



HW7

Liquid Cooling Container & Dry-cooling Tower Product Manual

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BITMAIN TECHNOLOGIES INC.

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The purpose of the Product Installation and Usage Manual (hereinafter referred to as the Product Manual) is solely to provide guidance to help you correctly use the “ANTSPACE HW7” liquid cooling container system (hereinafter referred to as the Product). Before installing and first using the Product, you should carefully read all delivered materials, particularly the precautions mentioned in the Product Manual. This will help you use the Product better and more safely. Please keep the Product Manual properly for future reference.

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CONTENTS

1	Introduction to This Manual	1
1.1	Scope of Application	1
1.2	Target Readers	1
1.3	Manual Use.....	1
1.4	Symbol Usage.....	1
2	Safety Instructions.....	3
2.1	General Safety Precautions	3
2.2	All Safety Precautions	3
2.3	Electrical Safety	4
2.4	Mechanical Safety	5
2.5	Operational Safety	6
2.6	Others	6
3	System Composition and Working Principle	8
3.1	System Overview	8
3.2	System Composition.....	8
3.3	Working Principle.....	9
4	System Performance Indicators	11
5	System Structure View	15
5.1	External View of the Liquid cooling container system	15
5.2	Internal View of the Liquid cooling container system	15
6	Installation of System Products	19
6.1	Leveling Before Container Installation	19
6.2	Installation of dry cooling towers.....	19
6.3	Hoisting of Dry Cooling Tower.....	20
6.4	Installation of Container and Dry Cooling Tower	21
6.5	Arrangement and Installation of Intermediate Connecting Pipes	21
6.6	Installation of Water Curtains.....	22
6.7	Server Installation.....	27
6.8	Power Distribution work	29
7	System Use and Operation.....	39
7.1	Safety Rules.....	39

7.2	System Pressure Testing	42
7.3	System fluid replenishment	45
7.4	Electrical Wiring.....	52
7.5	System Power-On and Power-Off Procedures	55
7.6	Touch Screen Operation Instructions	64
7.7	On-site Installation Summary.....	72
8	Common Faults and Troubleshooting Methods.....	76
8.1	Container Faults and Troubleshooting	76
8.2	Conventional Faults and Troubleshooting Methods of Dry Cooling Towers	82
9	System Maintenance	87
9.1	Overview	87
9.2	Preventive Maintenance	87
9.3	Regular Inspection of Containers	88
9.4	Dry Cooling Tower Maintenance and Upkeep	97
9.5	Maintenance of Dust Filters	101
10	Safety Instructions.....	103
10.1	Maintenance	103
10.2	Operation	103
10.3	Danger	104
	Appendix A: List of Maintenance Tools for the HW7 Liquid cooling container.....	105
	Appendix B: Requirements for Internal Circulation Coolant.....	109

Revision History

Version number	Change items	Previous content	Modified content	Change date	Changer
V1.0		/	/	2026.05	

1 Introduction to This Manual

This manual mainly introduces working principles, fault processing and maintenance methods of the ANTSPACE HW7 water-cooling system.

1.1 Scope of Application

This manual applies to the following model: ANTSPACE HW7.

Installation and operation methods of the product will be introduced.

1.2 Target Readers

This manual is applicable to professional technicians who need to install, operate, and maintain the product. Professional technicians must meet the following requirements:

You should have certain professional knowledge in electronics, electrical wiring, and mechanics, and be familiar with electrical and mechanical schematics.

You should be familiar with the composition and working principles of water-cooling systems and related products.

You should have received professional training related to the installation and commissioning of electrical products.

You should have the ability to respond urgently to dangers or emergencies that may occur during installation or commissioning.

You should be familiar with relevant standards and specifications of the country/region where the project is located.

1.3 Manual Use

Please read the manual carefully before using the product.

Contents of this manual will be continuously updated and revised, but there may inevitably be slight discrepancies or errors with the physical product. Users should refer to the actual purchased product and can download the latest version of the manual from www.bitmain.com or obtain it through sales channels.

1.4 Symbol Usage

To ensure the personal and property safety of users during product operation, and to enable more efficient and optimized product use, this manual provides relevant information highlighted by the following symbols.

The following lists the symbols that may be used in this manual. Please read them carefully to better use this manual.

 Danger

Indicates a high potential hazard which, if not avoided, will result in serious injury, fatalities, equipment damage, or other severe consequences.

 Warning

Indicates a moderate potential hazard which, if not avoided, could lead to equipment damage or other serious incidents.

 Caution

Indicates a potential hazard which, if not avoided, may result in equipment malfunction or operational failure.

2 Safety Instructions

2.1 General Safety Precautions

Statement: The equipment company shall not assume liability under any of the following circumstances.

- 1) The machine is operated outside the usage conditions specified in this manual;
- 2) The installation and usage environment exceeding provisions in relevant international standards;
- 3) Operators fail to follow operation instructions and safety warnings in the product and documentation;
- 4) Equipment damage caused by abnormal natural environments.

2.2 All Safety Precautions

In order to ensure personal and equipment safety during installation, operation, and maintenance, please follow all safety precautions indicated on the equipment and described in the manual.

“Caution”, “Warning” and “Danger” in the manual do not represent all safety matters that should be observed, but are only supplementary to all safety precautions.

1) Local laws and regulations

When operating the equipment, you should abide by local laws and regulations. The safety precautions in this manual are only supplementary to local safety codes.

2) Basic installation requirements

Personnel responsible for installing and maintaining the equipment must first undergo rigorous training, understand all safety precautions, and master correct operating procedures before they can install, operate, and maintain the equipment.

Only qualified and trained personnel are permitted to install, operate, and maintain the equipment.

Replacement and modification of equipment or components (including software) must be completed by personnel certified or authorized by the equipment manufacturer.

Operators shall promptly report any faults or errors that may lead to safety issues to the person in charge.

3) Grounding Requirements

The following requirements apply only to equipment requiring grounding:

When installing the equipment, grounding must be done first; when dismantling the equipment, the grounding wire should be removed last.

Damaging the grounding conductor is prohibited.

Operating the equipment without installing the grounding conductor is prohibited.

The equipment shall be permanently connected to the protective ground.

4) Personal Safety

Persons other than the operators are not allowed to approach this equipment.

Before operating the equipment, wear insulated shoes and gloves, protect your eyes, and remove conductive objects such as jewelry and watches to avoid electric shock or burns.

The handles of tools used must be insulated.

5) Equipment Safety

When installing, operating, and maintaining the equipment, please properly store the keys or special tools for the cabinet doors.

Before operation, the equipment shall be securely fixed to the floor or other stable objects such as walls or mounting frames.

Do not block the ventilation openings while the system is in operation.

When installing the panel, if screws need to be tightened, tools must be used for operation.

When the equipment installation is complete, please remove empty packaging materials around the equipment.

2.3 Electrical Safety

1) High Voltage

Danger

The high-voltage power supply provides operational electricity to the equipment. Direct contact or indirect contact through damp objects (or conductors) with the high-voltage supply poses a lethal hazard.

Improper or incorrect high-voltage operations may cause fire, electric shock, or other accidents. Signal cables must be bundled separately from high-current or high-voltage cables.

2) Large Leakage Current

! Danger

1. Before powering on the equipment, all components and the main grounding wire must be properly grounded. Failure to do so may endanger personnel and equipment safety.
2. If a "High Leakage Current" label is affixed near the power terminals, the protective grounding terminal of the equipment chassis must be connected to earth before connecting the AC input power supply. This prevents leakage current from causing electric shock to personnel.
3. Exposed bare wires inside the equipment must be immediately insulated with electrical tape and secured properly.

3) Power Cables

! Danger

Never install or remove power cables while energized. Contact between power cable conductors and live terminals can generate arcs or sparks, leading to fire or eye injuries.

Before installing or removing power cables, the power breaker must be turned off first.

Before connecting the power cables, the label identification of the power cables must be confirmed to be correct before proceeding with the connection.

Power cables damaged must be replaced by the manufacturer, its business agent, or personnel with similar qualifications to avoid risks.

This equipment shall be equipped with a means to disconnect from the main power supply, providing contact spacing at all levels to complete disconnection under Class III over-voltage conditions. This disconnection means must be incorporated into the fixed wiring in accordance with wiring principles.

2.4 Mechanical Safety

1) Drilling

! Warning

Do not drill holes in the cabinet without authorization. Improper drilling may damage internal components, pipelines, or cables.

2) Sharp objects

The fins of the air-cooled tower heat exchanger are extremely sharp. Protective gloves should be worn when working near the fins.

 Warning

When performing equipment maintenance, wear protective gloves to avoid cuts from sharp edges.

3) Fan

When replacing components, pay attention to properly placing components, screws, tools and other objects to prevent them from falling into the operating fan and damaging the fan or equipment.

When devices around the fan are removed, please do not insert fingers or single boards into the operating fan before the fan is powered off and stops rotating, so as to avoid hand injuries or equipment damage.

4) High-speed operation

Pay attention to the components in high-speed operation: fans and water pumps.

5) Handling heavy objects

 Warning

1. When handling heavy objects, wear protective gloves to prevent hand injuries.
2. Ensure proper lifting posture to avoid being crushed or strained by heavy loads.
3. Exercise caution when pulling equipment out of the cabinet, as unstable or oversized devices may cause crushing or impact injuries.
4. Do not move heavy equipment alone. When transporting, do not tilt the equipment beyond 15° (relative to the vertical position).
5. When moving or lifting equipment, take protective measures to prevent scratches or collisions.
6. Never use components as load-bearing points during transportation, as this may cause damage.

2.5 Operational Safety

1) High temperature and high pressure

Improper operation may cause excessive system pressure, leading to the ejection of cooling medium.

Please pay attention to high-pressure components: exhaust valves, drain valves, and plastic hoses.

2.6 Others

1) Bundling signal wires

! Caution

Signal cables must be bundled separately from high-current or high-voltage cables.

2) Cable laying

When the temperature is too low, severe impacts and vibrations may cause brittle cracking of the plastic outer sheath of the cable. To ensure construction safety, the following requirements should be followed:

All cables shall be laid and installed at an ambient temperature above 0°C.

If the storage temperature of the cables is below zero, they must be moved to a room-temperature environment and stored for more than 24 hours before laying and placing operations.

When handling cables, especially during construction in low-temperature environments, they should be handled with care. Unstandardized operations such as directly pushing cables off vehicles are strictly prohibited.

3) Storage

Equipment is prohibited from being stored in areas close to heat sources or exposed to direct sunlight.

Any open flames or high-temperature objects are prohibited from approaching equipment, especially equipment loaded with high-pressure nitrogen and equipment charged with refrigerant, to prevent explosions caused by high pressure or personal injury due to refrigerant leakage.

4) Recycling and disposal

The following symbol indicates that this product cannot be disposed of with other household waste in the EU region. To prevent uncontrolled waste disposal hazards caused by potential harmful substances to the environment and human health, please sort and recycle waste to promote the sustainable reuse of material resources.



Figure 2.1 Recycle marking

3 System Composition and Working Principle

3.1 System Overview

The liquid cooling container system aims to continuously supply cooling fluid with required pressure, temperature, and flow rate for the heat dissipation units of internal computing power servers, ensuring an optimal operating environment for the load.

The heat dissipation mode of the liquid cooling container system is forced air cooling (dry cooling tower). The internal cooling medium may be selected as either an antifreeze-type coolant or a corrosion-inhibiting coolant, depending on the local ambient temperature conditions.

3.2 System Composition

Table 3.1 Main components of liquid cooling container system

Sub-components	Component Functions	Main Components and Parts
Pump Station	Transport and monitor the status of the coolant to maintain the stable operation of the system	Centrifugal pump, sensor, valve, exhaust valve, filter, pipeline, and other related accessories
Control Cabinet	Control operations of each component in the pump station, read and display the values of each sensor, and upload them	Air breaker, intermediate relay, PLC, switching power supply, touch screen, and other related accessories
Network and Power Distribution System	Configure the network and distribute power for the computing power servers	Breaker, cable, switch, ethernet cable and other related accessories
Electrical distribution box	Power distribution for computing power Servers	Breakers, waterproof enclosures, cooling fans, and other related accessories.
Water divider assembly	Flow distribution and transportation	Manifold, elbow, hose, chuck, valve, and other related accessories

Sub-components	Component Functions	Main Components and Parts
Accessories with the Container	Supporting parts, components and accessories required for the use of the liquid cooling container system	Screws, micro breakers, hose clamps, rubber hoses, and other related accessories
Dry cooling tower	Transfer the heat from the load to the atmosphere	Stainless steel heat exchanger components, valves, pressure gauges, and other related accessories
Water Curtain	Reduce the inlet air temperature of the dry cooling tower	Water curtains, pumps, water tanks, pipes, valves, float valves, level gauges, and other related accessories.

3.3 Working Principle

HW7 include two liquid cooling systems, A and B. These two cooling systems can be turned on separately or simultaneously without interfering with each other, and they share one main control cabinet. When the A/B liquid cooling system is activated, the cooling fans on the A/B side of the dry cooling tower start simultaneously, after which the computing power servers on the A/B side can be started.

The pump station delivers coolant that meets the requirements for temperature, pressure, flow rate, and medium to the manifold assembly. After being distributed by the manifold, the coolant is delivered to the water-cooled plates, which remove heat from inside the equipment. The heated coolant enters the dry cooling tower for forced heat exchange with the external air. The cooled coolant is then delivered back to the water-cooled plates through the pump station and water divider assembly, forming a cycle that removes heat from the heat-generating loads and ensures they operate in a favorable environment.

Working principle of the dry cooling tower: Evaporative cooling reduces the temperature of the air entering the dry cooling tower, thereby achieving a lower feedwater temperature.

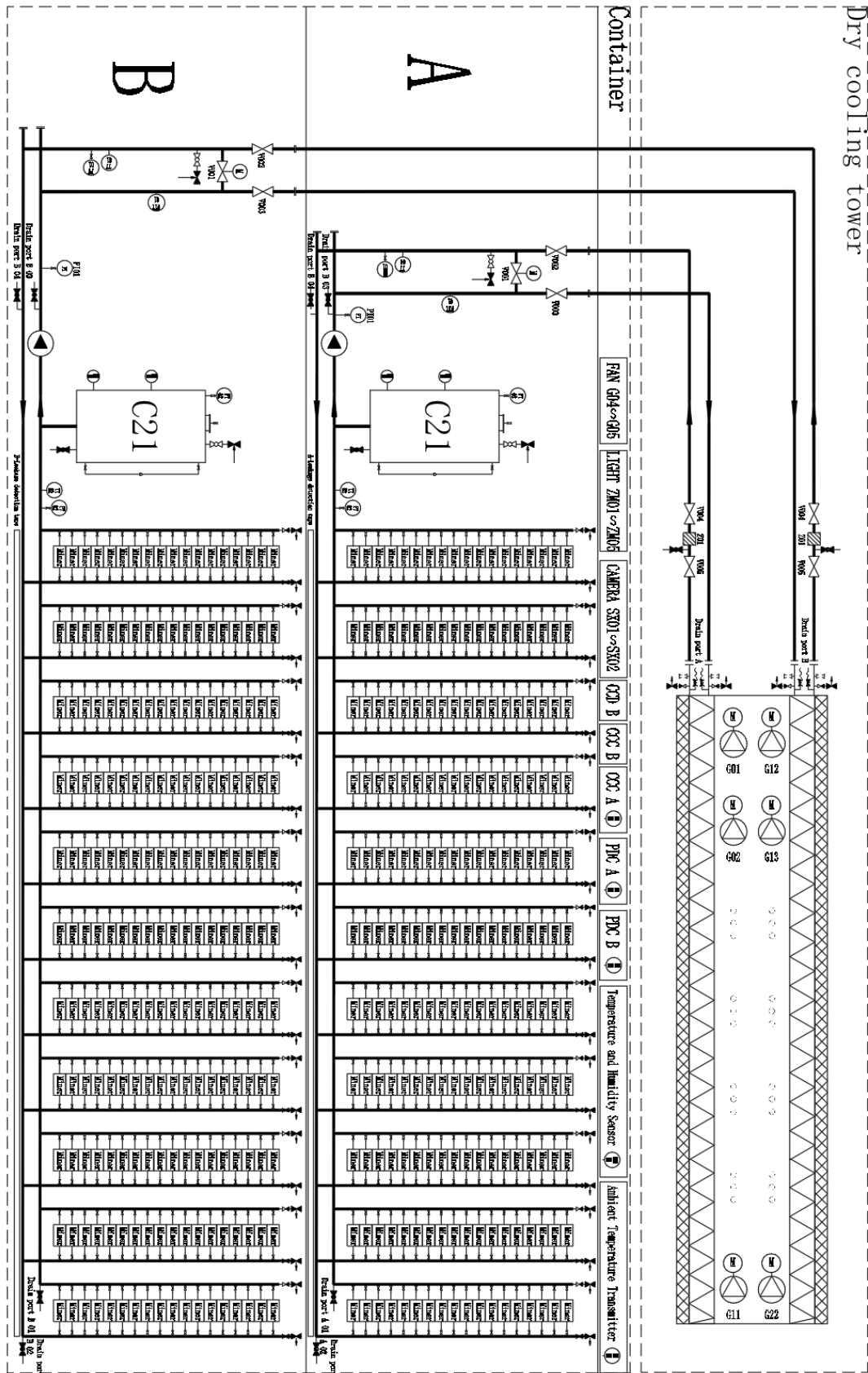


Figure 3.1 Schematic of liquid cooling container system

4 System Performance Indicators

The performance indicators of the container liquid cooling system mainly include environmental indicators and liquid cooling system performance indicators. The environmental indicators specify requirements for the ambient temperature, humidity, altitude, and other conditions for the use of the liquid cooling system. The performance indicators cover parameters such as the size, weight, noise, thermal performance, and electrical performance of the liquid cooling system during operation.

