if the pressure difference is still less than 20psi, the system will stop, the alarm indicator will be on, the touch screen will display the alarm information of compressor oil pressure protection.

⚠CAUTION

GENERAL HAZARD

All refrigeration operations must be completed by qualified refrigeration engineers, or risk death or serious injury accidents.

If the cryopump needs repairing, please contact qualified refrigeration engineer.

Problem	Cause	Solution
System breakdown, the alarm indicator light is on, and the touch screen displays the alarm information of compressor oil pressure protection	Failure of oil pressure sensor or suction pressure sensor	Connect a pressure gauge to the suction port and the oil pressure detector, press the reset button to check whether the suction pressure and oil pressure are consistent with the corresponding pressure value on the touch screen. If the difference is too large, the surface pressure sensor fault, need to replace the pressure sensor. Note that the pressure sensor is connected to the refrigerant, and the refrigerant will leak when it is replaced. Please contact WVCP manufacturer for repair.
	oil pump problem	Call an authorized repair agent or

	of compressor	WVCP systems for instructions.

6.4 How to deal with the cryopump has insufficient capacity to absorb water vapor

6.4.1 Check the cryocoil temperature

Problem	Cause	Solution
The water vapor cryopump has insufficient capacity to absorb water vapor	The temperature of the coil in and out exceeds the standard range	Select local control and STANDBY (STANDBY). Start the system and wait for 45 minutes. Choose COOL (COOL) and wait for 30 minutes. Record COIL input temperature and COIL output temperature. Note: for WVCP5550D/WVCP2600D/3000D/3600D/4200D/WVCP6000D : record 2# output and input temperature.
	The refrigeration temperature of the cryogenic surface is not cold enough	Through the above measurements, determine whether cryogenic interface refrigeration temperature is enough. The average temperature of the coil in and out of the pipe must be lower than the desired temperature in the vacuum chamber. See table 3-6 of section 3.4.4 "assessment of water vapor cryopump" section. Coil outlet temperature and the gap between the average temperature of above should be within 10 °C. Note: if the water vapor cryopump has been checked before, please refer to table 5-1 for more accurate specifications.

Troubleshooting points that need to be considered:

Is the cryocoil output temperature OK?	Is the cryocoil reflux temperature OK?	Action
Yes	Yes	Check the vacuum pump.
Yes	No	See 6.4.2 cryocoil inlet temperature meets the requirements, and the outlet temperature of the coil does not meet the requirements.
No	No	See 6.4.3 the inlet and exit temperature of the cryocoil does not meet the requirements.

Note: This assumes that the thermocouple readings and pressure gauges are

accurate.

6.4.2 COIL IN temperature is OK, but COIL OUT temperature is not OK

⚠CAUTION

GENERAL HAZARD
Risk at this point do not operate this system, otherwise it will damage to the device.
If you are not a qualified electrical engineer, call for help.

Problem	Cause	Solution
The water vapor cryopump has insufficient capacity to absorb water vapor	The temperature indication of the return pipeline thermocouple is not correct	Use a reliable thermometer sensor is connected to the reflux tube close to the pump (need to be cut into the insulation layer). Select local control and STANDBY (STANDBY). Start the system and wait for 45 minutes. Choose COOL (COOL) and wait for 30 minutes. Compare the measured value of the thermometer with the human-computer interface whether the reflux temperature is consistent.
	There is ice or water on the refrigerant tube	Before the refrigeration cycle is finished, check the refrigerant tube for ice or water. If any, it should be removed. According to 3.4.3 guide to the exposed pipes and joints in the insulation part, add a layer of insulation layer.
	The cryosurface is subjected to excessive heat load	Determine the deep cryosurface to meet the following requirements: ● The distance of cryosurface from the vacuum chamber wall should be at least 16mm. ● Cryosurface does not directly heat source for more than 50 ° C ● The dimensions of the cryosurface are within the standard range. ● The vacuum chamber must be evacuated

		during refrigeration.

Problem	Cause	Solution
The water vapor cryopump has insufficient capacity to absorb water vapor	Check the cryosurface whether there are large indentations or bends.	Call the authorized maintenance agent or WVCP system company for guidance.
	The isolation valve is not fully open	All isolation valves are closed when the system is shipped from the plant and all isolation valves are closed in accordance with the relevant instructions for refrigerant tube disassembly operations.
	The refrigerant tube has a large concave or curved kink.	Call the authorized maintenance agent or WVCP system company for guidance.
	The isolation	The isolation valves are closed when the system is
	Valve is not fully open.	shipped from the plant, and the isolation valves are also closed in accordance with the relevant guidelines for the disassembly of the operation.
	Check the cryosurface whether there are large indentations	Call the authorized maintenance agent or WVCP system company for guidance.
	The refrigeration solenoid valve is not fully open	Call the authorized maintenance agent or WVCP system company for guidance.
	The relief valve is stuck and keep open	Call the authorized maintenance agent or WVCP system company for guidance.

	The injected refrigerant is not suitable	Call the authorized maintenance agent or WVCP system company for guidance.
	The water vapor cryopump is leaking	Call the authorized maintenance agent or WVCP system company for guidance.
	Refrigerant leakage	See page 6-2 for example system leak section.
	Loss of refrigerating capacity for unknown reasons	See page 6-3 if the system performance drops section.

6.4.3 Both COIL IN & COIL OUT temperature is not OK

Problem	Cause	Solution
The water vapor cryopump has insufficient capacity to absorb water vapor	Is the temperature indication of the COIL IN and COIL OUT thermocouples correct?	Use a reliable thermometer sensor connected to the return line and output pipe near the refrigeration unit (need to open insulation layer). To choose the local control and STANDBY (STANDBY). Start the system and wait for 45 minutes. Choose COOL and wait for 30 minutes. Compare the measured value of the thermometer with the human-computer interface showing whether the reflux and output temperature are consistent.
	Isolation valves are not fully open	All isolation valves are closed when the system is shipped from the plant, and the isolation valves are also closed in accordance with the relevant guidelines for the disassembly of the operation.
	Is the COOL solenoid valve opening	Call the authorized maintenance agent or WVCP system company for guidance.
	The refrigerant tube has curved kinks	Replace the twisted part
	The refrigerant in the cryopump is not suitable	Call the authorized maintenance agent or WVCP system company for guidance.
	Cryopump has a leak	Call the authorized maintenance agent or WVCP system company for guidance.

	For WVCP550D/WVCP2600D/WVCP3000D/WVCP3600D/WVCP4200D/WVCP6000D system, a circuit is in a state of refrigeration while the other circuit is in a defrost state	If the temperature rises of less than 20 ° C, check the process, and in a circuit during defrosting another circuit cannot refrigerating. If the temperature rises more than 20 ° C, please call company authorized service agent or WVCP system, in order to obtain guidance.
	Refrigerant leakage	See page 6-2 if the system has a leak section.
	Loss of refrigerating capacity for unknown reasons	See page 6-3 if the system performance drops section

6.4.4 How to deal with the defrost low efficiency of cryosurface

Note: this part is applicable to the WVCP cryosurface is a coil.

⚠NOTICE

GENERAL HAZARD

Do not operate the system at this time, otherwise the device will be damaged。

If you are not a qualified electrical engineer, call for help.

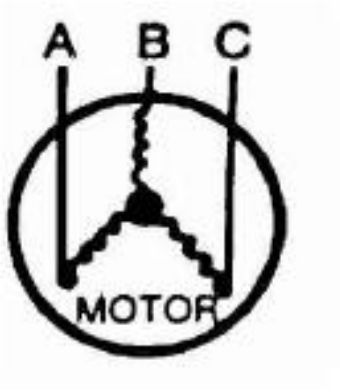
Problem	Cause	Solution
Defrosting efficiency of cryosurface is reduced	The dimensions of the cryosurface are not in the specification range	(See section 3.5 cryosurfaces and feedthrough specifications.)
	When the cryosurface is defrosted, the vacuum chamber is filling the atmosphere	The defrost operation is completed before the vacuum chamber is filled with air.
	The defrost cycle is terminated prematurely	Check whether the frost temperature setting is normal, and the system will automatically terminate the defrosting cycle when the temperature reaches the rear. This process usually takes about 3 minutes. Check the frost termination temperature (COIL OUT temperature) and set the temperature, whether they are the same. If a timer or other method is used to terminate the defrost cycle prematurely, check whether the defrost time of the cryosurface is sufficient to remove all the frost.
	Cryosurfaces have large concave or bend kinks	Call the authorized maintenance agent or WVCP system company for guidance.
	The isolation valve is not fully open	The isolation valves are closed when the system is shipped from the plant, and the isolation valves are also closed in accordance with the relevant guidelines for the disassembly of the operation.

Problem	Cause	Solution
Defrosting efficiency of cryosurface is reduced	Defrost solenoid valve is not open	Call the authorized maintenance agent or WVCP system company for guidance.
	The cold media tube has large concave or curved kinks	Call the authorized maintenance agent or WVCP system company for guidance.

6.5 How to calculate the voltage imbalance

The imbalance of voltage may cause overheating and failure of the motor. The following example is a method to determine the voltage imbalance, recommended. This example is from the Carlyle maintenance guide

Example: the power supply voltage is 240VAC- 3p-60hz



AB = 243V
BC = 236V
AC = 238V

1. Determine the average voltage:

$$\frac{243+236+238}{3} = \frac{717}{3} = 239V$$

2. Determine the maximum deviation of off-average voltage:

(AB) 243—239= 4 V
(BC) 239—236= 3 V
(AC) 239—238= 1 V

3. Determine the voltage imbalance %:

$$100 \text{ x } \frac{4}{239} = 1.7\%$$

The phase inequality is at an acceptable level because it is below the allowable 2% maximum. Important: if the power voltage phase imbalance

exceeds 2%, contact the local power supply company immediately.

7 Disassembly, storage and re-transport

Overview

Only qualified personnel who have been trained will be able to disassemble the product.