Table 4.1 Performance indicators of liquid cooling container system

Serial Number	Name	Indicator	Remarks
Environmental Indicators			
1	Working Temperature	-40~50℃	Outdoor
2	Working Humidity	10~90%	
3	Storage Temperature	-40~70℃	
4	Storage Humidity	10~90%	
5	Altitude	≤2000m	
Container Technical Indicators			
1	Overall Dimensions (L×W×H) (mm)	12192×2438×2896	The tolerances comply with the requirements of the classification society.
2	Number of Computing Power Server Bays	Maximum of 396 standard hydro-cooling high computing servers Maximum of 242 2U hydro-cooling high computing servers	
3	Container Certification	Classification Society Certification	

Serial Number	Name	Indicator	Remarks
4	Safety Certification	North American, CE	
5	Operating Power(kW)	≤ 160	No-load
6	Input Voltage and Frequency	AC380V-480V, 60Hz/50Hz	
7	Transport Weight (T)	16	Excluding computing power servers and cooling fluid
8	Operating Weight (T)	25	Including computing power servers and cooling fluid
9	Main breaker. Capacity of Power Distribution Cabinet (A)	960×4	The liquid cooling container system includes two power distribution cabinets, each equipped with two 960A main breakers
10	Rated Current (A)	866×4	Rated current of each external power supply circuit in the container.
11	Standard Power (kW)	2100	
12	Maximum Power(kW)	2500	
13	Rated Current per Server Bay (A)	≤ 14.5	The liquid cooling container system includes two power distribution cabinets, each equipped with two 960A main breaker.
14	External Interfaces	Clamp connection: ISO 139.7 ISO 2852	

Serial Number	Name	Indicator	Remarks
15	Rated Flow (m³/h)	95	Corresponding to 198 standard hydro-cooling high computing servers on one side
		116	Corresponding to 121 2U hydro-cooling high computing servers on one side.
Dry Cooling Tower Technical Indicators			
1	Type	Dry Cooling Tower	
2	Overall Dimensions(L×W×H)(mm)	12192×2438×2896	The tolerances apply with the requirements of the classification society.
3	Heat Dissipation Capacity(kW)	2000	1000×2
4	Water Outlet Temperature @30℃ Ambient Temperature	≤35±1 ℃ at an ambient temperature of 30 ℃ ≤55±1 ℃ at an ambient temperature of 50 ℃	Operating conditions without a water curtain(@ 30 ℃ ambient temperature, 60% RH; @ 50 ℃ ambient temperature, 40% RH)
		≤35 ℃ at an ambient temperature of 30 ℃ ≤55 ℃ at an ambient temperature of 35 ℃	Operating conditions with a water curtain(@ 30 ℃ ambient temperature, 60% RH; @ 50 ℃ ambient temperature, 40% RH)
5	Container Certification	Classification Society Certification	
7	Operating Power (kW)	≤95	
8	Transport Weight(T)	14	
9	Operating Weight (T)	16	

Serial Number	Name	Indicator	Remarks
10	External Interfaces (Container)	Clamp connection: ISO 139.7 ISO 2852	With connecting pipelines attached
11	Noise @25°C, 15m	≤75dBA	

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5 System Structure View

5.1 External View of the Liquid cooling container system

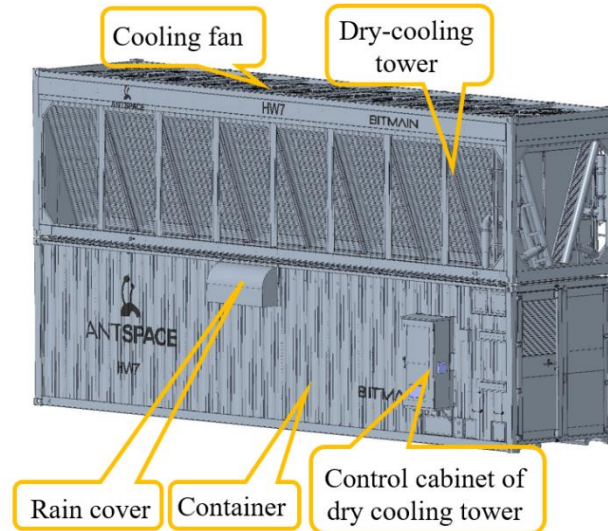


Figure 5.1 External view of the liquid cooling container system

5.2 Internal View of the Liquid cooling container system

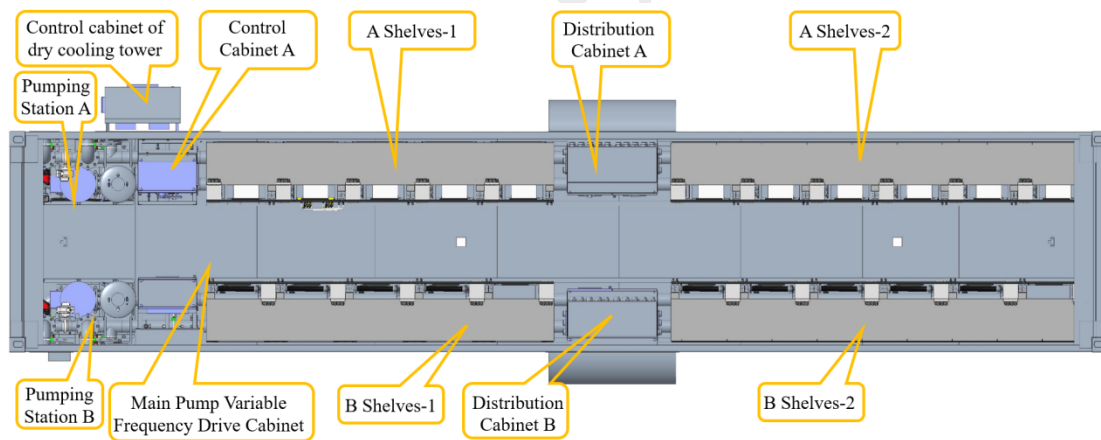


Figure 5.2 Internal view of the container

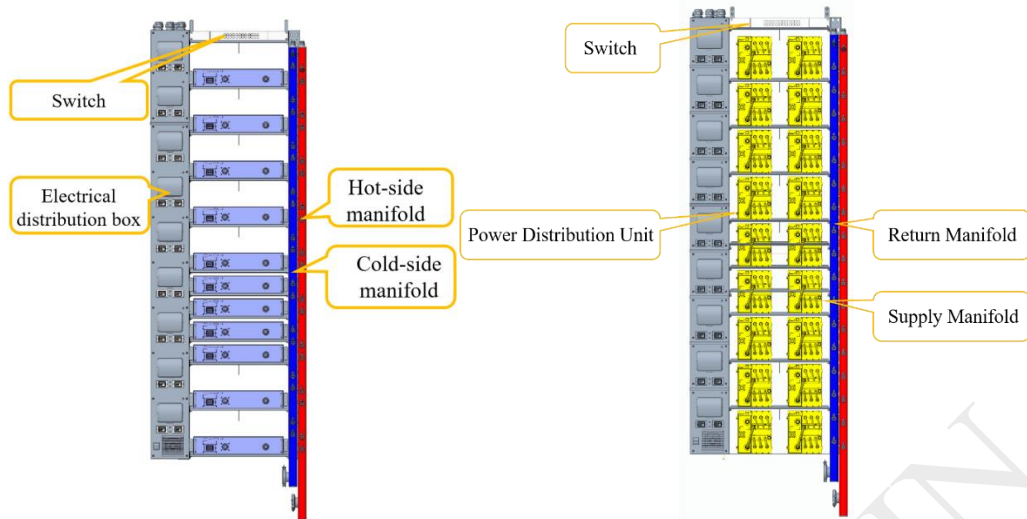


Figure 5.3 Internal view of the water divider assembly

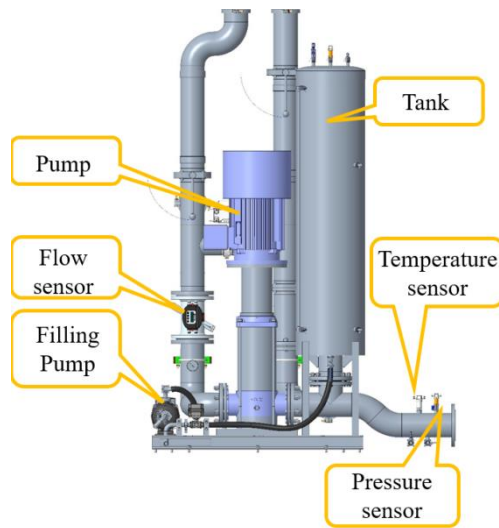


Figure 5.4 View of the pump station

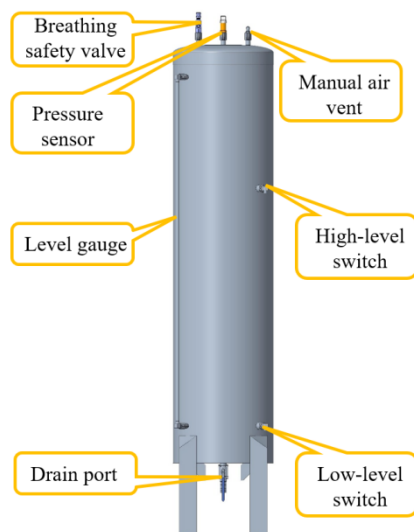


Figure 5.5 Liquid tank

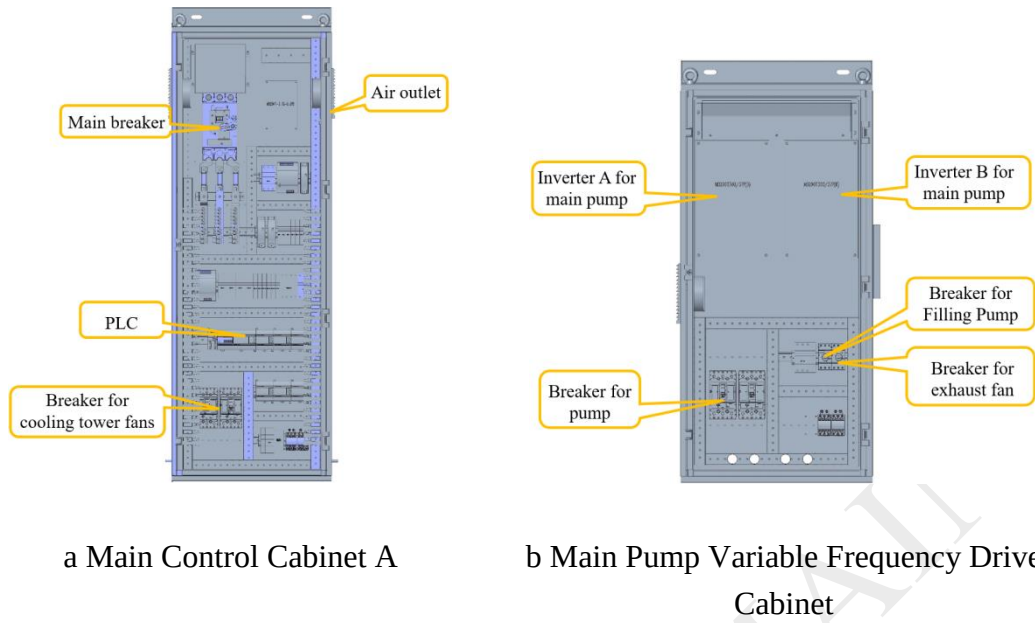


Figure 5.6 Internal view of the main control cabinet

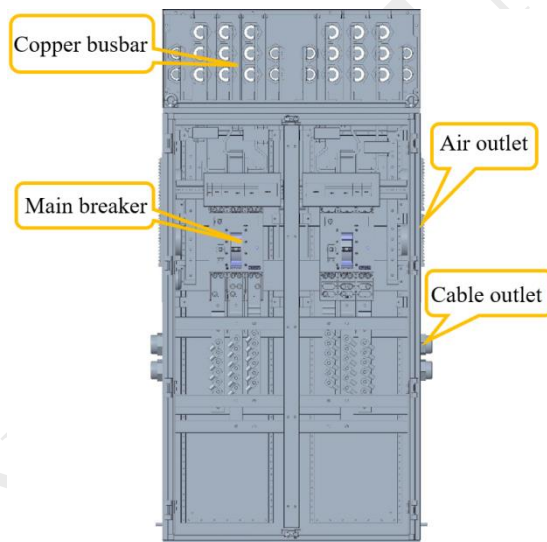


Figure 5.7 Internal view of power distribution cabinet B

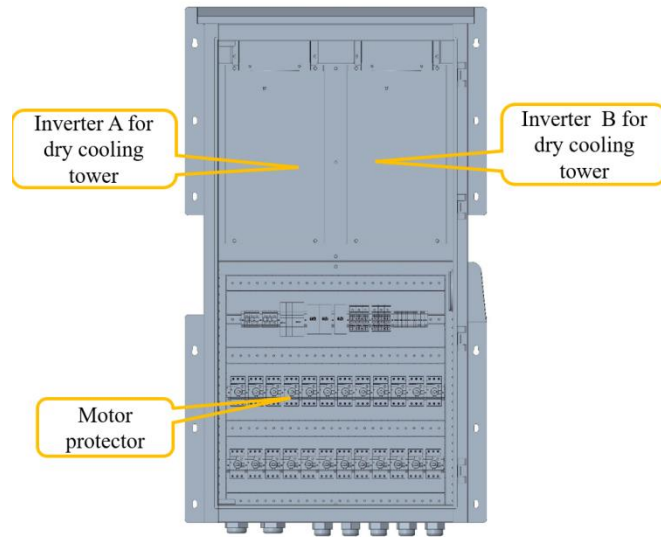


Figure 5.8 Internal view of the dry cooling tower control box

6 Installation of System Products

6.1 Leveling Before Container Installation

Place the spirit level on the ground. Before using the spirit level, it is necessary to carry out accurate leveling work so that the bubble of the spirit level can be in the middle position. The spirit level is used to create a reference line. Use a ruler to measure the height from the reference line to the top of the cement foundation. Use steel plates or other materials to adjust the height to the same dimension. After adjustment, the foundation is leveled, and the container can be hoisted onto the foundation for subsequent installation. The total operating weight of the system after stacking is greater than 40 tons. The foundation must be able to sufficiently support the weight of the system and have a safety margin.

6.2 Installation of dry cooling towers

Remove the outer packaging cover plates of the dry cooling tower. The cover plates of the dry cooling tower are divided into top cover plates and side cover plates. There is no assembly relationship between the top cover plates and the side cover plates, so either the top cover plates or the side cover plates can be disassembled first. The process for removing the side cover plates is shown in the figure:

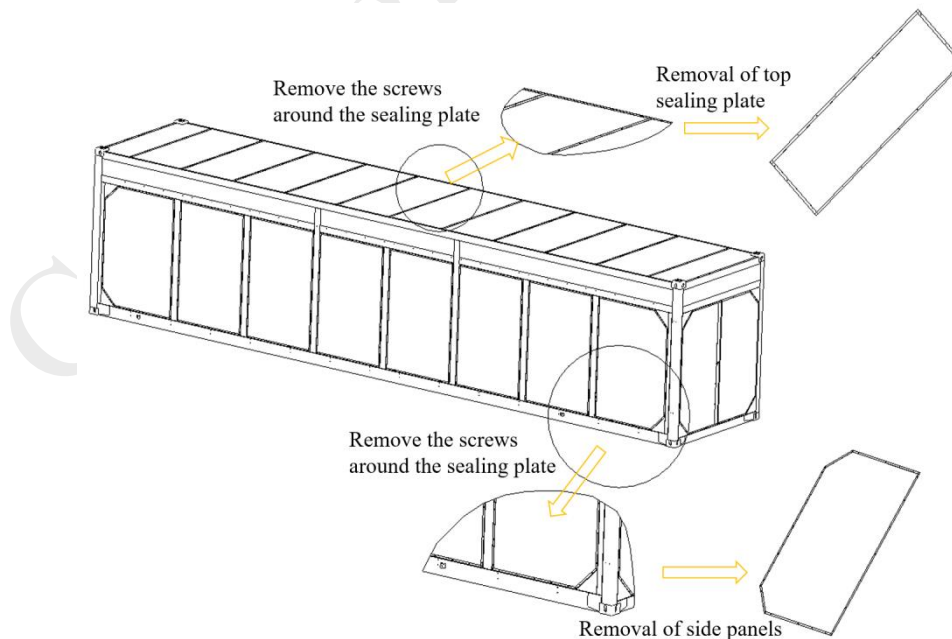


Figure 6.1 Schematic of removing top and side cover plates

The top and side sealing plate are independent of each other, and there is no requirement for the disassembly sequence.

! Caution

Retain all removed panels for subsequent transportation.

! Danger

Personal protective equipment must be worn during dry cooling tower panel removal to prevent cutting injuries from panels.

6.3 Hoisting of Dry Cooling Tower

The fixing procedures for the dry cooling tower are as follows:

- Determine and remove the engineering pipe components installed inside the dry cooling tower to prevent them from falling off during the hoisting process;
- Pass the lifting slings through the four corner fittings above the unit respectively, and the positions of the corner fittings are shown in Figure 6.2;
- Horizontally hoist the unit with a lifting beam and crane, place it on the cement ground, and leave sufficient space for container installation.

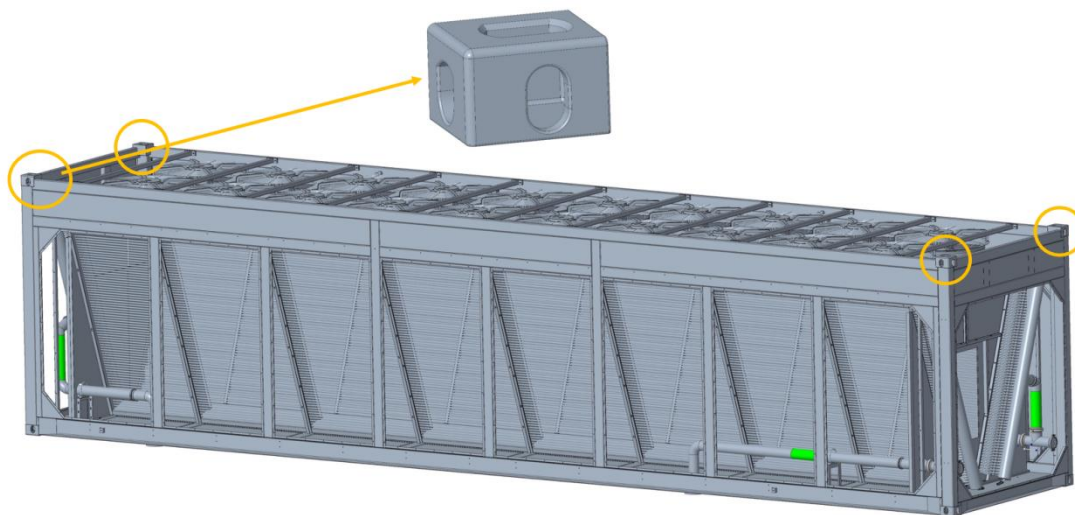


Figure 6.2 Lifting point diagram

! Danger

Lifting operations must be performed by qualified personnel.

During main hoisting, the lifting hooks must be attached exclusively to the four corner fittings of the container. Under no circumstances should they be attached to other parts of the unit.

Ensure that slings are not threaded into the corner fittings during lifting, as this may cause abrasion damage.

6.4 Installation of Container and Dry Cooling Tower

Place the container on the ground and there should be a certain strength (capable of bearing a weight of 40 tons, with a ground levelness of $\pm 1^\circ$), correctly position the twist locks on the four corner fittings at the top of the container. Then, hoist the dry cooling tower onto the top of the container (the hoisting direction should refer to the need for the inlet and outlet positions of the dry cooling tower to correspond vertically with those of the container). After the four corner fittings at the bottom of the dry cooling tower fully coincide with the twist locks, lock the twist locks.

During hoisting, the top of the dry cooling tower must be unobstructed, and the top of the container must be free of debris.

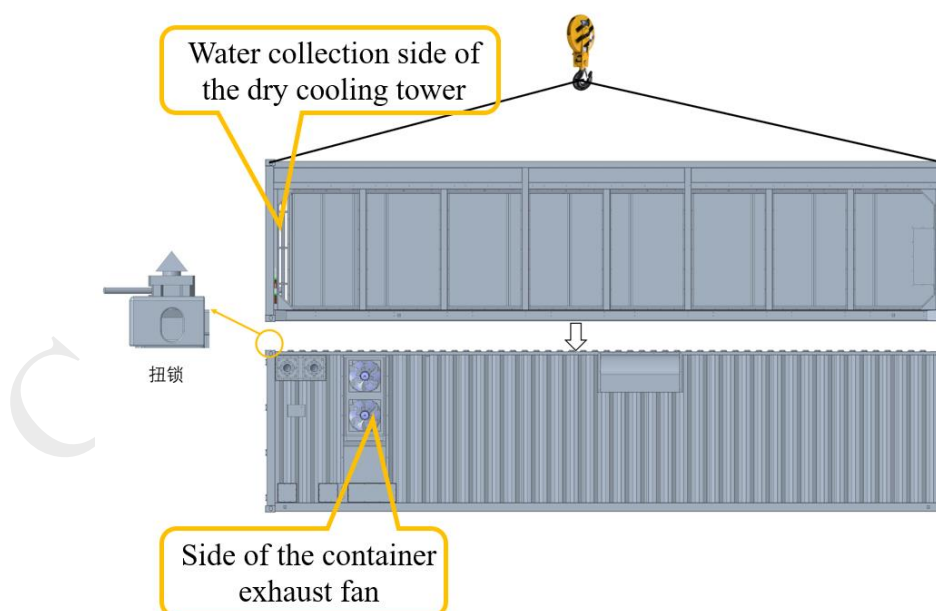


Figure 6.3 Installation of container and dry cooling tower

6.5 Arrangement and Installation of Intermediate Connecting Pipes

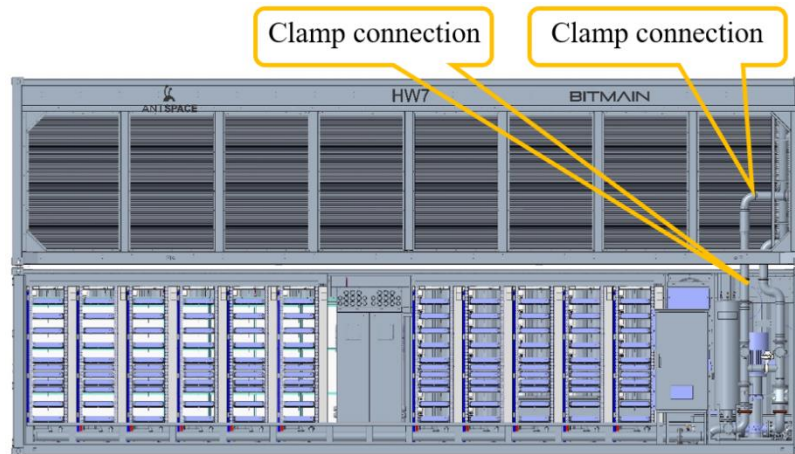


Figure 6.4 Schematic of pipeline assembly

Operations to connect the dry cooling tower are as follows:

- Connect the pipelines and components on both sides of the dry cooling tower in sequence according to the pipeline assembly schematic;
- The pipeline to be connected is of DN125 type. There are nuts and spring washers at the rear end of the steel pipe clamp, which are fixed with flat washers. The bolt specification is M16×75, and the tightening torque is 45 N·m.
- Lubricating oil shall be applied to the pipeline bolts before tightening, with the recommended brand being Mobilith SHC220 (the same as that for the water pump).

Warning

The flange fastening bolts are made of 304 stainless steel. Lubricant must be applied during installation to prevent thread galling.

6.6 Installation of Water Curtains

The HW7 water-cooled container can be equipped with a water curtain to cope with high-temperature environments. The water curtain works by using “water-air heat exchange” to lower the inlet air temperature of the dry cooling tower, thereby indirectly improving the heat dissipation efficiency of the heat exchanger inside the tower and ultimately ensuring the stable operation of the dry cooling tower’s associated equipment (servers). When ambient temperatures are excessively high and operating the dry cooling tower alone is insufficient to effectively lower the supply fluid temperature, water curtains can be installed to assist in reducing the supply fluid temperature.

The water curtain system can be broadly divided into four major categories: the heat exchange module, the water circulation module, the control and protection module, and the auxiliary installation module. Among these, the heat exchange module, with the water curtain at its core, is responsible for facilitating air-to-water heat exchange; The water circulation module includes pumps, water tanks, and piping, providing the power and water supply for heat exchange; the control and protection module encompasses components such as level sensors and flow meters, ensuring the system's safe and stable operation; and the auxiliary installation module—which includes side panels—ensures the equipment is securely installed and suited to the dry cooling tower environment. These components work together to form a complete water curtain cooling system, and each is indispensable.

The use of a water curtain requires sufficient water supply capacity at the site. Before turning on the water curtain pump, ensure that the water supply lines to the water curtain tank are connected and that the tank is sufficiently filled with water.

The water curtain is divided into two sides, A and B, which operate independently of each other. Each side consists of 8 individual water curtain modules (16 in total for both sides). The modules are bolted together, allowing for the replacement of a single module if it becomes damaged without the need to disassemble the entire water curtain, thereby reducing maintenance costs. The overall structure is shown in the figure.

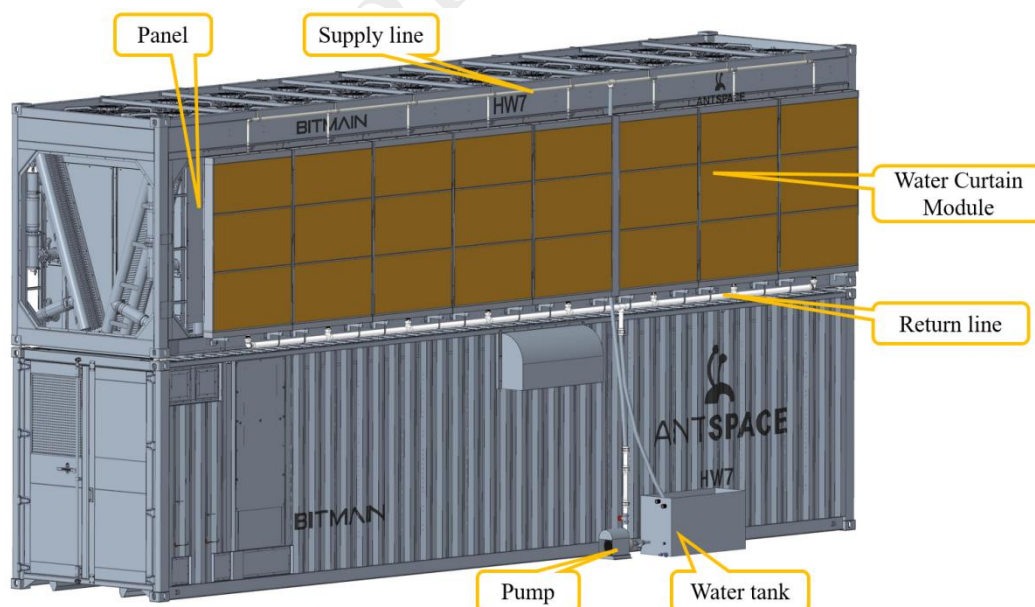


Figure 6.5 Water curtain installation diagram

The installation process for the water curtain can be divided into five steps: bracket installation, module installation, piping installation, end panel installation, and water tank and pump installation.

a) Bracket Installation

Before installing the water curtain modules, the brackets on the bottom of the modules must be installed. As shown in the figure, the bottom brackets are used to support the water curtain modules. Each module is supported by two brackets, with a total of 16 brackets on one side, secured using M10×30mm bolts. The return line hooks are used to secure the return lines and are mounted on the bottom brackets. There are 14 hooks in total, installed using M8×20 bolts; the two outermost hooks do not need to be installed.

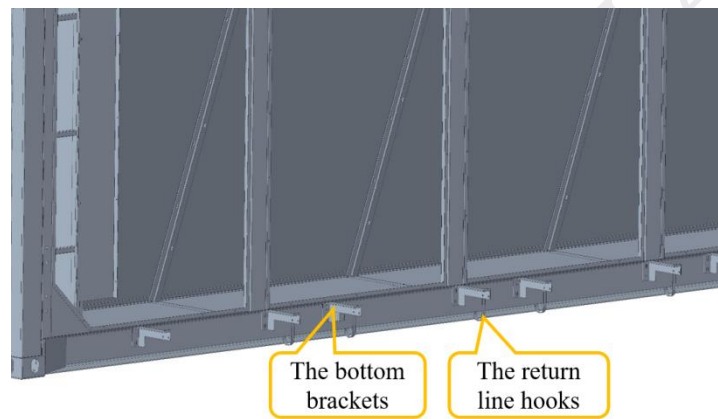


Figure 6.6 Installation of the bottom brackets

The top bracket is used to support the top fluid supply lines. Install the bracket as shown in the figure, securing it with M6 self-tapping screws. There are a total of 8 mounting brackets on the top.

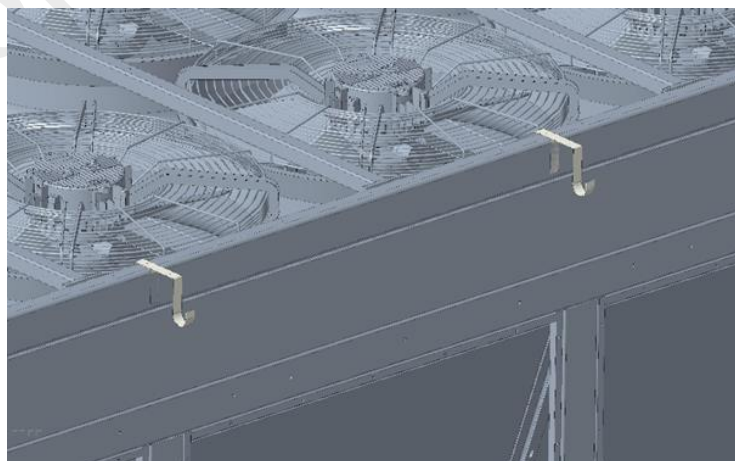


Figure 6.7 Installation of the top brackets

b) Installation of the Water Curtain Module

There are four mounting holes on the top of the water curtain module. Place the module on the bottom bracket, align the top holes with the holes in the container, and secure it using M8×20 bolts (if there is a height discrepancy between the holes, adjust the position of the bottom bracket).

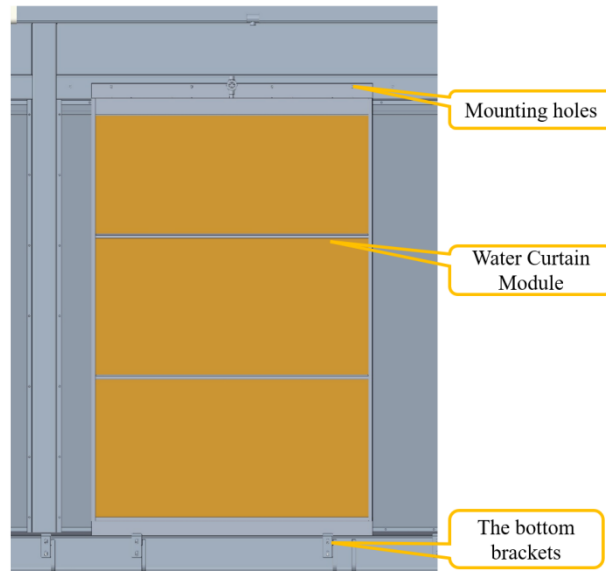


Figure 6.8 Installation diagram for water curtain module

c) Piping Installation

The water curtain piping system consists of supply lines, return lines, and supply/return connection hoses. The supply and return lines are connected to the water curtain via threaded couplings, while the supply and return hoses are secured to the piping using clamps. The supply and return lines are labeled IN-1, IN-2, IN-3, OUT-1, OUT-2, and OUT-3. Install according to the numbers shown in the diagram.

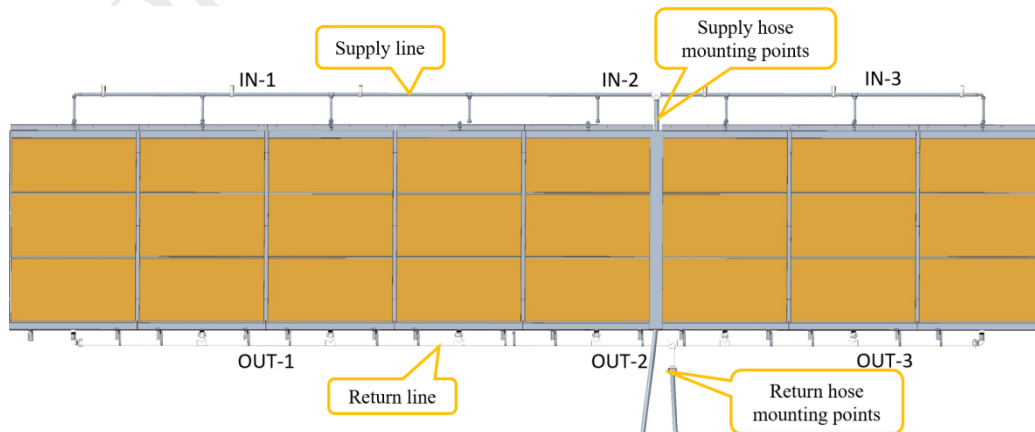


Figure 6.9 Water curtain piping installation diagram

d) Sealing Panel Installation

The sealing panels for the water curtain primarily consist of panels between the water curtain and the container, as well as panels between adjacent water curtains. These panels prevent air leakage during air intake, which could reduce the water curtain's cooling effectiveness. The panels are secured using M8 bolts and nuts. There are four types of sealing panels in total, with nine panels on each side. The panel locations are shown in the figure.