7.1 How to stop and transport the cryopump

How to stop the water vapor capture pump:

1. Define the cryogenic interface as described in Section 4.6, Using the Guide in the Water Cryopump section.
2. Turn off the system.
3. Turn off the power disconnect switch.
4. Turn off the cooling water.

How to prepare a water vapor capture pump before storing or transporting:

1. Follow the guidelines on how to make the water vapor capture pump shut down and how to transport the water vapor capture pump section.
2. Follow the instructions in 7.2 How to disassemble the refrigerant in the refrigerant section
3. Disconnect the cooling water connection.
4. Blow out the water from the condenser. (This step protects the system from damage during storage or at high altitude during transport.)
5. Disconnect the power supply.
6. Reinstall the compression nut of the compressor. (In 3.2.2 to the operation of the cooling unit positioning section, these nuts are removed for later use.)

7.2 How to open the refrigerant tube

Required tools and materials:

- 8mm hex wrench
- 15/16-inch flat wrench
- clogging parts (in 3.3.2.2 to determine the isolation valve has been closed, and remove the clogging part of the operation, remove the clogging pieces for later use)

For Parker CPI UltraSeal joints (standard accessories):

1 inch open wrench

15/16-inch open wrench

O-Seal Removal Tool

For Swagelok VCR joints (optional):

- 1-3 / 16-inch open wrench
- 1-1 / 16-inch open wrench

1. The refrigerant mixture is withdrawn into the refrigeration unit.

Define the cryogenic interface according to 4.6 How to use the guidelines in the water vapor capture pump.

Remove the front right-side panel of the cooling unit, loosen the catch, and open the bonnet cover.

	⚠attention
	There is extreme temperature There is a risk of frostbite. The temperature of the isolation valve may be very low and contact with the low temperature surface may cause minor or moderate damage. Do not touch the isolation valve. Before closing the isolation valve, make sure that the cryogenic interface has been completely defrosted, especially when the cryogenic interface cooled by the water vapor capture pump is cold trap, with particular attention to this, otherwise it will be formed in the refrigerant and cryogenic interfaces Dangerous low

	temperature。

Before using the isolation valve, let the temperature of the isolation valve rise to room temperature. If you do not take any auxiliary measures, the temperature rise process takes 2 to 3 hours or even longer, if you use a hot air heater to gently heat up, only 10 minutes on it.

	⚠attention
	**GENERAL DANGER** Do not operate the rotary valve handle when the manual isolation valve is at a low temperature. Operating the valve at low temperatures can damage the valve seal (irreparable damage), resulting in refrigerant leakage. Do not operate the rotary valve when the manual isolation valve is at low temperature or heat the valve to ambient temperature before operation.

Turn the cooling output isolation valve and defrost output isolation valve clockwise to turn them off. Start the system and wait 30 to 45 seconds. (Suction pressure should be 15-25 psi.) When the system is still running, turn off the common return isolation valve to shut down the system.

2. Release residual refrigerant

Find the right side of the valve box repair valve, unscrew the seal cap.

Record the equilibrium pressure and slowly open the service valve to release the refrigerant remaining in the refrigerant and cryogenic interfaces. (Turn the valve handle counterclockwise by 2 turns to open the valve.) Make sure that the system's equilibrium pressure does not drop. If it is descending, turn off the service valve and determine whether the cooling output, defrost output, and the common return isolation valve are fully closed.

Turn the service valve handle clockwise to turn it off. Install the valve seal cap.

Note: For WVCP550D/WVCP2600D/WVCP3000D/WVCP3600D/WVCP4200D /WVCP6000, the above steps release two refrigerants in the refrigerant and cryogenic interfaces.

3. Remove the thermocouple and install the plug

Remove the insulation layer around the joint on the refrigerant tube. Before removing the joint, determine the temperature at room temperature.

For Parker CPI UltraSeal joints (standard accessories):

Hold the male joint with a 15/16-inch wrench and loosen the nut with a 1-inch wrench. Unscrew the nuts on each joint.

Insert the O-ring removal tool into the male joint and tighten it to torque 14-27 Nm. Unscrew the O-ring removal tool. O-rings should be bent enough to be easily removed with two fingers. See Figure 7-1.

	⚠attention
	GENERAL DANGER If the O-ring removal tool is too tight, it will damage the sealing surface of the joint. And the use of O-ring removal tool for fastening when the force is too small, you cannot close the O-ring and easily remove it. If you try to pry out the O-ring from the slot, it will damage the sealing surface and damage the device. Remove the O-ring removal tool into the male joint.

Installed rubber O-ring and metal plug (This step ensures that the refrigerant will not continue to leak.) Use a plastic cover to protect the other half of the joint.

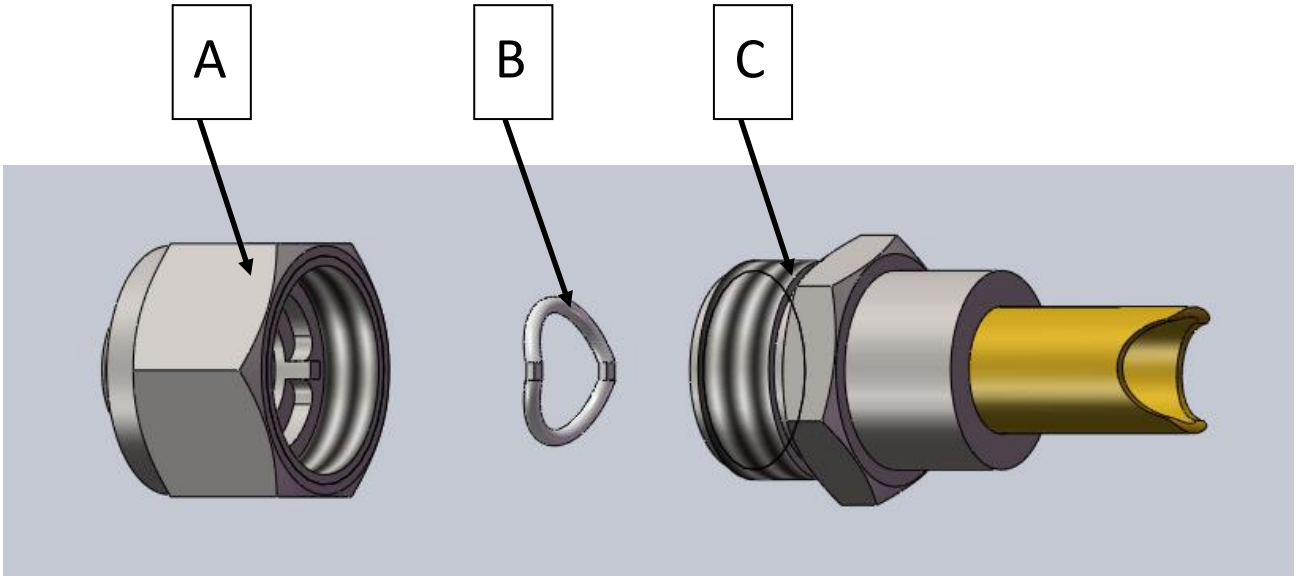


Figure 7-1. Parker CPI UltraSeal Joint - Use of O-Ring Removal Tool (Standard Accessories)

A. O-Seal Removal Tool
B. Silver-plated stainless steel O-ring
C. Male joint

For Swagelok VCR joint (optional accessories, not shown):

Hold a nut with a wrench to keep it, and use another wrench to loosen the other nut. Unscrew the two nuts. Remove the sealing gasket and attach the plug. (This step ensures that the refrigerant will not continue to leak.) Use a plastic cover to protect the other half of the joint.

7.3 How to replace the refrigerant

Please refer to the document number WVCP-RF-M000: WVCP cryogenic system replacement refrigerant guide.

8 Drawing

Overview

The electrical control diagram of the following pages is applicable to: WVCP550/WVCP2600/WVCP3000/WVCP3600/WVCP4200/WVCP6000/WVCP 550D/WVCP2600D/WVCP3000D/WVCP3600D/WVCP4200D/WVCP6000D.