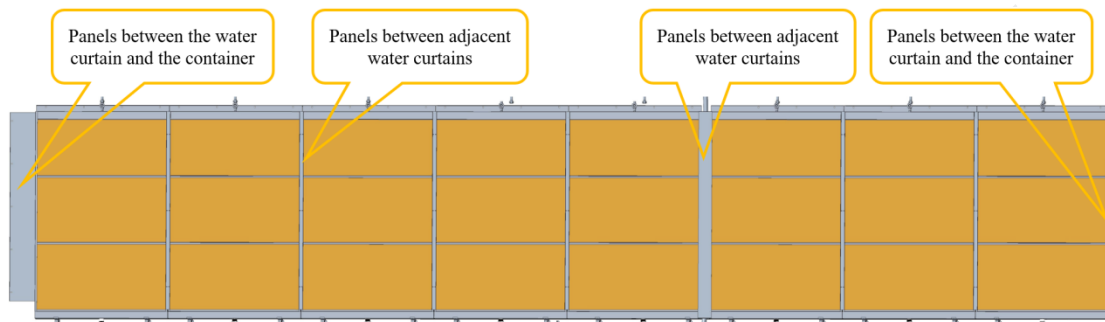


Figure 6.10 Water curtain sealing plate installation diagram

e) Water Tank and Pump Installation

The water tank serves as a reservoir for the water curtain's circulating water, while the pump provides the circulation power for the water curtain's spray. The figure below shows a schematic diagram of the connections for the water curtain pump and the supply and return lines. The pump is connected to the water tank via piping, which includes a filter to prevent impurities from entering the pump. The pump outlet serves as the supply line, which includes a float-type flow meter. The circulation water flow can be adjusted by monitoring the meter's reading. The supply hose is connected to the pump outlet pipe using a clamp, while the return hose is placed directly into the water tank; ensure the hose is securely fastened.

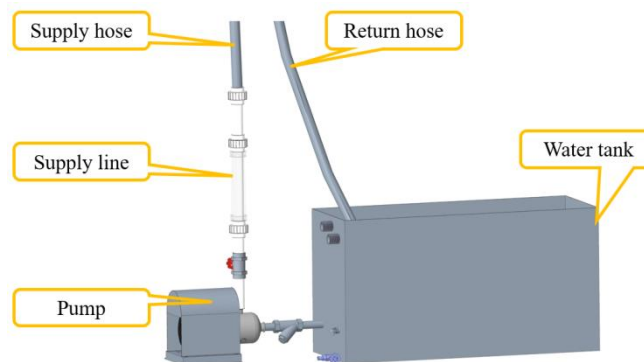


Figure 6.11 Schematic diagram of water tank and pump installation

6.7 Server Installation

The HW7 liquid cooling container is compatible with both T-type and U-type servers. Each rack can accommodate 18 T-type servers or 11 U-type servers. Server installation includes shelf layer installation, piping connection, and power cord and network cable connection.

1) T-type Server Installation

The container is delivered with 9 shelf layers per rack, allowing 9 layers of servers to be installed. Each shelf layer in the T-type configuration holds two servers; no shelf layer installation or removal is required. After the miners are installed, connect the water piping, power cords, and network cables.

The FEP pre-formed tubes used for T-type server connections come in four types: T-1, T-2, T-3, and T-4 (each tube is labeled with its corresponding number). Connect the tubes according to their numbers. During connection, ensure that each tube is fully inserted into place (limit lines are marked on the tubes).

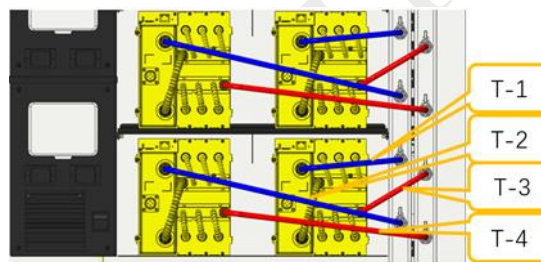


Figure 6.12 T-type Server Piping Connection Diagram



Figure 6.13 FEP Pre-formed Tube Diagram

Each shelf layer is pre-wired with two network cables, which connect directly to the servers. The power cords for T-type servers are divided into LP33 square connectors and LP-20 round connectors: the LP33 connector connects to the power distribution box on the right side of the shelf, while the LP-20 round connector connects to the server.

2) U-type Server Installation

The container is delivered with 9 shelf layers per rack, allowing 9 layers of servers to be installed. Each shelf layer in the U-type configuration holds one server. If 11 servers need to be installed, two additional shelf layers must be installed (at the 5th and 7th positions). The installation positions for the shelf layers are shown in the figure; only four M6×16 bolts are required for fixation.

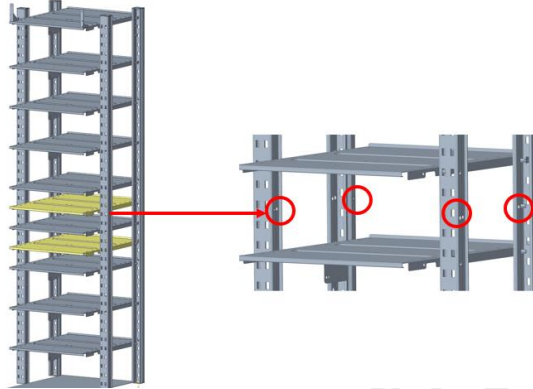


Figure 6.14 Shelf Layer Installation Diagram

The FEP pre-formed tubes used for U-type server connections come in two types: U-1 and U-2 (each tube is labeled with its corresponding number). Connect the tubes according to their numbers. During connection, ensure that each tube is fully inserted into place (limit lines are marked on the tubes).



Figure 6.15 U-type Server Piping Connection Diagram

Each shelf layer is pre-wired with two network cables; select one cable to connect directly to the server. The power cords for U-type servers have LP33 square connectors on both ends: one end connects to the junction box, and the other end connects directly to the server. The additional shelf layers at the 5th and 7th positions use the network cables from the shelf layer above them.

Danger

The quick-disconnect fittings do not support connection or disconnection under pressure. Before connecting or disconnecting the miner-side water lines (quick disconnects / FEP formed hoses), the corresponding mini ball valve on the manifold must be closed first, and the operation may proceed only after the branch flow is fully cut off. Connecting or disconnecting under pressure may cause coolant spray, resulting in server damage or personal injury.

Danger

The cover of the power distribution box (PDU) must be kept closed and securely fastened at all times to maintain its protection rating. After wiring or maintenance, always confirm that the cover is firmly latched and not loose. An unfastened cover may allow moisture or dust ingress, resulting in short circuits, equipment damage, or electric shock.

Danger

When connecting server power cords, switch off the corresponding circuit breaker in the junction box. Never plug or unplug power cords while energized. Ensure plugs are fully inserted to prevent poor contact, which may cause short circuits, cable burning, or other serious consequences.

6.8 Power Distribution work

Danger

Electrical work is a high-risk operation and must only be performed by qualified and certified personnel in compliance with local regulations. Standard operating procedures (SOPs) must be strictly followed. Unauthorized personnel are prohibited from performing any electrical work.

1) Power distribution steps

Liquid cooling container (HW7) adopts 4-way power cord inlet, with two power lines on each of the A side and B side. The cable specifications shall be subject to the

standards and requirements of the installation site. According to the materials used on site, the recommended specifications for copper wires and aluminum wires are as follows:

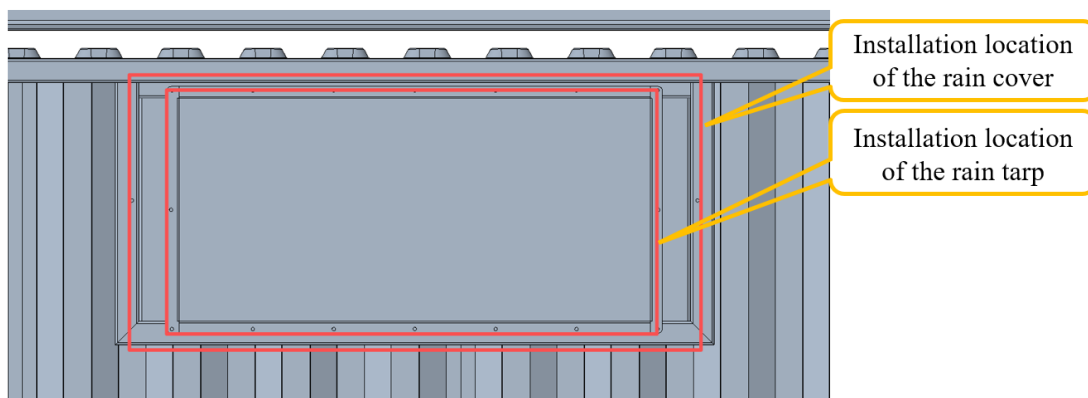
Table 6.1 Specifications of power supply cables

Power distribution cabinet	Phase sequence	Cable material	Cable cross-section	Number of cables
A/B	L1	Copper wire	600kcMil (300mm ²)	12 (three wires for single phase, two incoming lines for each of Cabinet A and Cabinet B)
	L2			12 (three wires for single phase, two incoming lines for each of Cabinet A and Cabinet B)
	L3			12 (three wires for single phase, two incoming lines for each of Cabinet A and Cabinet B)
	N			4 (one wires for single phase, two incoming lines for each of Cabinet A and Cabinet B)
	PE	Copper wire	600kcMil (300mm ²)	4 (one wires for single phase, one incoming lines for each of Cabinet A and Cabinet B)

Power distribution cabinet	Phase sequence	Cable material	Cable cross-section	Number of cables
A/B	L1	Aluminum wire	800kcMil (400mm ²)	12 (three wires for single phase, two incoming lines for each of Cabinet A and Cabinet B)
	L2			12 (three wires for single phase, two incoming lines for each of Cabinet A and Cabinet B)
	L3			12 (three wires for single phase, two incoming lines for

				each of Cabinet A and Cabinet B)
	N			4 (one wires for single phase, two incoming lines for each of Cabinet A and Cabinet B)
	PE	Aluminum wire	800kcMil (400mm ²)	4 (one wires for single phase, one incoming lines for each of Cabinet A and Cabinet B)

- a) The cables are respectively connected from the inlet openings on both sides of the container. Before connection, rain covers, rain tarp, etc. need to be installed first. In order to further prevent rainwater from seeping into the container through the connection points, the joints of the rain covers shall be sealed with glue after the rain covers are installed. The cables are connected from the top junction boxes of the two power distribution cabinets and extend to the corresponding copper busbars, which are fixed with screws. The specific positions are shown in Figure 6.16.
- b) There are grounding studs on both sides of the container, and the container's shell must be reliably grounded. It is necessary for the container to have at least two diagonal and reliable grounding points on the diagonal. And the top of the container and the bottom of the dry cooling tower are both equipped with grounding points, which are connected by grounding yellow-green cables, with specific positions shown in Figure 6.17.



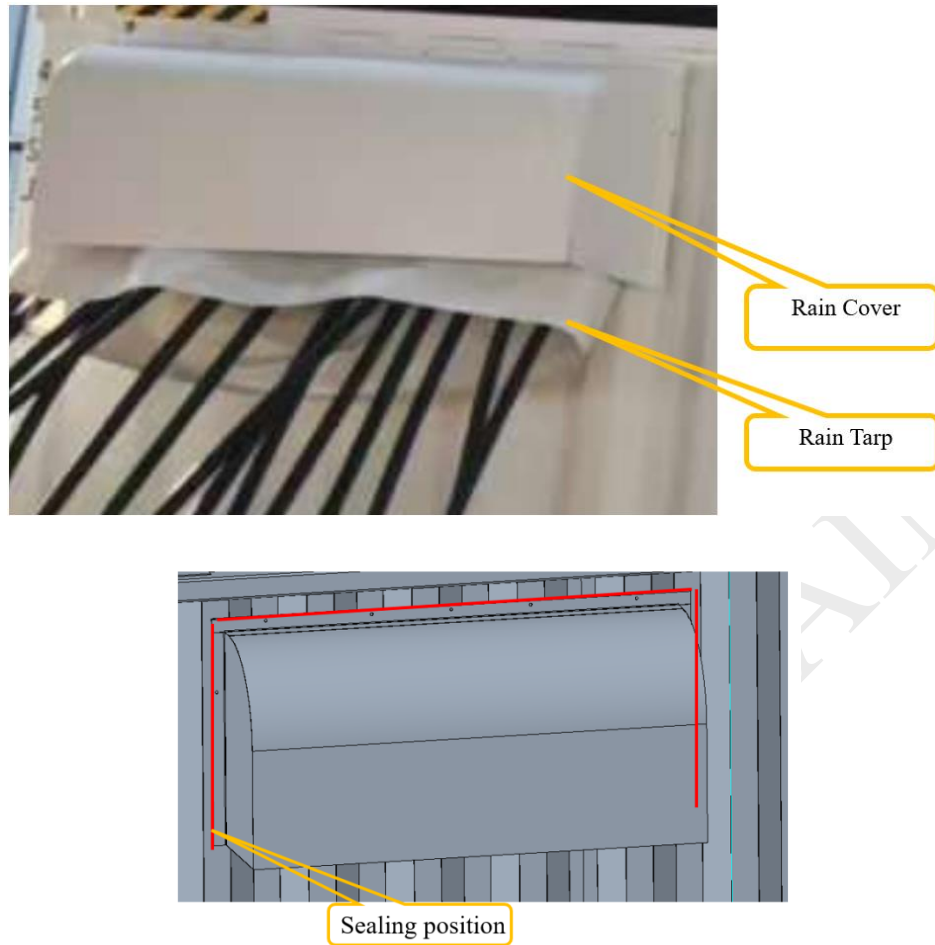


Figure 6.16 Installation of cable inlet holes and rain tarp

! Danger

After the installation of the rain cover and rain tarp, all junctions between the rain cover and the container must be thoroughly sealed with silicone sealant to ensure complete waterproofing. Failure to do so may result in water ingress at the power connection points, leading to short circuits and other severe incidents.

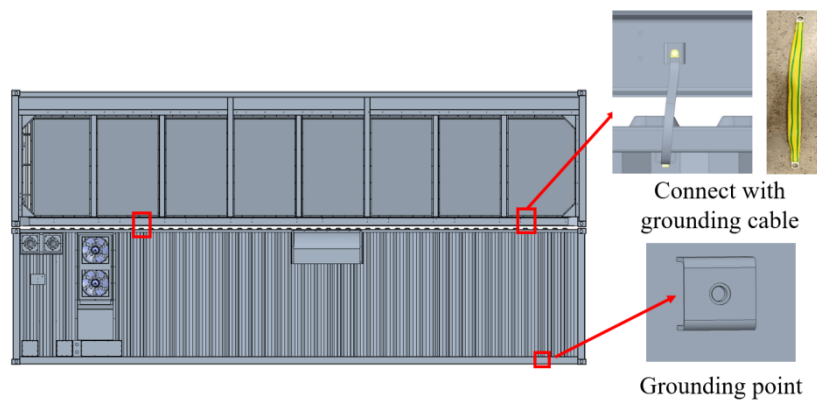


Figure 6.17 Schematic of the container grounding point

The phase sequence of the equipment is determined at the factory. After the equipment arrives at the site, it only needs to be adapted to the phase sequence of the on-site substation. Before wiring, the withstand voltage, insulation resistance, and grounding resistance should be measured.

 Danger

Before powering on the equipment, dielectric strength, insulation resistance, and grounding resistance must be tested. Power-up is permitted only after all parameters meet the specified requirements. Reference values are as follows:

Withstand Voltage: Using a hipot tester, measure the leakage current between phase conductors and between phase conductors and ground at the power input terminal. Test voltage: AC 1500V; test duration: 30 seconds; allowable leakage current: ≤ 10 mA.

Insulation Resistance: Using a megohmmeter, measure the insulation resistance between phase conductors and between phase conductors and ground at the power input terminal. Test voltage: DC 500V; required insulation resistance: ≥ 10 M Ω .

Grounding Resistance: Using a ground resistance tester, measure the resistance between the equipment's internal ground and the external grounding stud. Acceptable resistance: ≤ 0.1 Ω .

The operations are as follows:

- a) Connect the three-phase power from the substation to the power distribution cabinet;
- b) Power on the electric control box and observe for any faults in the power monitor;
- c) In case of a fault, after powering off, adjust the power phase sequence connected to the side of the A-side power distribution cabinet near the main control cabinet;

 Danger

Before adjusting the phase sequence, the equipment must be completely powered off. A multimeter shall be used to verify that the voltage level is ≤ 36 V. Phase sequence adjustment may only proceed after confirming the system is de-energized and safe to operate.

- d) If there is no fault, the machine can be operated normally. Connect the main power cables: L1, L2, L3, N, and PE busbars shall be respectively connected to the corresponding terminals, with attention to calibrating the torque (the copper busbar fixing bolts are M16, and the recommended torque is 120N·m). For the selection of wiring models, refer to the maximum operating current value of the entire machine. OT terminals shall be used at the container power distribution cabinet end,

and suitable terminals shall be selected according to actual conditions at the on-site substation end. For the wiring diagram of the copper busbar in the top junction box of the power distribution cabinet.



Figure 6.18 Diagram of junction box wiring

(The insulation plate between power supply phases is not shown)

! Danger

Prior to connecting any cables, personnel must implement appropriate electrostatic discharge (ESD) protection measures. Wiring should be carried out strictly in accordance with the professional wiring diagram affixed inside the unit. In case of any uncertainty, please consult with our technical specialists in advance. The company assumes no responsibility for any issues arising from unauthorized modifications to the wiring.

After the external incoming cables are connected, the cables need to be fixed in the form shown in Figure 6.19. Fixed holes are reserved on the outer side of the container (The insulation plate between power supply phases is not shown) (other cable fixing methods on site can also be adopted, ensuring that the external cables have support and other fixing measures). After the external cables are fixed, inspect the internal copper busbar wiring again to check for cable pulling deformation, loose fixing bolts, etc., and handle any abnormal conditions in a timely manner.



Figure 6.19 Schematic of external cable fixing frame for container

! Danger

External cables must be securely fastened to prevent movement caused by external factors, which could lead to serious consequences such as power supply instability or electrical hazards.

2) Wiring Instructions for Dry Cooling Tower

The control cabinet of dry cooling tower is located outside the container. It is necessary to connect 22 dry cooling tower fans and 2 water curtain pumps to the dry cooling tower power distribution cabinet. After the fan cables are introduced into the control cabinet, connect the fan cables or water curtain pumps cables to the motor protectors inside the control cabinet with reference to the cable labels. The internal layout diagram of the dry cooling tower control cabinet is shown in Figure 5.8 mentioned above.

The schematic of the AB side of the dry cooling tower is shown in Figure 6.20. The AB side of the dry cooling tower is consistent with the AB side direction of the container: the side of the container main control cabinet is the A side, and the side of the container exhaust fan is the B side.

The schematic of the dry cooling tower and the AB side of the container is as follows:

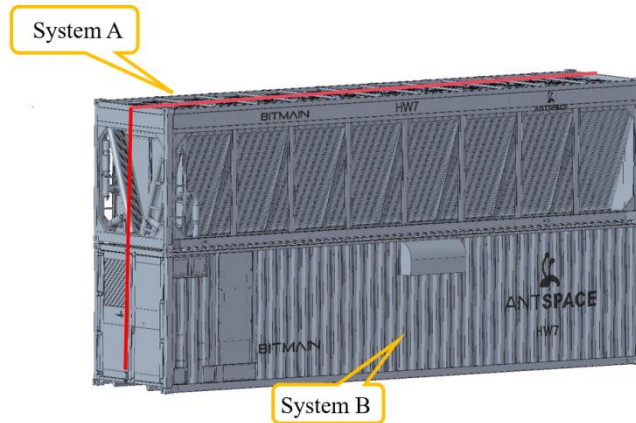


Figure 6.20 Schematic Diagram of Systems A and B
(Divided by red middle line)

The cabling for the dry cooling tower can be carried out according to the following route: the cables are routed upward along the side of the container's A-side (with cable entry holes reserved on the container side) to the dry cooling tower, as shown in Figure 6.21.

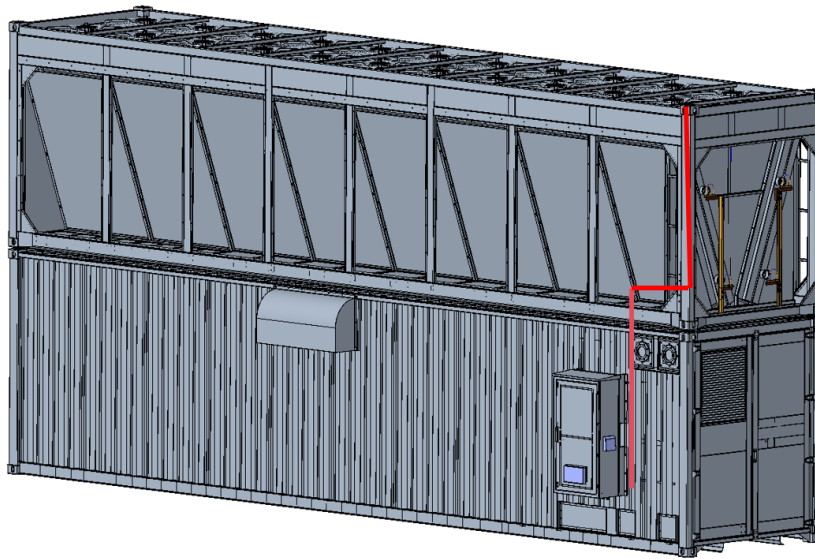


Figure 6.21 Schematic of cable layout along engineering pipeline
(Red indicates cabling path)

The cables shall be protected by metal bellows and routed along the pipelines below. The cabling must be close to the pipelines and shall not hang or touch the ground.

The cables connected to the dry cooling tower shall be routed from the control cabinet to the dry cooling tower and they are connected to 22 dry cooling tower fans by

4 strands and 22 bundles. The schematic of fan wiring is shown in Figures 6.22 and 6.23 below. Please check carefully to avoid incorrect connections. The recommended torque during fastening is 2.2N·m.

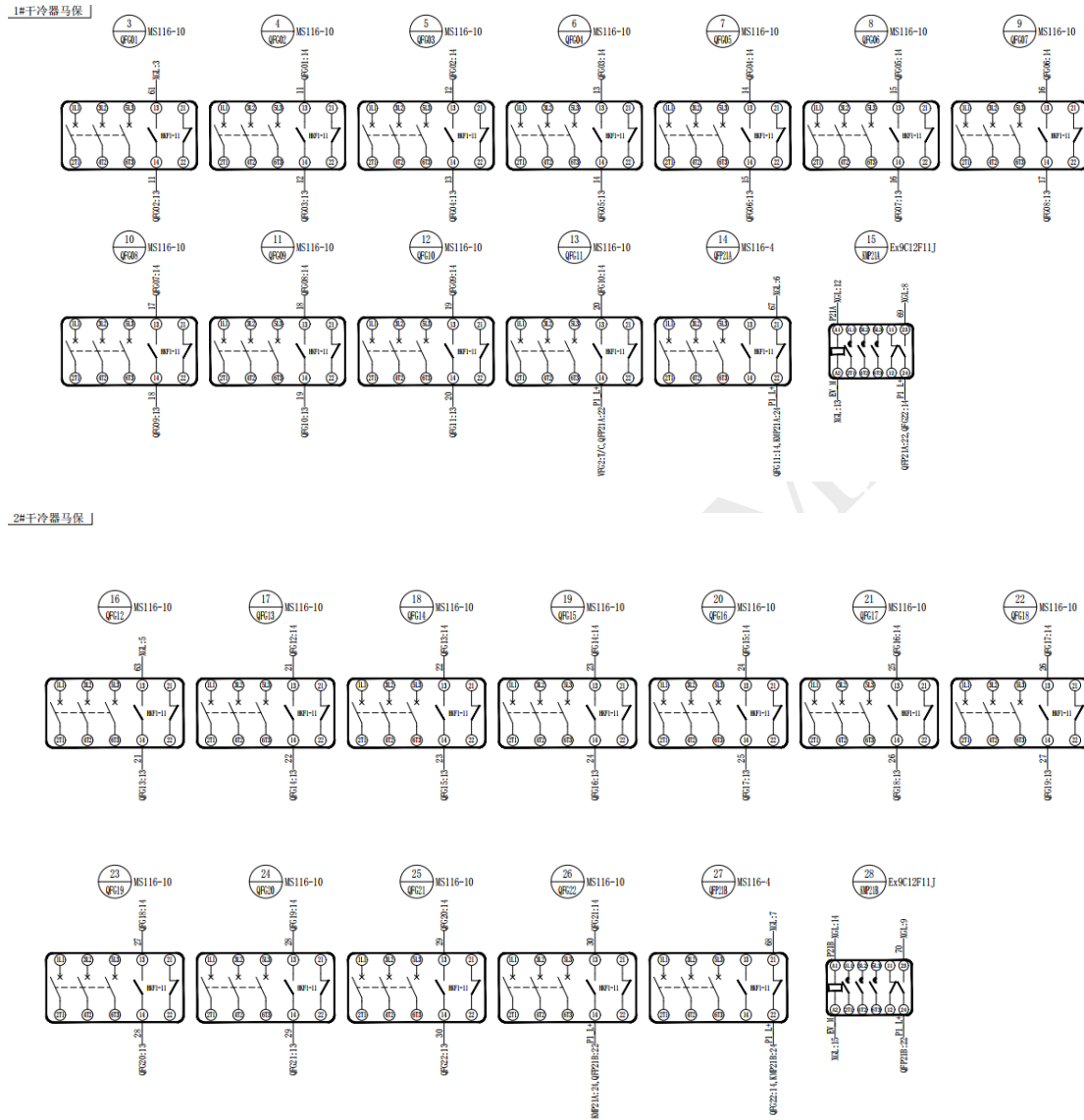


Figure 6.22 The schematic of fan wiring

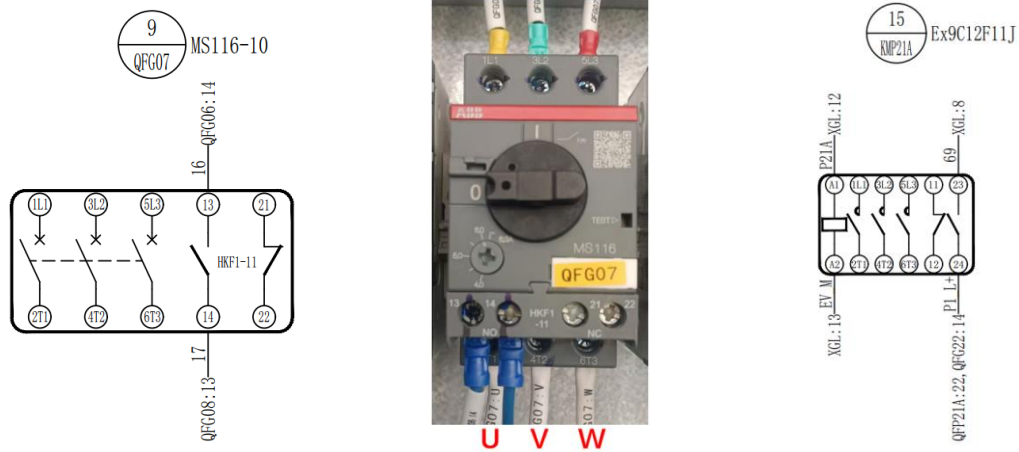


Figure 6.23 Schematic of wiring for a single fan

Warning

Carefully verify the wiring of the fan to ensure correct connections. Incorrect wiring is strictly prohibited. During the fastening process, a tightening torque of 2.2 N·m is recommended.

Caution

Before powering on for the first time, check that all current-carrying screws are tight. If any are loose, tighten them to the specified torque.

7 System Use and Operation

7.1 Safety Rules

1) Symbols for distinguishing the degree of danger

Danger

All internal  components of the equipment are designated as live. It is strictly prohibited to open any protective cover marked as “live” while the equipment is energized. Even when the equipment is powered off, only qualified personnel are permitted to open such covers.

2) Usage Precautions

- a) Filtered coolant should be used as the cooling medium, and there shall be no floating matter, particulate matter, etc. in the liquid supply circulation system;

Warning

The cooling medium must be a certified coolant manufactured by a reputable supplier. Homemade or manually mixed coolants are strictly prohibited. The use of unauthorized coolant will void any warranty or liability. It is strongly recommended to use organic-based coolant (inorganic coolants containing P, Si, B, Mo, nitrates, etc., may produce precipitates over time). Refer to the official Bitmain website for the recommended coolant. Coolant selection should be based on the minimum ambient temperature at the installation site.

Warning

Tap water or any coolant not specified above is strictly prohibited in the system. The coolant should be monitored regularly during operation. If any degradation or change in coolant properties is detected, the coolant must be replaced immediately.

Coolant official URL:

<https://shop.bitmain.com/product/detail?pid=00020240910144834316bANb9NFf067A>

- b) When the ambient temperature is below 0°C, if a water curtain is installed, the water in the collection pool and spray pipeline must be drained to prevent freezing from damaging the equipment;
- c) The equipment should avoid intermediate wiring, and parallel use with other equipment is strictly prohibited;

- d) In case of abnormal conditions with the equipment (such as a burnt smell, etc.), it shall be shut down, the power supply shall be disconnected, and an inspection shall be carried out;
- e) There are emergency stops on the inlet doors of the distribution cabinets A and B, as well as on the container door. In case of an emergency, pressing the emergency stop will immediately disconnect the power breaker. After emergency reset, first set the main breaker to the OFF position before reconnecting the power supply;
- f) The breaker MCB-A1 can only power off the A1 side of the power distribution cabinet A, and the breaker MCB-A2 can only power off the A2 side of the power distribution cabinet A;
- g) The breaker MCB-B1 can only power off the B1 side of the power distribution cabinet B, and the breaker MCB-B2 can only power off the B2 side of the power distribution cabinet B;
- h) The breaker QFWCU can only power off the main control cabinet.

Warning

All emergency stop knob used in this system are twist-release type. After an emergency stop button is pressed, it must be released by rotating it clockwise only after confirming that the system is safe. Once released, the main switch on the power distribution cabinet and the main control cabinet switch can be closed. Prior to closing the switches, they must first be set to the OFF position before re-engaging.

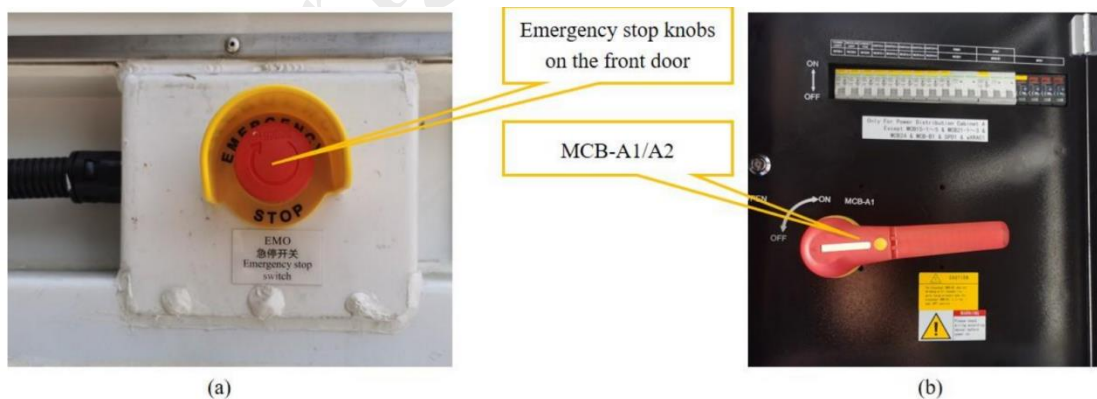


Figure 7.1 (a) Location of emergency stop knob on container door (b) Schematic of MCB-A1/A2/B1/B2 Positions

! Danger

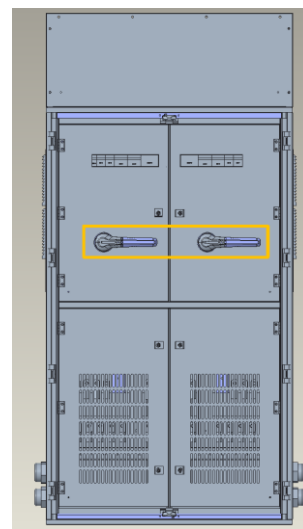
The inner door of the power distribution cabinet is labeled with information indicating which breakers remain live after the main breaker is turned off. Thoroughly read these labels before performing any operation to avoid the risk of electric shock.

In order to prevent hazards, when a single computing power server is maintained, the power breaker corresponding to the server's serial number in the power distribution cabinet must be disconnected. Then, unplug the power interface, network cable interface, and waterway interface of the corresponding computing power server. Finally, remove the power supply of the computing power server before carrying out maintenance. If a power-off of the entire container equipment is required, the steps are as follows:

- a) First, turn off all power breakers of computing power servers on the AB side;
- b) After a 10-second interval, turn off the main power supply of the main control cabinet;
- c) Turn off the four main breakers of the power distribution cabinets A and B;
- d) In case of long-term power outage, you should also turn off the main breaker at the transformer end. It is crucial to strictly follow the above sequence for turning off the breakers.



(a)



(b)

Figure 7.2 (a) Schematic diagram of a Server power switch

(b) Schematic of the main breaker in the main control cabinet

Caution

Since the container lighting circuit is powered from the main control cabinet, portable lighting equipment should be prepared when performing the above operations.

Warning

1. If the equipment will be out of operation for an extended period, please disconnect the main power supply.
2. It is strictly prohibited to remove the protective cover from the fan.
3. Do not attempt to check fan operation by touching the fan blades with your hand, nor should you manually rotate the fan blades.
4. Operating the equipment with wet hands is strictly forbidden, as it poses a serious risk of electric shock. Do not place any foreign objects inside the equipment. Ensure that fire escape routes remain unobstructed at all times.