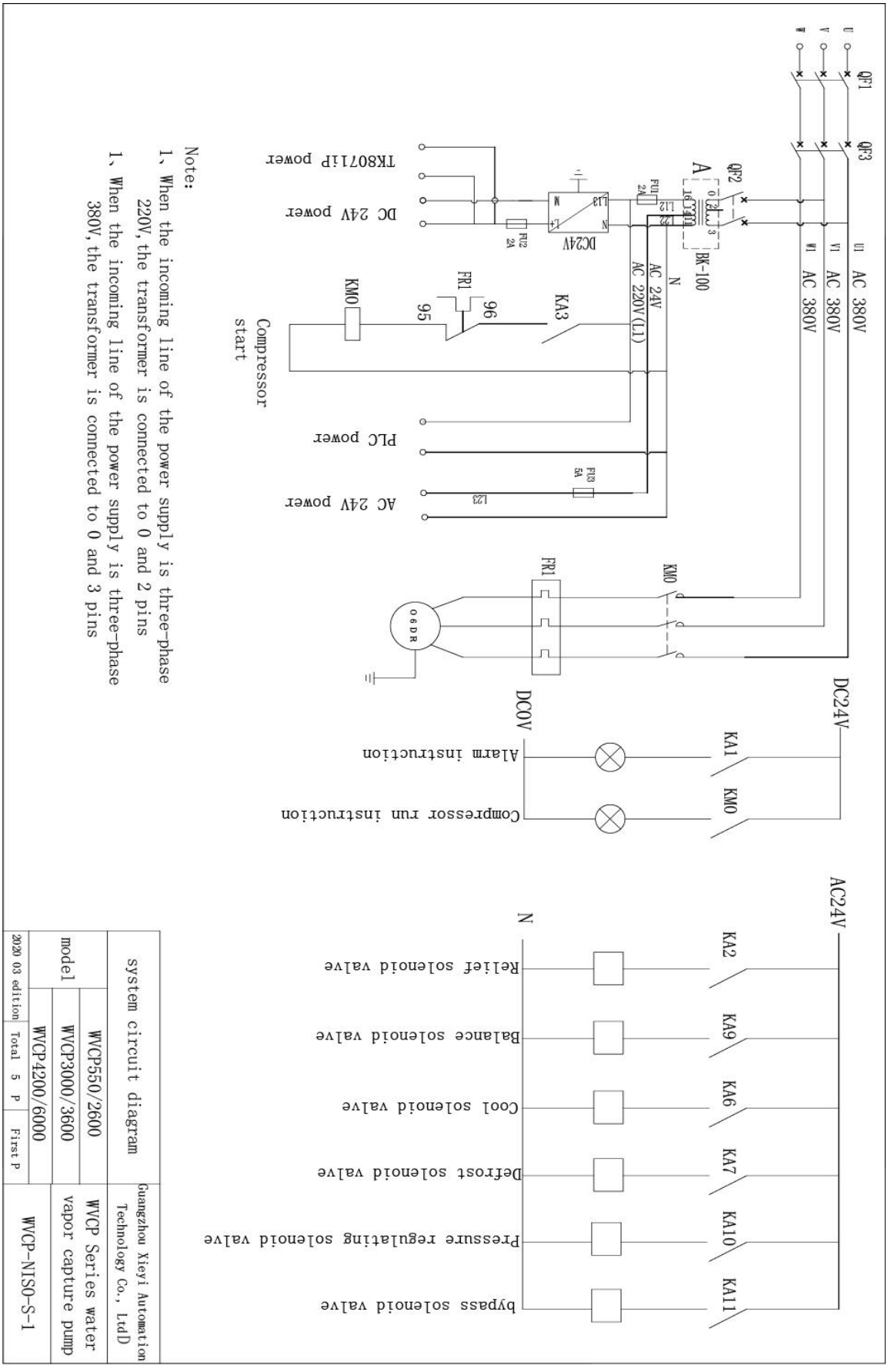


Figure 8-1. Main circuit diagram of WVCP Series single circuit system

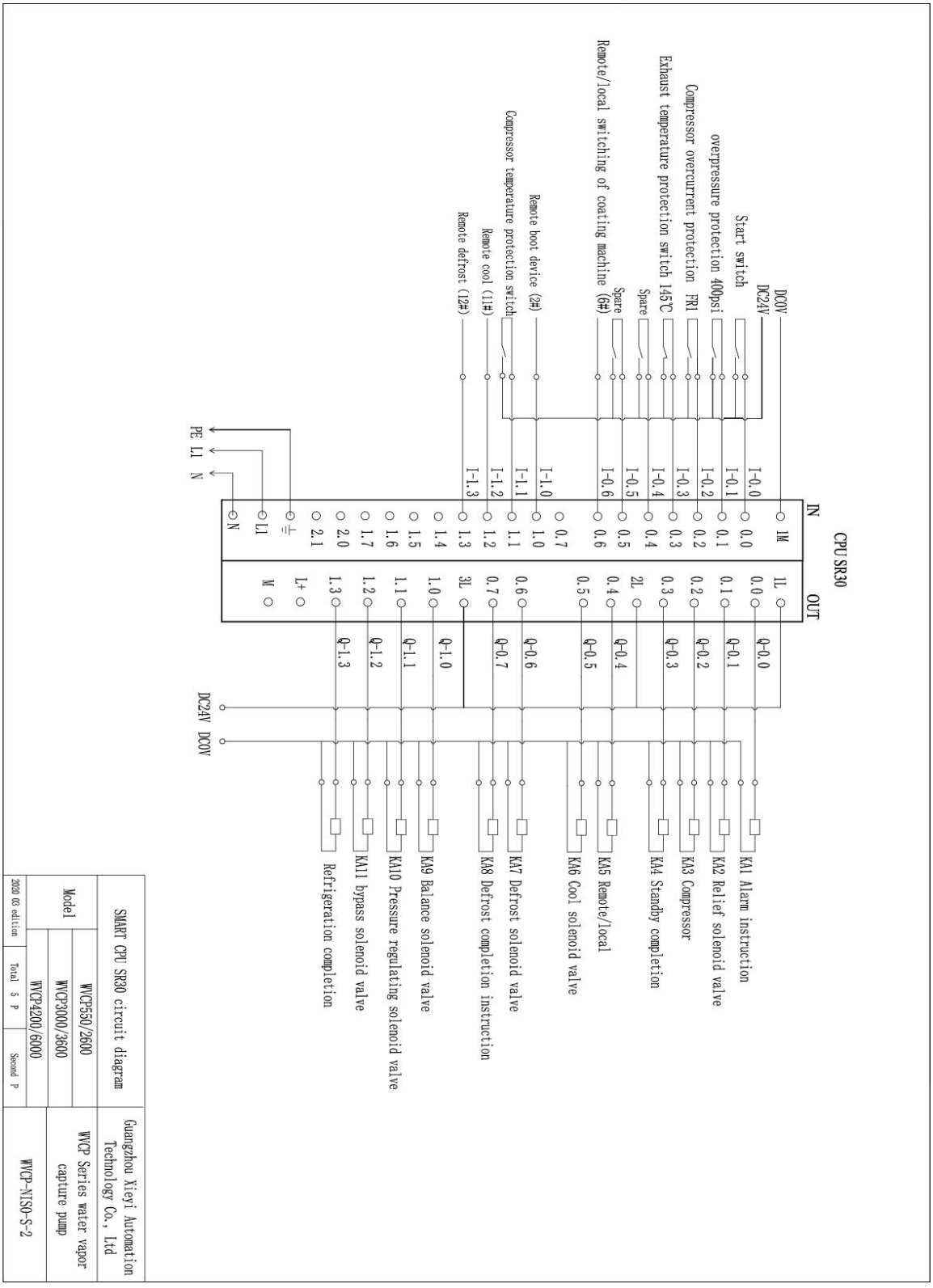


Figure 8-2. The wiring diagram of WVCP Series single circuit PLC CPU SR30

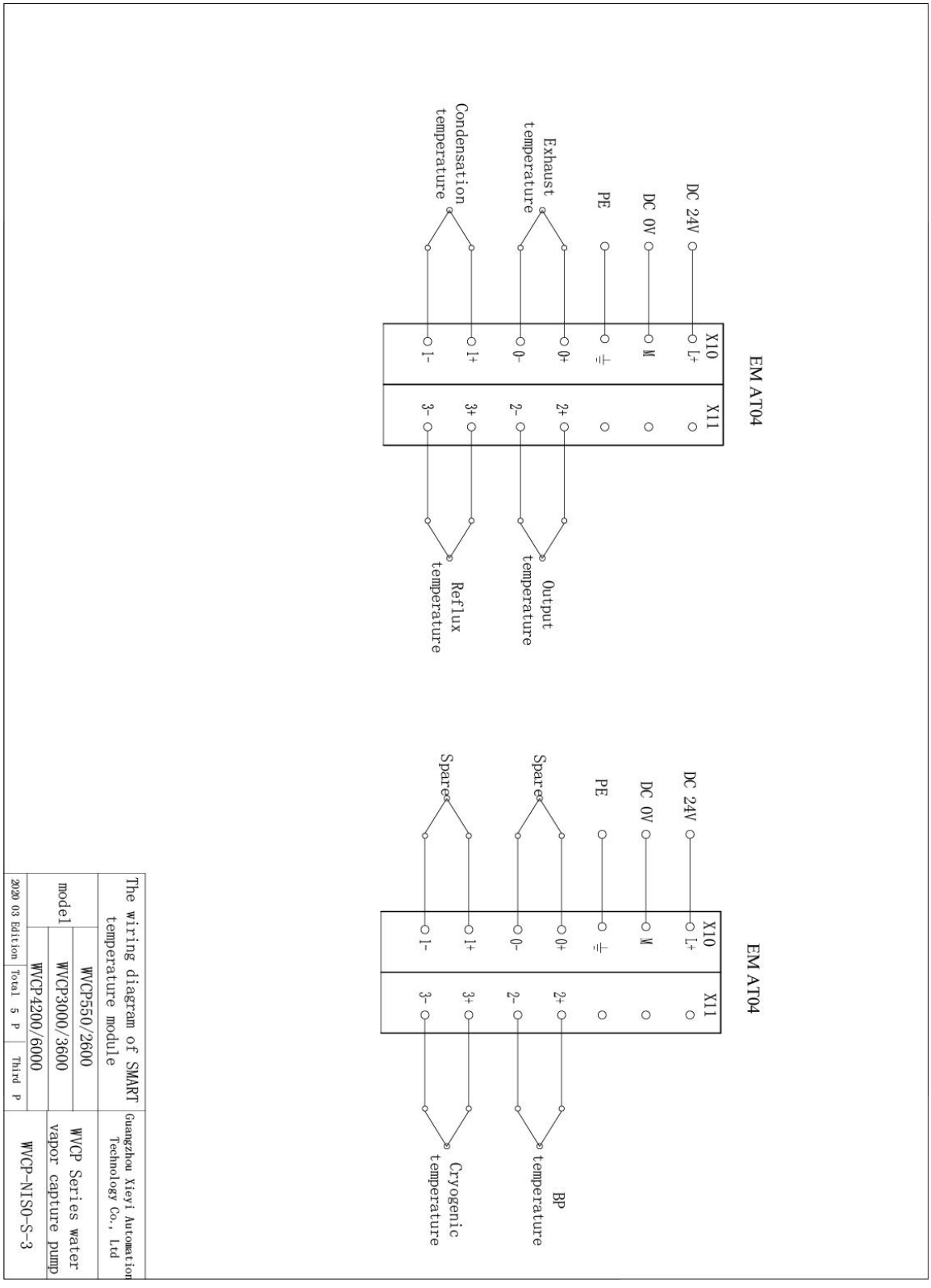


Figure 8-3. The wiring diagram of the temperature module of WVCP series single circuit system