7.2 System Pressure Testing

After on-site installation of the equipment and piping is complete, a 7-bar pressure test shall be conducted first, with the pressure maintained for at least 12 hours; during the 12-hour pressure retention period, the pressure drop shall not exceed 5% of the initial pressure. Then a 7-bar water pressure test shall be carried out, with a pressure holding time of at least 90 minutes, to inspect whether there is any leakage in each pipeline and interface. If there is no leakage and the pressure reading decreases by no more than 5%, the on-site installation is considered qualified. (A drop in ambient temperature can cause a decrease in system pressure; environmental factors must be taken into account during the pressure-holding process). The pressure testing process is as follows:

1) Preparation

- a) Prepare the PU hose (OD10) and air pump (recommended brand: OUTSTANDING, model 2200W - 40L; selection basis: t The internal volume of one side of the system is approximately 1.7m³, and the air pump with corresponding air displacement is selected according to the time requirements; the maximum output air pressure is required to be above 8bar, and 10bar is the best);
- b) Connect the external pipeline as described in the preceding chapter;
- c) Check whether all plugs on the automatic exhaust valves of the internal pipeline of the container and the dry cooling tower are fully closed (including 44 automatic

exhaust valves on 22 manifolds, 4 automatic exhaust valves on the dry cooling tower, and 4 manual exhaust valves.). (The automatic exhaust valves can be opened/closed by screwing the nuts on the top of the automatic exhaust valves);
d) Check that the ball valve at the inlet of the breathing safety valve is closed, and check that all filling and discharge valves are closed (including the discharge valves on the liquid supply and return lines, the drain valve on the tank, and the four drain valves on the dry cooling tower).

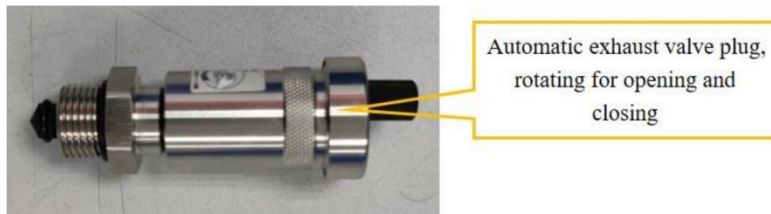


Figure 7.3 Automatic exhaust valve

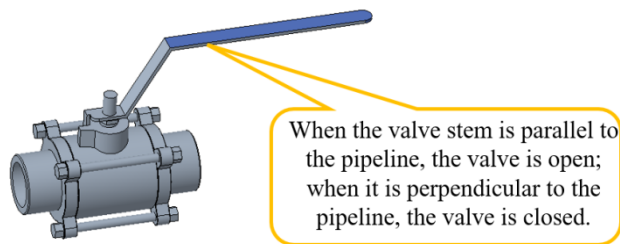


Figure 7.4 Schematic of valve opening and closing

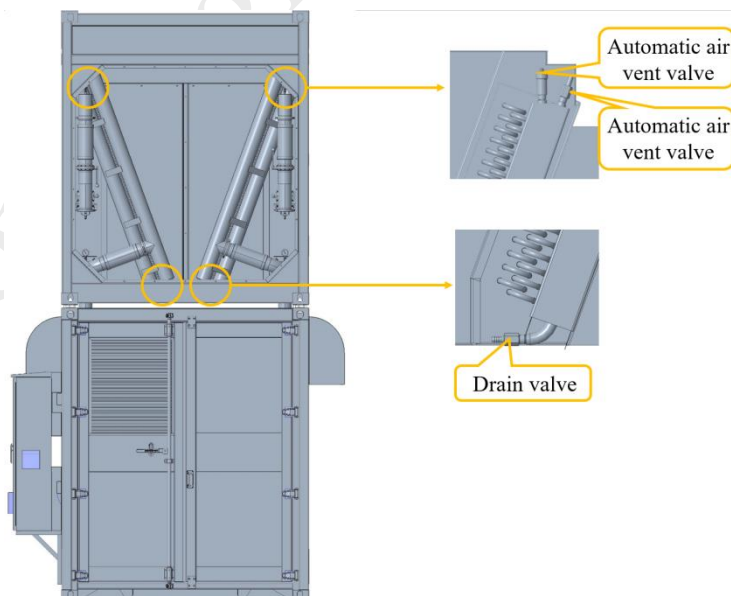


Figure 7.5 Positions of exhaust valves and drain valves for dry cooling tower

! Danger

The manual air vent valves is located at the upper end of the dry cooler, at a height exceeding 5 meters. Operation of this valve qualifies as working at height and requires personnel to hold valid high-altitude work certification. Appropriate access equipment such as ladders and protective devices compliant with local regulations for working at height must be used.

2) Pressure testing procedures

- Check again to see whether the plugs of the exhaust valves and ball valves are in the closed state;
- Close the ball valves on the tank used for filling and draining, the valve upstream of the breathing safety valve, and the ball valve for draining on the pump station;
- Open all the mini ball valves on the manifold (after connecting the mining machine and U-tube);
- Connect PU hose to any quick-connect fitting and close the corresponding ball valve for that line.

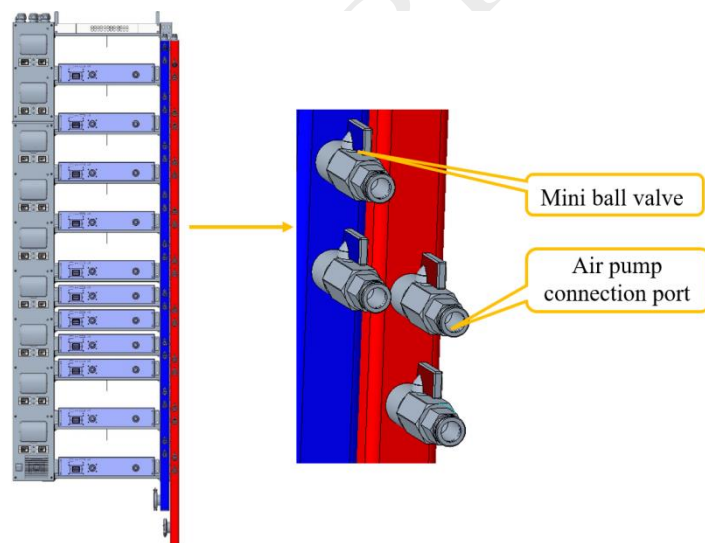


Figure 7.6 Ball valves for system pipeline connection

- Use an air compressor to pressurize to 7 bar, stabilize for more than 12 hours, and check for any leakage points.

3) Key inspections:

- Inspection parts: Connections between quick-connect fittings and mini ball valves, connections between quick-connect ball valves and U-tube, connections

between mini ball valves and manifold, connections between quick-connect fittings and computing power servers, and all flange/chuck/thread/welded connections;

b) Inspection methods: visually observe, listen, and touch to detect leaks; select any one of soap, washing powder, or detergent, mix with water to make soapy liquid, apply it to suspected leakage points (especially at interfaces), and the parts where bubbles form are the leak points.

4) Pressure testing again

After the computing power server is put into operation, it is necessary to conduct another gas-liquid mixture inspection at a pressure of 7 bar for a stability period of over 2 hours. Check the aforementioned locations for any signs of leakage.

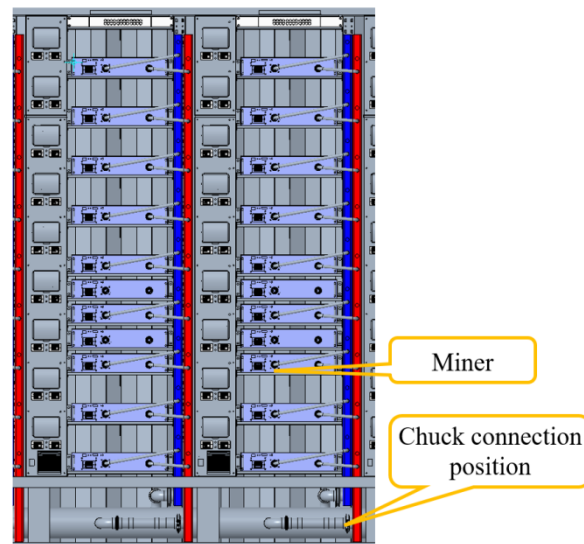


Figure 7.7 Schematic of system chuck connections

7.3 System fluid replenishment

During the installation of external pipelines, the filters in the external pipelines need to be checked to ensure their positions are intact.

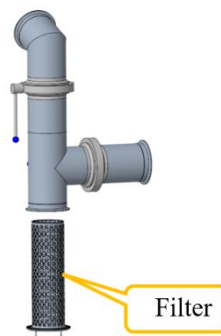


Figure 7.8 Filter inspection

The selection of circulating media for dry cooling towers and containers should be based on local climatic conditions and operating environments. Recommended coolants include antifreeze coolants (water & antifreeze) and corrosion-inhibiting coolants (water & corrosion inhibitor).

When operating conditions involve temperatures below 0°C, antifreeze coolant must be used to prevent equipment and piping damage caused by freezing at low temperatures. The requirements for antifreeze coolant are specified in Table B.1 of Appendix B. The concentration of the antifreeze coolant should be formulated based on the target freezing point, referring to the relationship between ethylene glycol coolant concentration and freezing point in Table B.2 of Appendix B.

 Danger

Antifreeze must be selected and configured strictly according to the lowest possible ambient temperature conditions. Failure to comply with the specified antifreeze requirements, resulting in ambient temperatures falling below the antifreeze freezing point and causing heat exchanger freezing and cracking, will absolve the company of any liability.

When the ambient operating temperature exceeds 0°C, it is recommended to use a corrosion-inhibiting coolant. Corrosion inhibitors form a protective film on the metal surfaces of the system, effectively suppressing corrosion and scaling, thereby enhancing the system's long-term operational reliability and extending maintenance intervals. Refer to Table B.3 in Appendix B for the medium requirements for corrosion inhibitors. Regarding the dilution ratio of the corrosion inhibitor concentrate, it is recommended to dilute it to a volume concentration of 10%. When preparing coolant, both antifreeze-type and corrosion-inhibiting coolants must be prepared using deionized water.

When the ambient temperature at the site remains above 0°C throughout the year and the customer opts not to use corrosion-inhibited coolant for cost reasons, deionized water may also be used as the internal circulation medium. Deionized water provides no freeze protection, no corrosion inhibition, and no bacteriostatic function; therefore, stricter routine water-quality monitoring is required. When deionized water is used, the medium requirements specified in Table B.4 of Appendix B and the testing frequency specified in the maintenance chapter must be strictly followed.

Bitmain official website link for coolant:

<https://shop.bitmain.com/product/detail?pid=00020240910144834316bANb9NFf067A>

First, use the filling pump (the external liquid must be pressurized or the liquid level must be higher than the pump) or an external self-priming pump to refill the tank. Once the liquid level in the tank reaches the required height, stop refilling. The specific refilling procedure is as follows:

The system replenishment includes four steps:

Preparation: Prepare tools, and open all exhaust valves of the system (manually open the system exhaust valve and the manual exhaust valve on the dry cooling tower for the first liquid addition);

System replenishment: Use the filling pump (the external liquid must be pressurized or the liquid level must be higher than the pump) or an external self-priming pump to refill the the system with liquid;

Water tank replenishment: Use the filling pump (the external liquid must be pressurized or the liquid level must be higher than the pump) or an external self-priming pump to refill the water tank with liquid;

Regular replenishment: Use the filling pump (the external liquid must be pressurized or the liquid level must be higher than the pump) or an external self-priming pump to refill the water tank with liquid.

1) Preparation work

- a) Prepare the coolant. (The system requires approximately 3.3 cubic meters of coolant to be prepared internally).
- b) Connect the external pipelines as per Section 6.5.
- c) Check whether all the plugs on the automatic exhaust valves of the internal pipelines of the container and the dry cooling tower are fully opened.
- d) Open the liquid filling manual valve and close the discharge valve.
- f) Open the manual exhaust valve of the dry cooling tower (to speed up the first liquid filling).

2) System/water tank replenishment

- a) Use the replenishment pump P11 to replenish the system and water tanks C21 A/C21 B with fluid.
- b) Find an external water source ((the external liquid must be pressurized or the liquid level must be higher than the pump)), connect a hose to the container's liquid filling port. For the first liquid addition, ensure the connecting pipeline is fully filled with liquid (until water flows out) (if there is air in the pump or pipeline, water may

not be drawn). Insert the hose into the external liquid filling port of the container (at the side door), thus connecting the external water tank to the liquid filling pump.
c) Open the exhaust valve on the fluid replenishment pump (using an Allen wrench); once water begins to drain out, close the exhaust valve on the filling pump, as shown in Figure 7.9.

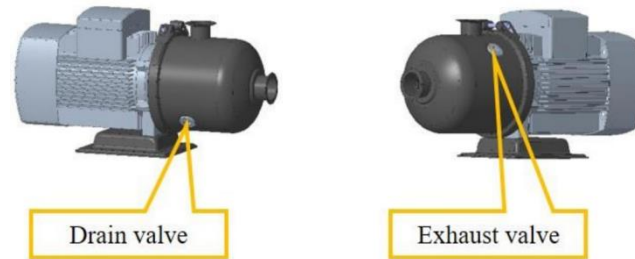


Figure 7.9 Drain and exhaust valve of the replenishment pump

- d) Switch to manual mode on the touchscreen, start the “P11 Filling Pump” on the A side to infuse fluid into the A system, and start the “P11 Filling Pump” on the B side to infuse fluid into the B system.
- e) During system liquid addition, observe whether water flows out from the dry cooling tower exhaust valve and the system manual exhaust valve. When water flows out, it indicates the system is full. Close the dry cooling tower manual exhaust valve, open the automatic exhaust valve, and close the system manual exhaust valve.
- f) start the circulation pump for 10 seconds (the filling pump does not need to stop), After a low-level alarm is triggered in the water tank, stop the circulation pump.
- g) Continue liquid addition and repeat this twice to ensure 1.6–1.7 tons of cooling fluid are added (for a single-side system).
- h) Stop adding liquid when the water level in the tank stops dropping.
- i) Then start the circulation pump again to circulate the medium in the system, ensuring all automatic exhaust valves remain open.
- j) Once the above steps are completed, the return fluid pressure sensor PT02 will stabilize at around 0.7 bar, allowing the system to operate normally. You may then enable automatic mode.

⚠ Caution

Ultrasonic flow sensors are highly sensitive to bubbles. During initial operation, the flowrate displayed on the screen may appear low, Normal readings will only be achieved after prolonged operation and multiple purges.

⚠ Caution

During system operation, monitor system flow and pressure closely. If gas within the system is not fully purged, system protection may be triggered due to excessively low liquid return pressure and flow rate.

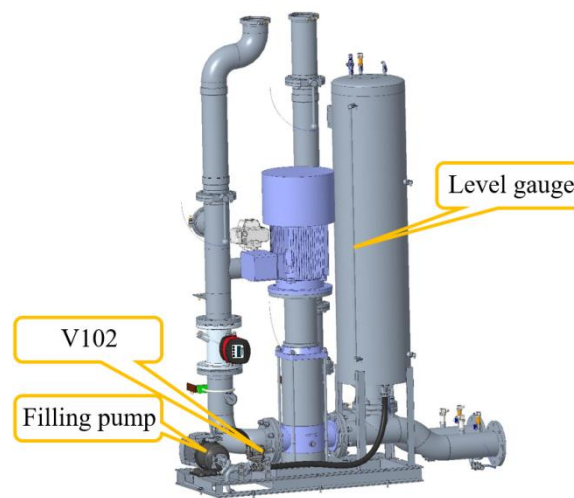


Figure 7.10 Distribution of solenoid valves in the replenishment system

ANTSPACE HW7 >> Manual						2026-05-20 16:57:15		
Equipment	Start OP	Stop OP	State	Equipment	Start OP	Stop OP	State	
P01 Main pump	Start	Stop	Stopped	P02 Main pump	Start	Stop	Stopped	
DWI fan	Start	Stop	Stopped	DWI fan	Start	Stop	Stopped	
P21A Pump	Start	Stop	Stopped	P21B Pump	Start	Stop	Stopped	
Reset A				Reset B				
Equipment	A Fluid Replacement OP		B Fluid Replacement OP		Equipment State			
V102	V102→A		V102→B		V102→A Ready	V102→B Ready		
P11 Pump	Start		Stop		P11 Start	P11 Stop		
matic fluid repleni:				matic fluid repleni:				
G04 Fan	Start	Stop	Stopped	G05 Fan	Start	Stop	Stopped	
MainScreen		Manual	Parameters	Instrument	Alarm	ALARcord	DataRecord	Cabinet

Figure 7.11 Interface of the fluid replenishment system

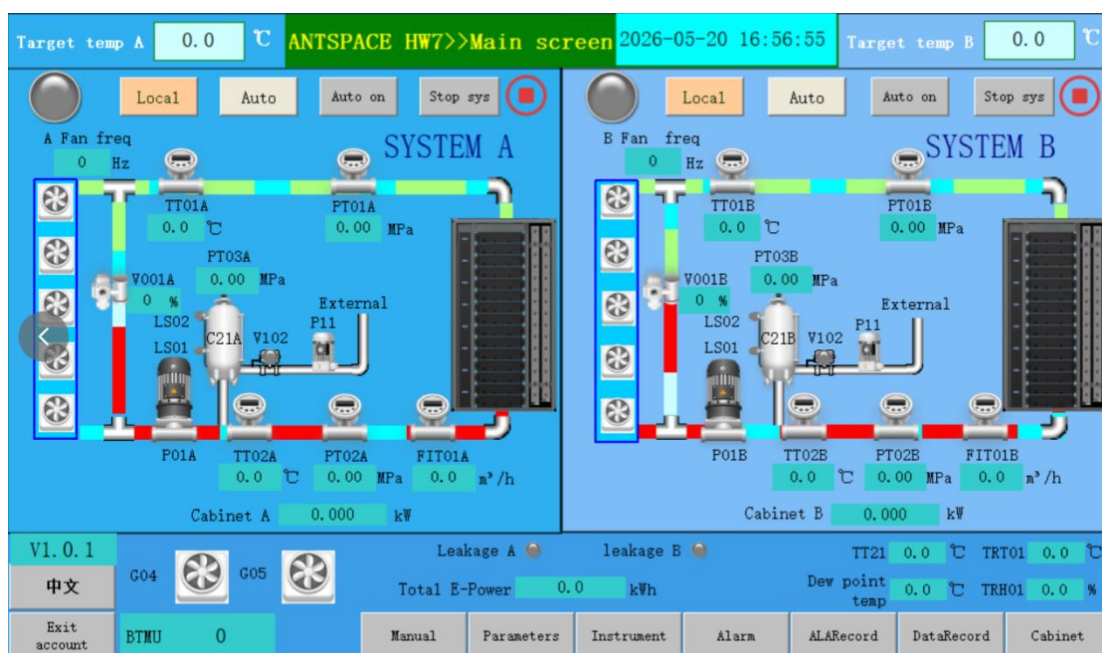


Figure 7.12 System operation screen

3) Regular Water Tank Replenishment

When it is necessary to replenish water to the water tank C21:

The same as the initial water replenishment, you should connect the replenishment pump to an external water source (the external water source has a certain pressure to fill the connecting pipeline), Open the valve on the replenishment line and start the filling pump.

4) Operating Procedures for Low Ambient Temperatures

If the ambient temperature is below the specified temperature for the mining rig's coolant (20°C) during the first startup, the mining rig will not start. In this case, the internal coolant must be heated to above 20°C before the system can operate. You can achieve this by running the coolant in a fully closed-loop internal circulation to quickly raise the temperature of the circulating fluid. The procedure is as follows:

a) Switch the system operating mode to manual mode. For specific operating procedures, refer to Section 7.6.10;

b) Switch the main screen to the parameter settings screen. Set the V001 valve opening to 100%, then click the open button. After the motor completes the operation, verify that the V001 valve opening on the main screen and the valve dial display both

read 100%. Confirm that the bypass valve V001 is in the open state. (Perform the same operation on both sides A and B.)

c) Close valves V002 A and V002 B leading to the dry cooling tower to ensure the coolant circulates entirely internally.

d) The A-side and B-side systems operate independently. Press the inverter operation button at the top of the main control cabinet panel, click the downward arrow, and adjust the main pump frequency to 40Hz. Start the water pump to initiate internal circulation, utilizing the pump's own heat generation for system heating. This heating power is relatively low.

e) When necessary, the ANTSPACE PTC Heater V1 can be added to heat the internal circulation coolant. For the heater, please refer to the following Bitmain official website address:

<https://shop.bitmain.com/product/detail?pid=00020240205134219891UqjJJ9NH0688>

f) When the internal circulation fluid temperature rapidly rises above the mining machine's operating temperature, gradually open butterfly valves V002 A and V002 B to the 45° position. Then switch to automatic mode and start the mining machine. Once the system temperature increases by 30°C or more, fully open butterfly valves V002 A and V002 B.

g) Press the inverter operation button at the top of the main control cabinet panel to adjust the flow rate is approximately 86 m³/h.

h) After normal operation in automatic mode, the system will automatically adjust the coolant temperature to the set value.

DANGER

The above operations must be performed by personnel with thorough knowledge of this water-cooling system and relevant operational experience. A supervisor must remain on-site during the process to monitor whether all system parameters remain within normal ranges.

The following precautions must be observed during operation:

1. Do not close the V002 valve when V001 is not activated.
2. Do not close the V002 valve in automatic mode.

Improper valve operation may cause water flow blockage, excessive pressure at the pump outlet, and subsequent pump damage.

7.4 Electrical Wiring

The equipment's power supply system requires a three-phase five-wire system. Since the equipment has two power distribution cabinets internally, and each cabinet has two incoming power supplies, four three-phase five-wire cables should be prepared on site in advance to ensure the safe and stable operation of the equipment. The cable parameters are shown in Table 6.1.

Danger

Electrical connections must be performed exclusively by personnel holding valid professional electrical qualifications. In addition to complying with the procedures outlined in this manual, all operations must adhere to applicable local electrical and safety regulations.

Under no circumstances shall unqualified personnel perform electrical connections on the equipment.

The specifications and quantity of input cables must comply with local electrical code requirements. When in doubt, consult a certified electrical engineer.

For Cabinets A and B, the top-mounted L1, L2, and L3 input copper busbars are pre-equipped with three M16 bolts. The center hole of the cable terminal is specified to be 17 mm in diameter. The neutral (N) busbar is pre-fitted with two M12 bolts, and the protective earth (PE) busbar is equipped with M12 bolts.

Caution

The tightening torque for M16 bolts shall be 100 N·m, and for M12 bolts, 80 N·m. Alternatively, refer to the local electrical standards applicable at the project site. It is essential to ensure that all electrical connections are secure and reliable.

The wire stripping and crimping diagrams are as follows. If the terminal width exceeds the diameter of the gland on the mounting plate, remove the gland before crimping the terminal. Pass the wire through the gland, then crimp the terminal.

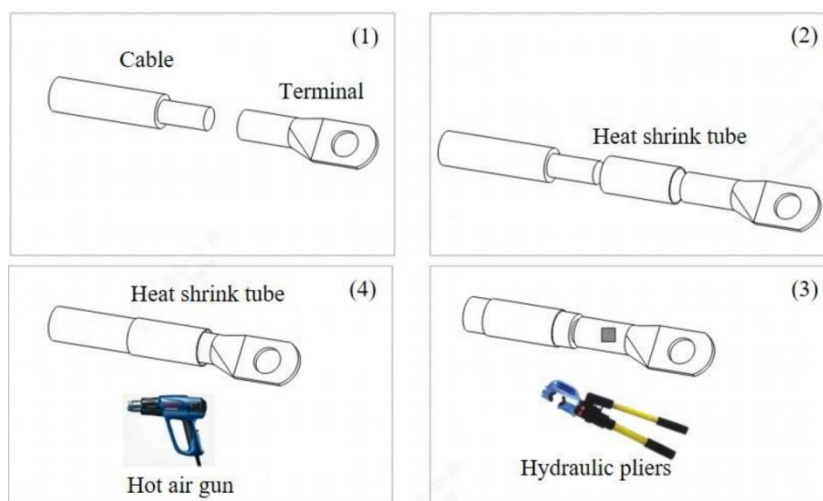


Figure 7.13 Stripping and crimping diagrams

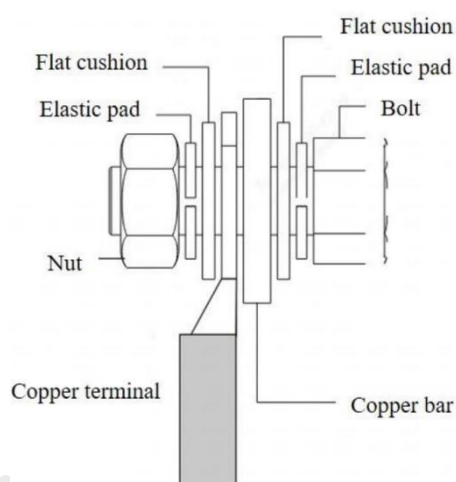


Figure 7.14 Selected copper connection

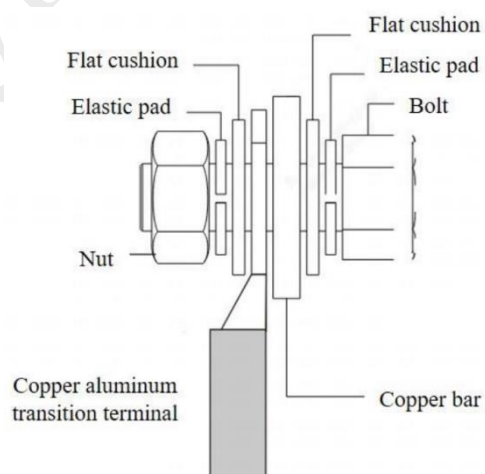


Figure 7.15 Selection of aluminum wire connection

! Danger

Copper-aluminum terminals that comply with relevant safety standards shall be used. To prevent deformation caused by prolonged mechanical stress or tension, ensure proper installation and conduct routine inspections during operation. If any signs of deformation, cracks, or other abnormalities are observed, replace the components immediately to eliminate potential safety hazards.

After fixing the bolt with torque, use a marker pen to draw a line on the nut head for convenient subsequent inspection.



Figure 7.16 Schematic of cable connection (Two cables used together)

! Danger

After completing the connection of the main power cable to the copper busbar, the connection area must be thoroughly cleaned and inspected. Ensure that the junction box is free from any loose wires, terminal lugs, fasteners, or foreign objects, as these pose significant safety risks.

The cables are respectively connected through the two upper openings on the side of the container exhaust fan. For the specific positions of the cable inlet holes, refer to Figure 6.5 (Note: The rainproof cloth and rainproof cover in the accessories must be used for protection). The cables are introduced from the top junction boxes of the two power distribution cabinets and extend to the corresponding copper busbars, where they are fixed with screws (already installed in the openings of the copper busbars).

Grounding studs on both sides of the container can ensure that the power distribution cabinets are reliably grounded. Therefore, both the container shell and the power distribution cabinet shell should be reliably grounded. The phase sequence of the

equipment is determined at the factory. After the equipment arrives at the site, only the phase sequence of the on-site substation needs to be adapted.

The operations are as follows: Connect the substation's three-phase, five-wire L1, L2, L3, N, and PE lines to the distribution cabinet. After testing the withstand voltage and insulation resistance, energize the main switch on the main control cabinet and observe the LCD screen for any power failure alarms. If a power failure alarm appears, adjust the phase sequence of the L1, L2, and L3 phases connected to the main control cabinet at the copper busbar in Distribution Cabinet A. If no fault alarm appears on the LCD screen, the system is ready for normal operation.

 Danger

The three-phase power supply from the transformer must be connected by personnel with appropriate professional electrical qualifications. During phase sequence adjustment, the incoming voltage at the transformer's input must be completely de-energized prior to any operation. This can be confirmed by ensuring the white indicator light on the front panel of the main control cabinet is off and by using a multimeter to verify that the input line voltage reads 0V. Under no circumstances is phase sequence adjustment allowed while the system is energized.

7.5 System Power-On and Power-Off Procedures

The keys for opening the main control cabinet and power distribution cabinet for the first time are located near the main control cabinet inside the container and should be kept by a dedicated person during use.

Breakers of the main control cabinet are shown as follows:

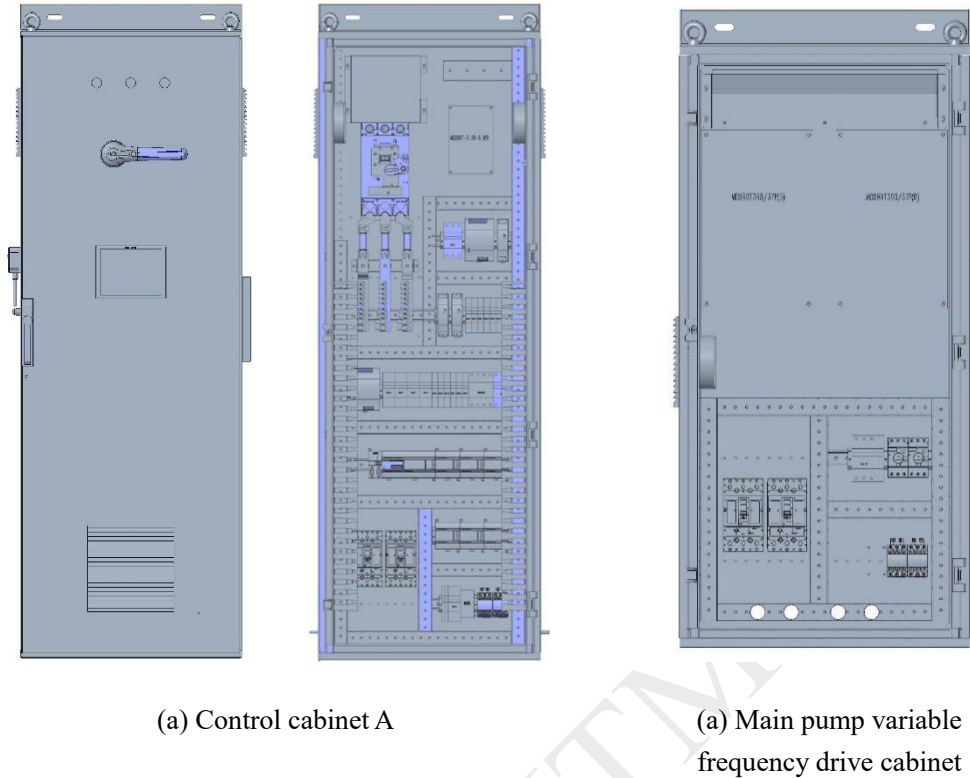


Figure 7.17 Internal and external views of the main breaker of the main control cabinet

1) Descriptions of functions of breakers in the system

Table 7.1 Function descriptions of breakers in the main control cabinet of the liquid cooling container system

Serial Number	Name	Starting Point	Direction	Ending Point
1	QFWCU	Power inlet XT1, L1, L2, L3	→	QFWCU
2	QFKR1	XD11, L1	→	Power monitor L1
3	QFKR2	XD12, L12	→	Power monitor L2
4	QFKR3	XD13, L13	→	Power monitor L3
5	QFHL1	Power inlet L1	→	Power indicator light (white)
6	QFHL2	Power inlet L3		
7	QFHL3	Power inlet L11	→	Error indicator light (yellow)

Serial Number	Name	Starting Point	Direction	Ending Point
8	QFHL4	Power inlet L13	→	Closing indicator light (green)
9	QFD1	L11, N	→	Standby power supply
10	QFVF01	L11, L12, L13	→	Main pump frequency converter VF01: R, S, T
11	QFVF02	L11, L12, L13	→	Main pump frequency converter VF02: R, S, T
12	QFP11	L11, L12, L13	→	Infusion pump frequency converter VF03: R, S, T
13	QFVFG1	L11, L12, L13,N	→	Power supply for frequency converter of dry cooling tower on side A
14	QFVFG2	L11, L12, L13,N	→	Power supply for frequency converter of dry cooling tower on side B
15	QFP1	L11	→	PLC switch power P1 Pin L
16	QFPZ1	Switch power P1 PinV+	→	P1_L+
17	QFP2	XD13, L13	→	Lighting P2 pin L
18	QFPZ2	P2 WDR-480-24 PinV+	→	Container lighting power breaker.
19	QFJRQ	L13,N	→	Main control cabinet heater breaker.
20	QFRDC	P2 WDR-480-24 PinV+	→	Fans for AB power distribution cabinets and dry cooling tower electrical cabinets
21	QFMF	P2 WDR-480-24 PinV+	→	Cooling fan inside the main control cabinet
22	QFP3	L13	→	WDR-60-12V P3 引脚 L
23	QFPZ3	WDR-60-12V P3 pin V+	→	Spare
24	QFP4	L11	→	WDR-60-5 P4 pin L
25	QFPZ4	WDR-60-5 P4 pin V+	→	Power supply for router and camera

Serial Number	Name	Starting Point	Direction	Ending Point
26	QFRST	EV_L+	→	Power distribution cabinet Shunt trip
27	QFV1A	EV_L+	→	Power supply for Side A system valves
28	QFV1B	EV_L+	→	Power supply for Side B system valves

Table 7.2 Instructions for the functions of breakers in power distribution cabinet A of the liquid cooling container system

Serial Number	Name	Starting Point	Direction	Ending Point
1	MCB-A1	1L1, 1L2, 1L3	→	Main busbars L1, L2, L3
2	MCB-A2	2L1, 2L2, 2L3	→	Main busbars L4, L5, L6
3	MCB24	1L1	→	Power indicator light HL1
		1L3	→	
4	MCB26	2L1	→	Power indicator light HL3
		2L3	→	
5	MCB25	L1	→	Closing indicator light HL2
		L2	→	
6	MCB27	L5	→	Closing indicator light HL4
		L6	→	
7	MCB-A3	L1, L2, L3	→	SPD1
8	MCB-A4	L4, L5, L6	→	SPD2
9	MCB21-1	1L1	→	PMM1 V1
10	MCB21-2	1L2	→	PMM1 V2
11	MCB21-3	1L3	→	PMM1 V3
12	MCB21-4	2L1	→	PMM2 V1
13	MCB21-5	2L2	→	PMM2 V2
14	MCB21-6	2L3	→	PMM2 V3
15	MCB23	XRDC 1	→	24V+ of cooling fan in Cabinet A

Table 7.3 Instructions for the functions of breakers in power distribution cabinet B of the liquid cooling container system

Serial Number	Name	Starting Point	Direction	Ending Point
1	MCB-B1	1L1, 1L2, 1L3	→	Main busbars L7, L8, L9
2	MCB-B2	2L1, 2L2, 2L3	→	Main busbars L10, L11, L12
3	MCB34	3L1	→	Power indicator light HL5
		3L3	→	
4	MCB36	4L1	→	Power indicator light HL7
		4L3	→	
5	MCB35	L7	→	Closing indicator light HL6
		L8	→	
6	MCB37	L11	→	Closing indicator light HL8
		L12	→	
7	MCB-B3	L7, L8, L9	→	SPD3
8	MCB-B4	L10, L11, L12	→	SPD4
9	MCB22-1	3L1	→	PMM3 V1
10	MCB22-2	3L2	→	PMM3 V2
11	MCB22-3	3L3	→	PMM3 V3
12	MCB22-4	4L1	→	PMM4 V1
13	MCB22-5	4L2	→	PMM4 V2
14	MCB22-6	4L3	→	PMM4 V3
15	MCB33	XRDC 1	→	24V+ of cooling fan in Cabinet B

2) Precautions for the first power-on of the system

After completing the wiring of the entire system, use an insulation megohmmeter to test the insulation between phases and to ground. The equipment can only be powered on for debugging if no issues are found. If there is a short circuit in any of the above items, the fault should be identified and resolved before powering on. After powering on the front end of the system (before the system itself is powered on and the main breakers of the power distribution cabinet and main control cabinet are not closed), measure the front-end voltage to ensure it meets the power requirements of the equipment.