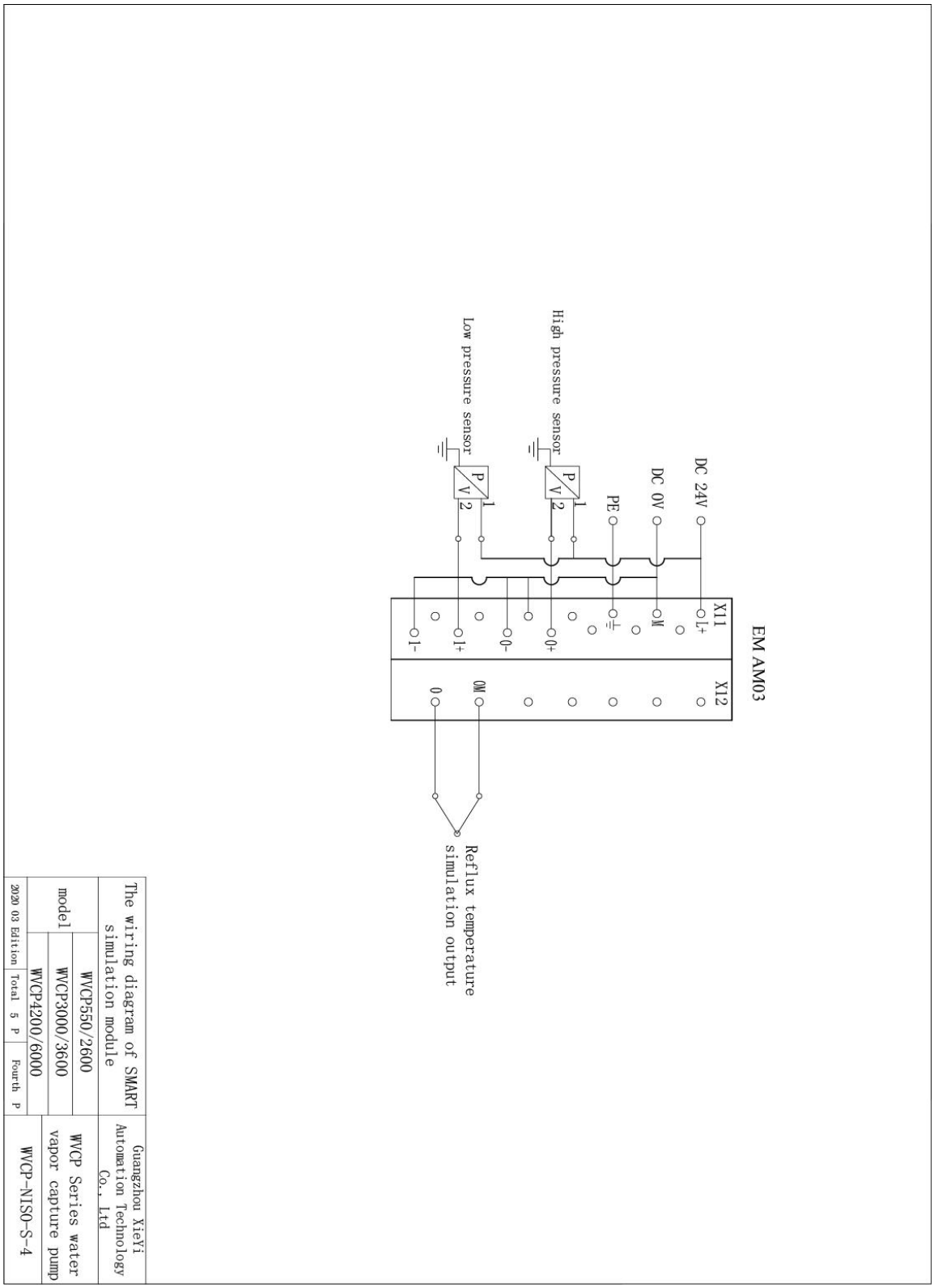


Figure 8-4. The wiring diagram of WVCP series single circuit system remote control

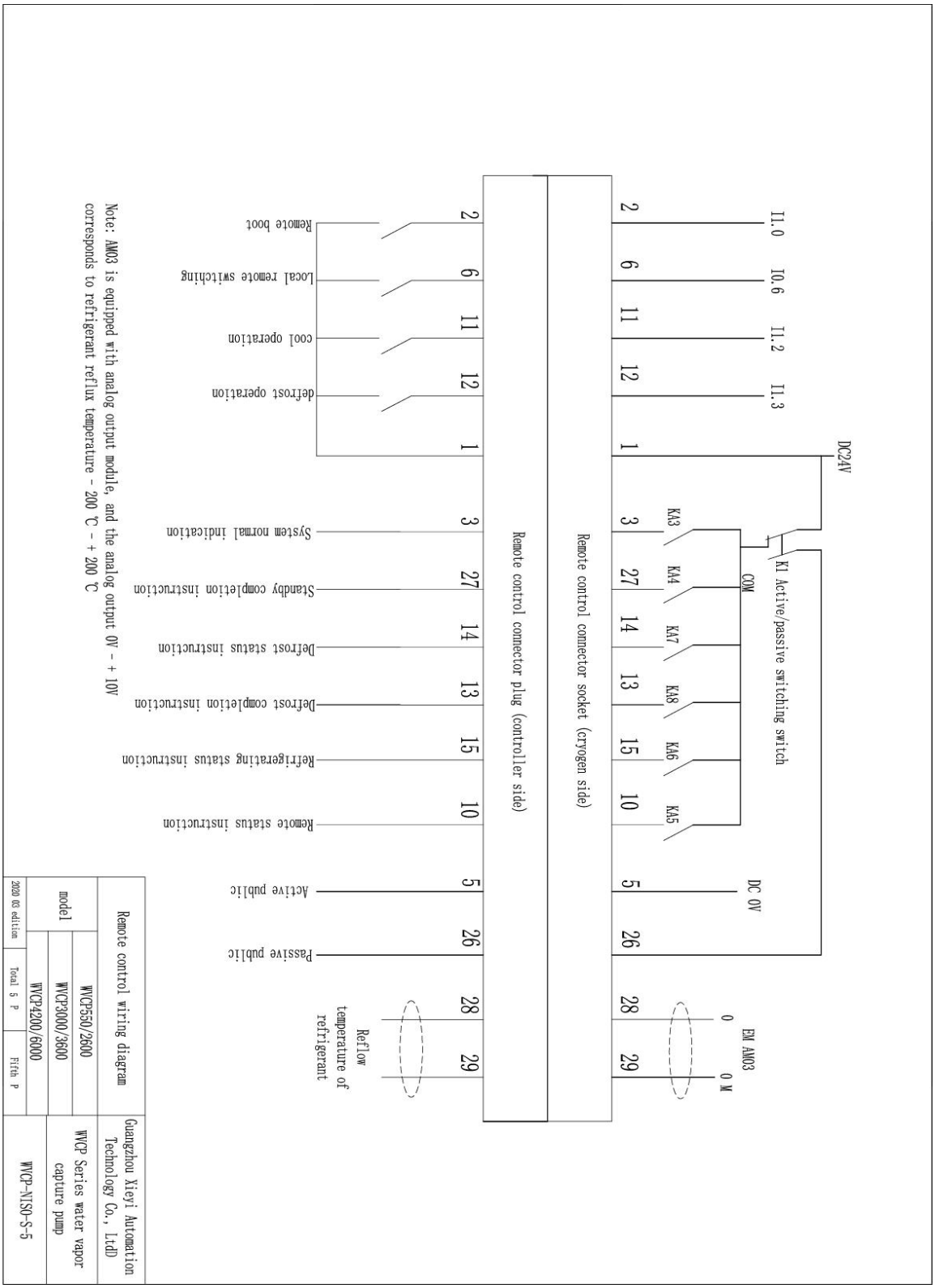


Figure 8-5. The wiring diagram of WVCP series single circuit system remote control

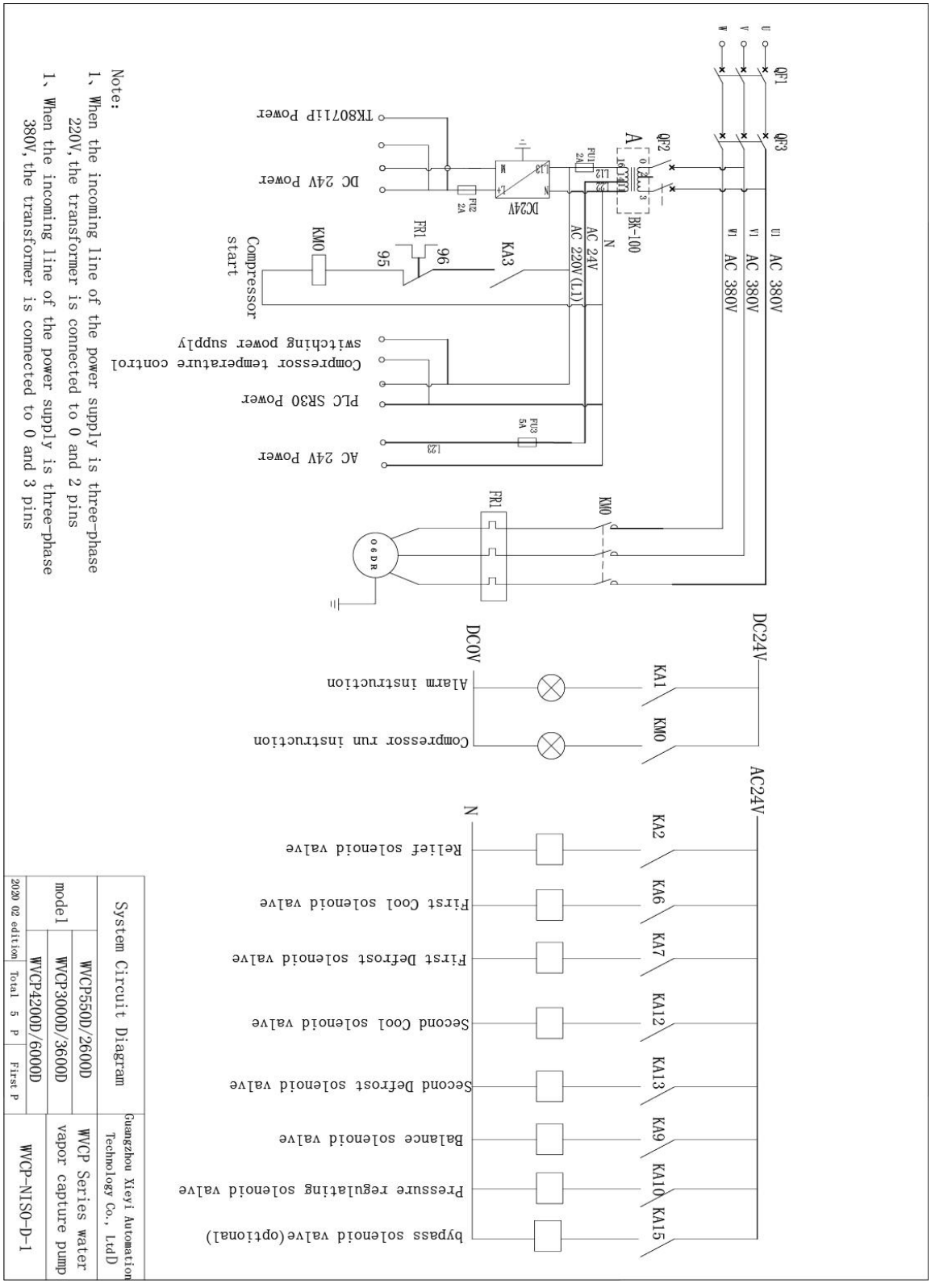


Figure 8-6. Main circuit diagram of WVCP system dual circuit system

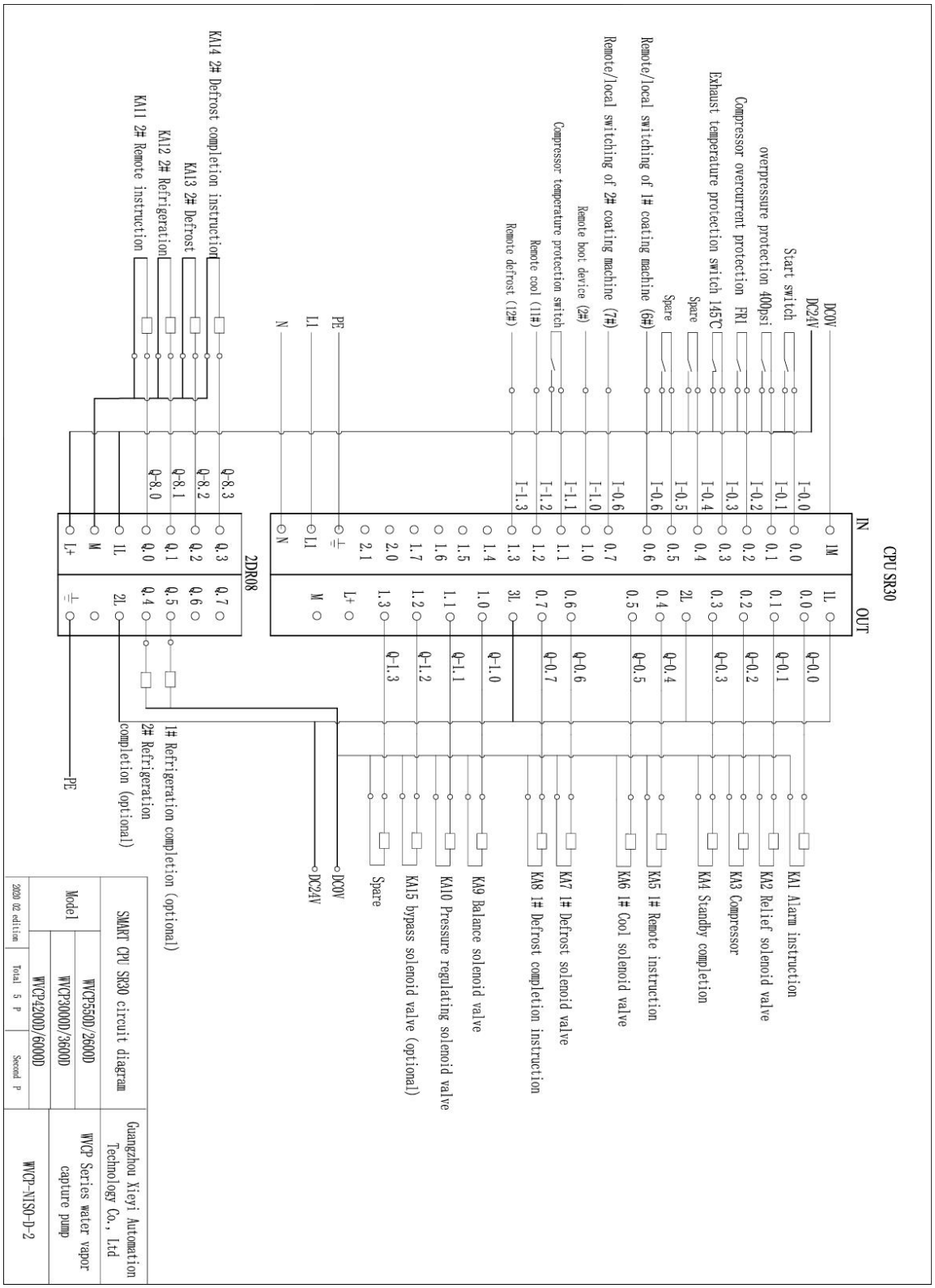


Figure 8-7. The wiring diagram of WVCP series dual circuit PLC CPU RS30

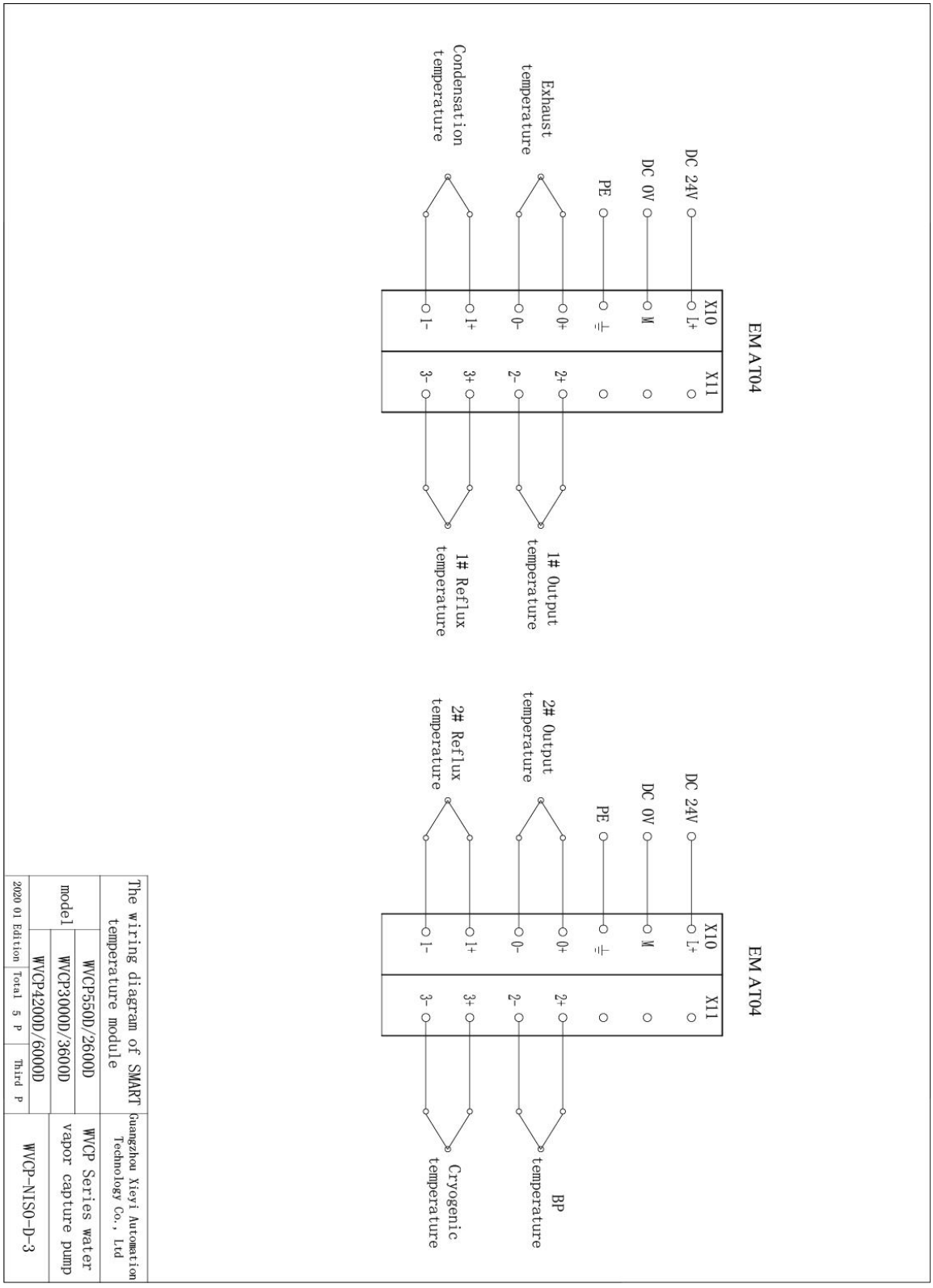


Figure 8-8. The wiring diagram of the temperature module of WVCP series dual circuit system

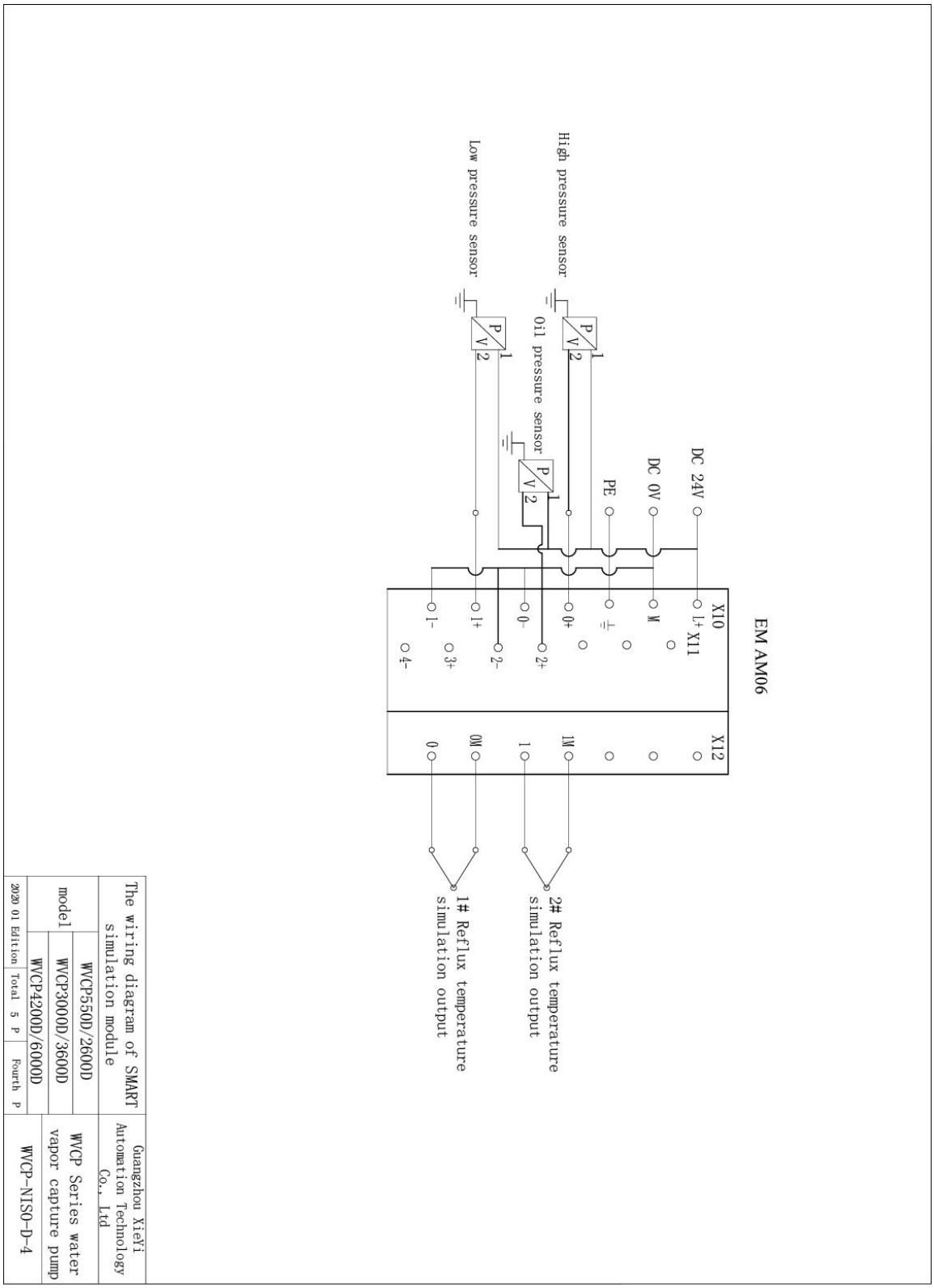


Figure 8-9. The wiring diagram of WVCP series dual circuit system remote control

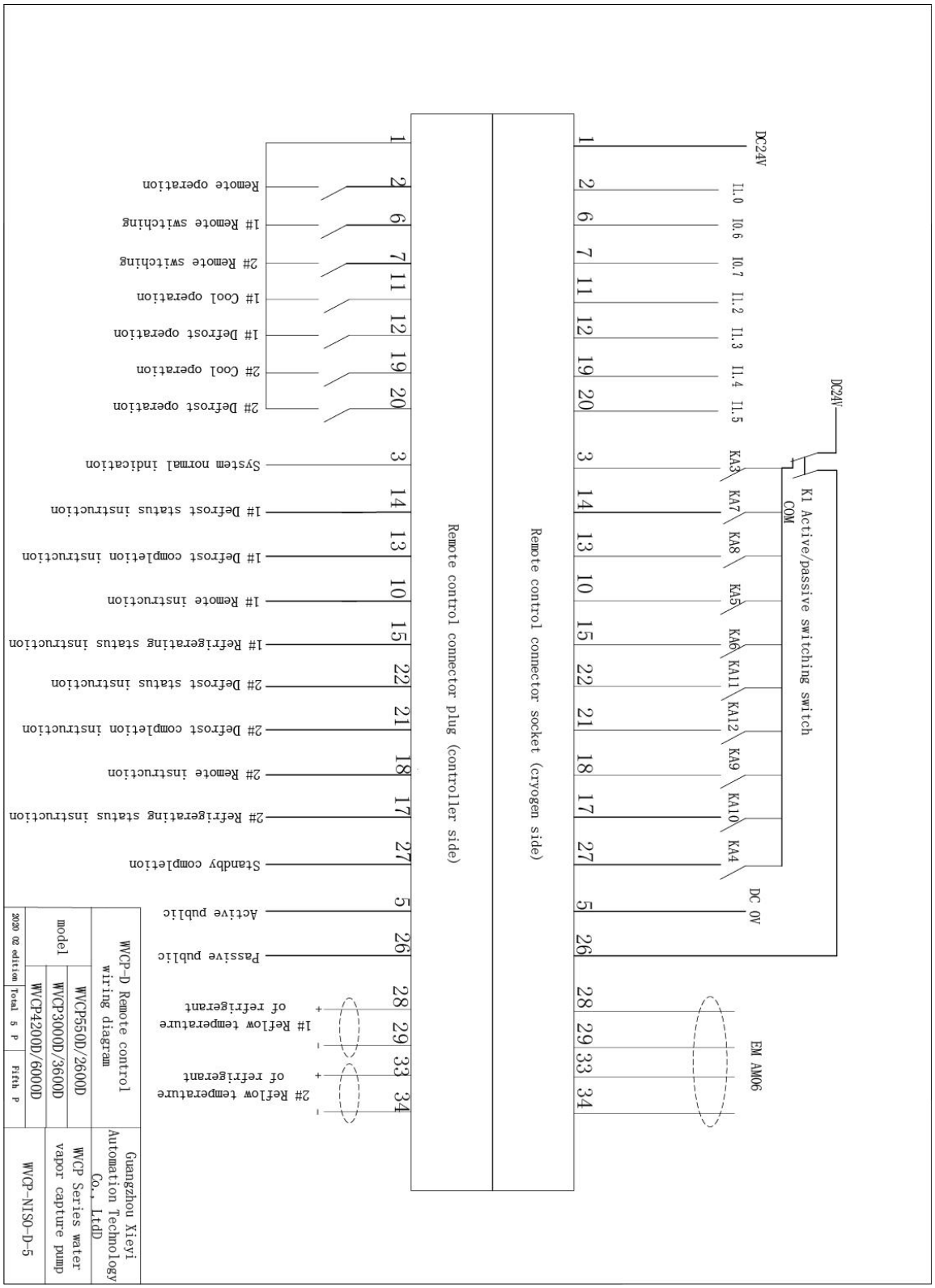


Figure 8-10. The wiring diagram of WVCP series dual circuit system remote control

9 Additional catalogs

9.1 Refrigerant Material Safety Data Sheet (MSDS)

- **The first part of the chemical and corporate logo**

Chemical name: inert low temperature refrigerant

Chemical name or trade name: hydrofluorocarbons and inert gas

Corporate name: Guangzhou Xieyi Automation Technology Co., Ltd

Address: Zengcheng District, Guangzhou City, the new town of sand Po Industrial Park Station Road on the 14th

Zip code：511338

Enterprise emergency telephone：020－82351819

effective date：June 20, 2015

- **The second part of the composition / composition information**

Component: Hydrofluorocarbons and inert gas mixture

Chemical Name	The Ratio	Applicability
HFC mixture	42%	not applicable
FC mixture	48%	not applicable
INERT mixture	10%	not applicable

- **The third part: Summary of Hazards**

Hazard category：Class 2.2 Non-combustible gas。

Invasive route: inhalation, skin and eye contact

Health Hazards: Hazards are mainly caused by inhalation, excessive inhalation can lead to central nervous system suppression and lack of excessive inhalation effects may include: dizziness, vertigo, shortness of breath, headache, in severe cases there will be irregular heartbeat, cardiac arrest and death. Lower concentrations may appear in short eyes, nose and throat

irritation.

Danger of explosion：This product is not burning. In case of high temperature, the container pressure increases, there is the risk of leakage and rupture.

- **The fourth part：first aid Measures**

skin contact：Remove contaminated clothing and rinse the skin thoroughly with soap and clean water for at least 15 minutes. If there is frostbite, seek medical attention immediately.

eye contact：Splash into the eyes, rinse with running water or saline, medical treatment.

Inhalation：Quickly from the scene to the fresh air, keep the airway smooth, such as breathing difficulties, to oxygen. Such as breathing to stop, immediately artificial respiration, medical treatment。

Ingestion：If ingestion of liquid refrigerant may cause gastrointestinal perforation and nausea or other potential damage.

- **The fifth part：Fire-fighting measures**

Hazardous characteristics：Not burning in case of high temperature, the container pressure increases, there is a risk of leakage and rupture.

Harmful combustion products：Not burning.

Firefighting methods and extinguishing agents： Surrounding the fire should immediately cut off the gas source, the cooling container water, if possible, the container moved from the fire to the open. Extinguishing agent: mist water, plenty of water.

Fire extinguishing matters and measures： If the material leaks in the fire, the material will break down and produce toxic hydrofluorocarbons and carbonyl fluoride gas, wear special protective clothing and self-contained positive pressure respirator, in the wind direction.

- **The sixth part：Leakage emergency treatment**

Emergency treatment：Rapid evacuation of polluting areas of personnel to the

upper wind, and isolation, strict restrictions on access. It is recommended that emergency personnel wear self-contained positive pressure respirator and wear general work clothes. As far as possible cut off the source of leakage, leakage containers properly handled, repair, inspection and then use.

Note: Do not allow products to enter the water or sewer.

Eliminate the method：Reasonable ventilation to accelerate the spread.

- **The seventh part：Handling and storage**

Operating Precautions: Airtight container, full ventilation, operators must be specially trained. Follow the rules of operation. Keep away from flammable and combustible materials. When in high concentration contact, self-priming respirator and general protective gloves can be worn. To prevent the gas body leakage into the workplace, avoid contact with oxidants. Light loading and unloading during handling to prevent damage to cylinders and accessories. Equipped with spill emergency processing equipment.

Storage Precautions: Store in a cool, ventilated warehouse. Keep away from fire and heat source to prevent sun direct light (storage temperature shall not exceed 50℃). Should be stored separately with oxidant, avoid mixing storage. The storage area should be equipped with leakage emergency treatment equipment. Pay attention to the name of the product, the date of inspection and ship the advanced warehouse first.

- **The eighth part：Contact control individual protection**

Maximum allowable concentration：China PC-TWA（mg/m^3）3500 STEL 5250 GBZ 2-2002 55

Monitoring method：Gas chromatography

engineering control：The production process is closed and fully ventilated.

Respiratory protection ： Generally, do not need special protection, high concentrations of contact can wear self-contained breathing

apparatus. Eye protection：Anti-splash goggles.

Body protection：Wear general work clothes.

Hand protection：Wear protective rubber gloves.

Other protection：Avoid high concentrations of inhalation. Into the tank, restricted space or other high-risk areas of operation, to be guarded.

- **The ninth part：Physical and chemical properties**

Appearance and traits：Colorless, no turbidity, no smell of gas.

PH value：Not applicable

Molecular weight：Not applicable

freezing point（℃）：Less than－100℃

Boiling point（℃）：Less than－128℃

Critical temperature（℃）：Not applicable

Critical pressure(MPa)：Not applicable

Saturated liquid density 30℃(g/cm^3)：Not applicable

Liquid specific heat 30℃［KJ/(kg·℃)］：Not applicable

Isotonic vapor specific heat(Cp),30℃ and 101.3kpa［KJ/(kg·℃)］：Not applicable

Global warming coefficient（GWP）：5380

Boiling potential，KJ/Kg ：Not applicable

The main purpose ： Used as WVCP series of water vapor capture pump refrigeration.

- **The tenth part：Stability and reactivity**

stability：Stable

Avoid contact conditions：Heated

Taboo：Strong oxidizing agents, flammable materials

Risk of polymerization：Cannot happen

Decomposition products ： High temperature decomposition of toxic hydrofluorocarbons and carbonyl fluoride gas.

- **The eleventh part：Toxicological information**

Acute toxicity： Rats inhaled 90% (oxygen) × 15 minutes, approximate lethal concentration; rats inhaled 895000ppm × 15 minutes, the minimum lethal concentration.

Subacute and chronic toxicity： Rabbits, mice, mice were inhaled at 0.2% concentration, 6 hours / day for 10 months, all non-toxic.

- **The twelfth part：Ecological information**

Ecotoxicity：No data

Biodegradability：No data

Non-biodegradable：No data

- **The thirteenth part：Exhaust gas disposal**

Nature of waste：Empty cylinder

Disposal method：According to the national and local regulations to deal with the requirements, the empty cylinder back to the manufacturer, for recycling.

- **The fourteenth part：Transport information**

Packaging logo：Non-combustible gas

method of packing：Class III packaging

Transport precautions：Operating Precautions: Airtight container, full ventilation, operators must be specially trained. Follow the rules of operation. Keep away from flammable and combustible materials. When in high concentration contact, self-priming respirator and general protective gloves can be worn. To prevent the gas body leakage into the workplace, avoid contact with oxidants. Light loading and unloading during handling to prevent damage to cylinders and accessories. Equipped with spill emergency processing equipment.

- **The fifteenth part：Regulatory Information**

Regulatory Information：

1. "Conditions for the Administration of Hazardous Chemicals Safety" (Decree No. 344 of the State Council, implemented on March 15, 2002).
2. "Regulations on the Safe Use of Chemicals in Workplaces" ([1996] Labor Department No. 423).
3. National Standard GB13690-1992 "Classification and Marking of Commonly Used Hazardous Chemicals".
4. National Standard GBZ-2002 "Workplace Hazardous Occupational Exposure Limits".
5. GB16843-2000 "Preparation of Chemical Safety Technical Data".

- **The sixteenth part：Other Information**

Fill in time：June 20, 2015

Fill in the department：Technical department

Data review unit：Guangzhou Xieyi Automation Technology Co., Ltd

Modify the description：Written for the first time

9.2 Compressor Oil Material Safety Data Sheet (MSDS)

1. Chemical products and company LOGO	
	Lubrizol the company **29400 Lakeland Boulevard** **Wickliffe, Ohio 44092** **Tell:(440) 943-4200**
Product name **American Chemical Abstracts (CAS) number** **Synonyms** **Chemical name** **product type** **Preparation / revision date** **Transport emergency telephone number** **Material Safety Data Sheet (MSDS) number**	SOLEST LT-32 Not applicable to mixes NO Mixing Multi-purpose 01 March 2011 For transport emergencies, call CHEMTREC: 400-186-9588,1-800-424-9300 (within the US) 1694503-2601133-808181-102103

2. Hazard identification	
form **odor** **Major danger**	● Net color liquid. ● Moderate Be careful ● May cause skin irritation.

3. Composition / component information	
Dangerous ingredients	This substance does not contain ingredients that are required to be disclosed in the Hazardous Materials Regulations of this jurisdiction. See Chapter 11 for details.

4. First-aid	
eye	Rinse with water for at least 30 minutes. If the eye irritation, you have to get a doctor to help.
skin	Wash with soap and water. Remove contaminated clothing. If skin irritation occurs, seek medical attention. Re-use contaminated clothing before use.
Inhalation	If harmful effects are observed, the contacts will be moved to fresh air.
mouth	Not vomiting. Seek medical attention immediately.
Additional information	Physician Tip: According to the symptoms of treatment.

5. Fire-fighting measures	
Flash point	248 ° C, 478.4 ° F COC (typical)
Extinguishing media	CO2, dry powder or foam. Water can be cooled and protected from exposed substances.
Fire procedures	Recommended self-contained breathing apparatus. Water may cause splashing. Use water to cool the container exposed to fire.
Abnormal fire and explosion hazard	See Section 10 for additional information.

6. Accidental discharge measures	
Leaked emergency treatment	Must wear personal protective device, see PPE recommendations for personal protection. Ventures in enclosed spaces or other places where ventilation is poor. To prevent access to sewers and drains. Pick up the free liquid for recirculation and / or treatment. The inert substance absorbs the residual liquid.

7. Processing and storage

Pump suction	Not determined.
temperature	Not determined.
Maximum processing	Away from the source of possible fire. When not in use, close
temperature	the container. Avoid breathing dust, smoke, gas, spray, steam
Processing procedures	or spray. After treatment to thoroughly rinse. Re-use
	contaminated clothing before use. Empty containers contain
Maximum storage	product residues that may indicate a product hazard. Dispose
temperature	of packaging or containers in accordance with local, regional,
Save the program	national and international regulations.
	Not determined.
Maximum load	Keep in cold, dry place. See Section 10 for incompatible
temperature	materials.
	Not determined.

8. Exposure controls / personal protection

Exposure limits	Not established
Other exposure limits	no data.
engineering control	Sufficient ventilation when used.
Wear glove program	Neoprene.
Eye protection	Safety glasses.
	If the recommended exposure limit is exceeded, use NIOSH /
Respiratory protection	MSHA approved respirator with organic vapor cartridge. When entering a closed space, other poorly ventilated areas and large-scale removal of spillage sites, use a self-contained respirator. Consult an industrial hygienist to determine the proper respiratory protection when using this substance. Workplace conditions When using a respirator, you must observe a respiratory protection plan that complies with all relevant regulations.
Clothing advice	Recommended long-sleeved shirt. Do not wear earrings, watches or similar clothes that can be interfered with substances and cause skin reactions, and then use previously washed contaminated clothing.

9. Physical and chemical properties

Flash point	248 ° C, 478.4 ° F COC (typical)
Flammable upper limit	Not determined.
Combustible lower limit	Not determined.
Spontaneous point	Not determined.
Explosive data	The substance is not explosive.
Vapor pressure	Not determined.
pH	Not determined.
proportion	0.98 (15.6 ° C)
Bulk density	Not determined.
Water soluble	Insoluble.
Percent solids	Not determined.
Volatile percentage	Not determined.
Volatile organic compounds	Not determined.
Steam density	Not determined.
Evaporation rate	Not determined.
odor	Moderate
form	Net color liquid.
viscosity	30.7 centimeters (40 ° C) 5.4 centimeters (100 ° C)
Odor limits	Not determined.
Boiling point	Not determined.
Pour point temperature	<-40 ° C, <-40 ° F
Melting / freezing point	Not determined.

The above data is a typical value, does not represent the composition specifications.

10. Stability and reactivity

stability	At medium high temperatures and pressures, the material is usually stable.
Decomposition temperature	Not determined.
Incompatibility	strong acid. strong base.
polymerization	will not happen.
Thermal decomposition	Smoking, carbon monoxide, carbon dioxide, aldehydes and other incomplete combustion products.
Should be avoided	high temperature.

11. Poison information

	-- Acute exposure --
Eye irritation	Should not cause eye irritation. According to composition or similar material.
Skin irritation	May cause minor skin irritation. Does not comply with the Canadian D2B or the EU R38 standard. According to composition or similar material data.
Breathing stimulation	No available data indicate that the product or ingredient may cause respiratory irritation based on normal workplace conditions and excellent industrial hygiene practices.
Percutaneous toxicity	The LD50 is > 2000 mg/Kg. According to composition or similar material data.
Inhalation toxicity	No data indicates that the product or ingredient may be a toxic inhalation hazard.
Oral toxicity	The LD50 is> 10,000 mg / kg According to the constituent or similar substances.
Skin sensitization	No data indicates that the product or ingredient may be a skin sensitizer.
Inhalation sensitization	No data indicates that the product or ingredient may be a respiratory sensitizer.
	-- Chronic exposure--
Chronic toxicity	No data indicate that more than 1% of the product or ingredient will be chronically hazardous to health.
Carcinogenicity	No data indicates that any component present in greater than 0.1% poses a risk of cancer.
Mutation	There is no available data to indicate that the product or any more than 0.1% of the contained ingredients are mutated or genetically poisoned.
Reproductive toxicity	No available data indicate that greater than 0.1% of the product or ingredient may cause reproductive toxicity.
Teratogenicity	No available data indicate that the product or any ingredient greater than 0.1% may cause birth defects.
others	**-- Additional information --**
	There are no other known health hazards.

12. Ecological information

	-- Environmental toxicity --
Freshwater fish toxicity	Not determined.
Freshwater invertebrate toxicity	Not determined.
Inhibit algal growth	Not determined.
Salt water fish toxicity	Not determined.
Salt water invertebrate toxicity	Not determined.
Bacterial toxicity	Not determined.
Other toxicity	Not determined **-- Environmental toxicity-**
Biodegradable	There is not enough data to determine the biodegradability of this substance.
Biological accumulation	Ingredients are not biologically aggregated by less than 1.0%, depending on the actual data.
Soil activity	Not determined.

13. Disposal considerations

Waste disposal	According to RCRA (Resource Conservation and Recycling Act) CFR 261, if the substance is discarded, it is not a hazardous waste. Handling, storage, transportation and disposal must comply with applicable federal, state and provincial regulations.

14. Transport information

International Civil Aviation Organization (ICAO) / International Air Transport Federation (IATA) I	Non-dangerous goods.
International Civil Aviation Organization (ICAO) / International Air Transport Federation (IATA) II	Non-dangerous goods.
International Maritime Transport of Dangerous Goods (IMDG)	Non-dangerous goods.
International Maritime Dangerous Goods Regulations（IMDG）EMS Fire	Not applicable.
International sea transport（IMDG）EMS	Not applicable.
International Maritime Dangerous	

Goods Regulations (IMDG)	Not applicable.
International Margin (MFAG) Marine Pollution Act (MARPOL) Appendix II	Not decided.
US Coast Guard (USCG) compatibility	Not determined.
US Department of Transportation (DOT) bulk materials	Non-dangerous goods.
North American Emergency Response Guidance Document	Not applicable.
US Department of Transportation (Medium Temperature)	Non-dangerous goods.
US Department of Transportation	
US Department of Transportation (DOT) non-bulk materials	Not applicable.
US Department of Transportation Canada	Non-dangerous goods.
Mexico	Not applicable.
Bulk quantity	Non-dangerous goods.
The number of medium temperatures	Non-dangerous goods.
Non - bulk quantity	85,000 kg, 187391 pounds 11,000 kg, 24251 pounds 400 kg, 882 pounds **Please refer to the classification requirements before shipping the material at elevated temperatures.**

15. Regulatory Information

	- Global Chemicals Directory -
United States	All components are in the US TSCA catalog or in their exempt directory.
Other Toxic Control Act (TSCA)	no data.
The European Economic Community (EEC)	According to EC (EC) seventh revision guidance 92/32 / EEC, may need to be notified.
Japan	In Japan, you may need to be notified.
Australia	In Australia, all ingredients are in compliance with the chemical requirements.
New Zealand	According to New Zealand regulations, it may be necessary to give notice prior to sale.
Canada	This substance contains one or more of the ingredients listed in the list of non-domestic chemical substances (NDSL). This substance or product containing this substance may be limited to output to Canada.

<table>
<tr><td>Switzerland</td><td>Before you can sell in Switzerland, you may need to be notified.</td></tr>
<tr><td>North Korea</td><td>You may need to be notified before North Korea sells.</td></tr>
<tr><td>Philippines</td><td>All components comply with the 1990 Philippine Regulations on the Control of Toxic Substances and Hazardous and Nuclear Waste (R.A.6969).</td></tr>
<tr><td>China</td><td>All ingredients of this product are listed on the list of existing chemical substances in China.</td></tr>
<tr><td>Taiwan</td><td>You may need to be notified before selling in Taiwan. -- --</td></tr>
<tr><td></td><td>Other US Federal Regulations --</td></tr>
<tr><td>Superfund Amendments and Reauthorization Act (SARA) Hazardous Substances</td><td>The product does not contain any more than 1.0% of the chemical substances in the list of SARA Very Hazardous Substances.</td></tr>
<tr><td>Superfund Amendments and Reauthorization Act (SARA) Part 313</td><td>According to SARA Part 313, the product does not contain any chemical substances greater than 1.0% (greater than 0.1% carcinogenic).</td></tr>
<tr><td>Superfund Amendments and Reauthorization Act (SARA) 311 Classification</td><td><table>
<tr><td>Acute hazard</td><td>no</td></tr>
<tr><td>Chronic hazard</td><td>no</td></tr>
<tr><td>Fire hazard</td><td>no</td></tr>
<tr><td>Reactive hazards</td><td>no</td></tr>
</table></td></tr>
<tr><td>Integrated Environmental Response, Compensation and Liability Act (CERCLA) Hazardous Substances</td><td>no data.</td></tr>
<tr><td></td><td>-- State regulations --</td></tr>
<tr><td>California proposal 65</td><td>This product is not intended to contain any chemical substances known to be carcinogenic and / or congenital defects in California. In addition, we do not regularly analyze the product in order to detect impurities that may be such chemicals.</td></tr>
<tr><td></td><td>--Product registration--</td></tr>
<tr><td>US fuel registration</td><td>Not applicable.</td></tr>
<tr><td>Finland registration number</td><td>Unregistered</td></tr>
<tr><td>Swedish registration number</td><td>Unregistered</td></tr>
<tr><td>Norwegian registration number</td><td>Unregistered</td></tr>
<tr><td>Danish registration number</td><td>Unregistered</td></tr>
<tr><td>Swiss registration number</td><td>Unregistered</td></tr>
<tr><td>Italian registration number</td><td>Unregistered</td></tr>
<tr><td></td><td>-- Other / international--</td></tr>
</table>

Other regulatory information	Not determined.

16. Other information

American Fire Protection Association (NFPA) standard

health	Fire	Reactivity	special
1	1	0	N/E

(N/E) - Not confirmed

Hazardous Materials Information System (HMIS) code

health	Fire	Reactivity
1	1	0

Precautionary label

Be careful.

- May cause skin irritation.

Correction instructions

The MSDS is not modified, 1 March 2011

We are not responsible for the conditions of use and how we use it, and we expressly disclaim any liability whatsoever for the use of this product. The information provided herein is believed to be true and correct, but neither statement nor advice contains any express or implied warranties as to the accuracy of this data, the risks associated with the use of the substance, or the results obtained from the use of the substance. It is the user's responsibility to follow all applicable federal, state, and local regulations.

9.3 Term Definition

Listed below are the terms commonly used in this document and their definitions.

Balance pressure：The pressure in cryopump when the compressor suction and discharge pressures are equal. The cooling unit must be shut down for 48 hours or until the equilibrium pressure is restored before the equilibrium pressure can be obtained.

Cryogenic temperature： Part of the refrigeration circuit to obtain the lowest temperature before evaporation.

Compressor: Components in the refrigeration unit increase the pressure of the refrigerant and allow the refrigerant to move in the pipeline.

Compressor room：The lower part of the cryopump, including the compressor and the condenser.

Condenser： The components in the refrigeration unit remove the heat from the vapor of vaporous refrigerant just discharged from the compressor.

Interface sleeve：Connect the fluid or power between the vacuum chamber and the atmosphere, with a tube that seals, insulates, or insulates.

Cryopump：WVCP cryogenic refrigeration system for capturing water molecules in a vacuum chamber. Including the refrigeration unit, the refrigerant pipe and the cryogenic interface (with cryogenic heat bridge device) parts.

Cryosurface：Vacuum chamber trapping of water molecules in the coil or cold trap, allows moisture to condense on its surface.

High pressure piping： Part of the refrigerant circuit that contains the high temperature and pressure refrigerant just discharged from the compressor.

Feed pipe： One of the copper lines in the refrigerant tube that sends the refrigerant from the refrigeration unit to the cryogenic interface.

High-pressure refrigerant pipe： A part of the refrigeration unit contains the high-pressure refrigerant just cooled by the water-cooled condenser.

Manifold table：Gas manifold and pressure gauge components.

WVCP inner pipe：The upper part of the refrigeration unit is sealed in a thermal insulation material.

Refill refrigerant：Operating procedures for replacing refrigerant in water vapor capture pump.

Refrigerant：Guangzhou Xieyi Automation Technology Co., Ltd. patent refrigerant mixture.

Refrigerant circuit：From the refrigeration unit, the refrigerant flows through the outlet pipe, the cryogenic interface, the return pipe and finally back to the passage of the refrigeration unit.

Refrigerant gas tank： Containers located in the cooling unit keep the gas refrigerant at a safe pressure in the cooling unit when the system is not at operating temperature.

Refrigerant tube：The refrigerant is output to the cryogenic interface and to the insulation of the refrigeration unit.

Refrigeration unit：Mechanisms, including compressors, condensers, and WVCP inner tubes, allow refrigerant mixture temperature to drop to extremely low

temperatures.

Reflow tube: one of the copper tubes in the refrigerant tube, the refrigerant from the cryogenic interface back to the cooling unit.

Thermocouple: The sensor used to collect temperature for a cooling unit.

Refrigerant Supplements: A refrigerant mixture that can be added to the existing refrigerant in a water vapor trapping pump.