The power supply requirements for this equipment are: 380-480v, AC 50/60Hz.

 Danger

After system wiring is completed, a multimeter must be used to measure for potential short circuits between the following points: phase-to-phase between A/B distribution cabinets, phase-to-neutral, phase-to-ground, and neutral-to-ground. If any of these measurements show a resistance of $\infty \Omega$, a short circuit is indicated. Power must not be applied until the issue is fully investigated and resolved, as doing so may result in equipment damage due to short circuiting or pose a serious risk of electric shock.

 Danger

Before powering on the equipment, dielectric strength, insulation resistance, and grounding resistance must be tested. Power-up is permitted only after all parameters meet the specified requirements. Reference values are as follows:

Withstand Voltage: Using a hipot tester, measure the leakage current between phase conductors and between phase conductors and ground at the power input terminal. Test voltage: AC 1500V; test duration: 30 seconds; allowable leakage current: $\leq 10 \text{ mA}$.

Insulation Resistance: Using a megohmmeter, measure the insulation resistance between phase conductors and between phase conductors and ground at the power input terminal. Test voltage: DC 500V; required insulation resistance: $\geq 10 \text{ M}\Omega$.

Grounding Resistance: Using a ground resistance tester, measure the resistance between the equipment's internal ground and the external grounding stud. Acceptable resistance: $\leq 0.1 \Omega$.

3) System Power-On Sequence

After the front-end of the system is powered on (the white indicator light of the power distribution cabinet is on) and the voltage meets the equipment's requirements, the system can be powered on.

 Danger

The personnel responsible for power-on and closing the switch must have received professional training and possess electrician qualifications that comply with local regulations. When power-on, they should wear personal protective equipment to prevent electric shock accidents.

a) First, power on the main control cabinet.

i) If the ambient temperature is below -25°C , first close the main switch QFWCU. Then close the heater switches QFJRQ in both the main control cabinet and the dry cooling tower control cabinet. Preheat each cabinet for 30-40 minutes before proceeding to step ii).

ii) If ambient temperature is normal (above -25°C), follow these steps: During initial power-up, open the main switch QFWCU, then open all switches inside the main control cabinet. Switch definitions are listed in Table 7.1. After powering on, the screen on the cabinet door and the PLC start to operate. When the main control cabinet door is closed and the system needs to be powered on, first turn on all micro-breakers inside the cabinet and the two plastic-case breakers QFVFG1 and QFVFG2, then close the cabinet door, and turn on QFWCU through the operation handle on the cabinet door. At this point, the device is powered on.

Trained electricians can operate the system through the touch screen to set parameters, modify thresholds, change operation modes (automatic/manual), start/stop a single motor, or run automatically. At this time, the liquid cooling container can be started first to control the supply liquid temperature within the required range, and then the conditions for starting the computing power server are met.

b) Power-on of the distribution cabinet

After the main control cabinet is powered on, according to the control system operation procedure, the computing power servers can be turned on only when the supply liquid temperature is maintained near the target temperature. At this time, you can turn on the breakers in distribution cabinets A and B to start powering on the computing power servers.

First, turn on MCB-A1, A2, B1, and B2, then turn on the other miniature circuit breakers. Next, start the servers row by row in an orderly manner as required. Since there are a total of 396 computing power server bays, arranged in 22 rows on the left and right, when starting the servers, you should start one row, wait for 20 seconds, then start the next row, and so on. Avoid starting a large number of servers in a short period.

Caution

For the corresponding device and switch reference designations, please refer to Table 7.1.

4) System power-off sequence

When the system needs to be powered off for some reason, according to requirements, the power supply of the computing power server should be disconnected first. This is to ensure that the water temperature of the computing power server is consistent before and after power-off, which is equivalent to protecting the power

module of the computing power server. After the computing power server is powered off, a 20-second delay is applied, and then the liquid cooling container is manually stopped through the touch screen. At this time, the water temperature may rise slightly, but it has no impact on the system. Finally, the main power supplies of the main control cabinet and the power distribution cabinet are disconnected, putting the entire system in a completely powered-off state.

The above practice is a safe power-off behavior. However, when a serious fault occurs in the system, the emergency stop button on the door inside the container can be directly pressed, causing the main breaker of the power distribution cabinet to trip instantly and the main breaker of the main control cabinet to trip after a 5-second delay, putting the system in a completely powered-off state to facilitate maintenance by professional personnel.

Common causes of power outages include the following:

Table 7.4 Explanation of Power Outages in Water-Cooled Container Systems

Alarm Name	Trigger conditions	Action Logic
Power failure	Detection of low voltage, high voltage, or phase loss in power phase sequence for 3 seconds	First, power off the distribution cabinet; then, stop the cooling system after a delay
Low coolant flow & low return pressure & low tank level	Low coolant flow & low return pressure & low tank level	Power off to distribution cabinet
Smoke alarm in A/B distribution cabinet & High temperature alarm in A/B distribution cabinet	Smoke alarm in A/B distribution cabinet & High temperature alarm in A/B distribution cabinet	System power off
P01-A main circulation pump failure	Failure of the variable frequency drive controlling the P01-A main circulation pump	Power loss in Side A distribution cabinet

	or power loss to the main circulation pump	
P01-B main circulation pump failure	Failure of the variable frequency drive controlling the P01-B main circulation pump or power loss to the main circulation pump	Power loss in Side B distribution cabinet
Pressing the Distribution Cabinet Emergency Stop	Accidental activation of the distribution cabinet emergency stop button, causing the button to trigger	Power Loss in Distribution Cabinet
Pressing the Container Emergency Stop	Container emergency stop button triggered	Power is first cut to A and B distribution cabinets, followed by a 5-second delay before power is cut to the control cabinet

Danger

In case of emergency, press the emergency stop button located on the front panel of the power distribution cabinet. Each emergency stop button controls the power supply of its respective cabinet. Once pressed, the power to that specific cabinet will be cut off; however, devices such as network switches, surge protectors, and power meters will remain energized. Only qualified personnel are permitted to open the cabinet door and perform any operations inside.

Caution

After pressing the emergency stop button and resolving the fault, before restoring power, the emergency stop switch must be released by rotating it clockwise. Then, the main switch on the power distribution cabinet and the main control cabinet switch must first be turned to the OFF position before being reclosed.

5) Classification of Operators' Responsibilities

Responsibilities of operation and maintenance personnel: Powering on/off the system and computing power servers (breaker turn on or off), starting and shutting down the system (touch screen button operations), network cable detection and replacement.

Responsibilities of professional electricians (required to obtain corresponding qualifications): Powering on/off the system and computing power servers (switching on or off), starting and shutting down the system (touch screen button operations), network cable detection and replacement. When equipment malfunctions such as short circuits, phase loss, phase reversal, sensor display failure, no response from corresponding equipment after breaker closing, or abnormal motor operation occur, professional electricians must be relied on for handling.

7.6 Touch Screen Operation Instructions

Danger

Warning: It is strictly prohibited to connect or disconnect the communication cable between the touchscreen and the PLC while the system is energized, as this may cause damage to the touchscreen or the PLC communication ports.

Caution

The touchscreen operation password is "1000."

1) Initial Screen

After the system is powered on, the initial screen display is as shown in Figure 7.18.

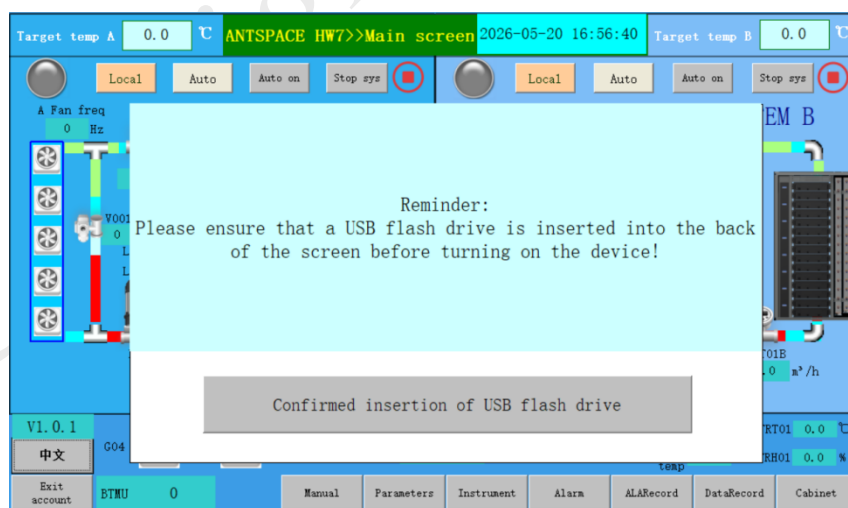


Figure 7.18 Initial startup screen

After confirming that the USB flash drive has been inserted, enter the main interface.

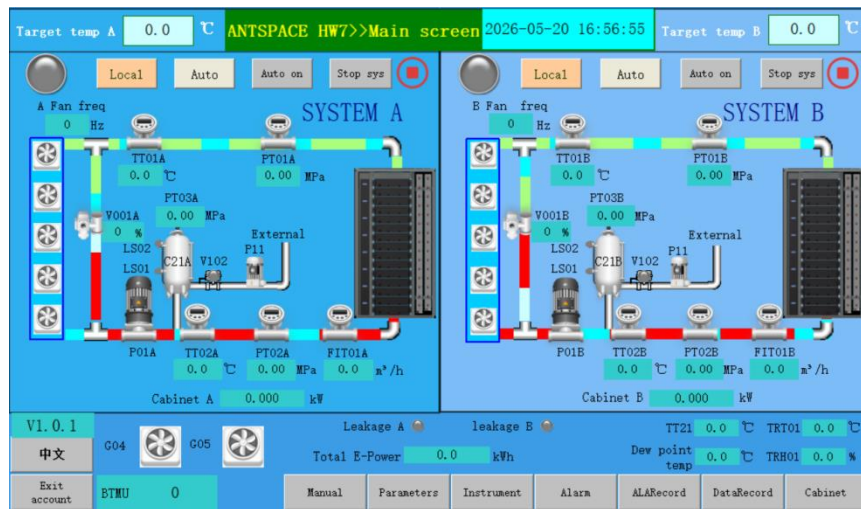


Figure 7.19 Main control screen

The screen displays the device control modes "Automatic/Manual" and "Local/Remote", target temperature, total fault indication, and analog quantity display. The system can set the operation control mode of equipment through the main screen.

The screen is divided into Area A system monitoring area, Area B system monitoring area, and a public area.

After the system's automatic exhaust opens, the internal coolant will automatically purge air during operation. Please wait until the purging is complete before restarting the server.

2) Main Screen

When the dry cooling tower mode is activated, manual control is used for debugging, and automatic control is used for system operation.

Click the "Automatic A/Automatic B" button to enter the manual control screen for System A/B.

Click the "Manual Control" button to enter the manual control screen.

Click the "Parameter Settings" button to enter the parameter settings screen.

Click the "Instrument Settings" button to enter the instrument settings screen.

Click the "Alarm Display" button to enter the fault alarm screen.

Click the "Historical Alarms" button to enter the historical alarms screen.

Click the "Data Records" button to enter the data information screen.

Click the "Power and Positioning" button to enter the power and positioning information screen.

The remote control mode is only effective when the unit is in automatic mode and has a lower priority than local control.

3) Manual Control Screen

When equipment requires liquid addition for debugging, the equipment control mode must be adjusted to "Manual", and then the "Manual Control" screen should be entered. The manual control interface is divided into System A, System B, and a public area, as shown below:

ANTSPACE HW7 >>> Manual						2026-05-20 16:57:15		
Equipment	Start OP	Stop OP	State	Equipment	Start OP	Stop OP	State	
P01 Main pump	Start	Stop	Stopped	P02 Main pump	Start	Stop	Stopped	
DWT fan	Start	Stop	Stopped	DWT fan	Start	Stop	Stopped	
P21A Pump	Start	Stop	Stopped	P21B Pump	Start	Stop	Stopped	
Reset A				Reset B				
Equipment	A Fluid Replacement OP		B Fluid Replacement OP		Equipment State			
V102	V102→A		V102→B		V102→A Ready	V102→B Ready		
P11 Pump	Start		Stop		P11 Start	P11 Stop		
matic fluid repleni				matic fluid repleni				
G04 Fan	Start	Stop	Stopped	G05 Fan	Start	Stop	Stopped	
MainScreen		Manual	Parameters	Instrument	Alarm	ALARRecord	DataRecord	Cabinet

Figure 7.20 Manual control screen

At this point, the motors and frequency converters to be operated can be started by jogging. Generally, when the system requires liquid addition, it is necessary to manually start the corresponding electric valves, refilling pumps and circulation pumps. However, before starting, the correct operating direction of the motor must be ensured.

Therefore, after powering on, turn on the G04 and G05 exhaust fans and observe their operating directions. When air is drawn out from the container, it indicates forward rotation. All motors have been debugged for forward rotation before factory shipment, so only the operating status of one motor needs to be observed. When a motor rotates in reverse, the phase adjustment of the three-phase power input to the QFWCU is required, i.e., changing the phase sequence of two cables.

4)Parameter setting interface

The parameters in the system have been set, and the interface is divided into Side A, Side B, and a public area. The screens are as follows (to be displayed on the actual screen):

ANTSPACE HW7 >> Parameters		2026-05-20 16:57:36
V001 opening setting A Open Close Opening 0 %	V001 opening setting B Open Close Opening 0 %	
DWT operating parameters A Fan freq 0 Hz Target temp 0.0 ℃ Fan freq set 20.0 Hz	DWT operating parameters B Fan freq 0 Hz Target temp 0.0 ℃ Fan freq set 20.0 Hz	
Exhaust Fan Operation Setting All fans start Temp 0.0 ℃ Single fan start temp 0.0 ℃ Stop Temp 0.0 ℃		
Reset	MainScreen	Manual Parameters Instrument Alarm ALARRecord DataRecord Cabinet

Figure 7.21 Parameter setting screen

The interface shown above is used to configure the V001 valve, the frequency of the dry cooling tower fan, and the on/off parameters for the container exhaust fan in manual mode. Through this parameter configuration interface, you can manually set the opening of the V001 electric butterfly valve, as well as the operating parameters for the container fan and the dry cooling tower fan.

5) Instrument Setting Screen

ANTSPACE HW7 >> Instrument		2026-05-20 16:57:54									
Equipment	TT01 temp A	PT01 pressure A	PT02 pressure A	FIT01 flow A	C21A pressure	TT01 temp B	PT01 pressure B	PT02 pressure B	FIT01 flow B	C21B pressure	
Low alarm value	0.0 ℃	0.00 MPa	0.00 MPa	0.0 m³/h		0.0 ℃	0.00 MPa	0.00 MPa	0.0 m³/h		
High alarm value	0.0 ℃	0.00 MPa			0.00 MPa	0.0 ℃	0.00 MPa			0.00 MPa	
High high alarm Value	0.0 ℃					0.0 ℃					
Equipment	High alarm value		Correct time								
TT41 control cabinet temperature	0.0 ℃		2026-05-20 16:57:54								
TT43 cabinet A temperature	0.0 ℃										
TT45 cabinet B temperature	0.0 ℃										
MainScreen		Manual	Parameters	Instrument	Alarm	ALARRecord	DataRecord	Cabinet			

Figure 7.22 Schematic of the instrument setting interface

The instrument setting interface is also divided into Side A, Side B, and a public area. Through this interface, alarm thresholds for supply/return liquid temperature, supply/return liquid pressure, flow rate, temperature inside the main control cabinet, temperature inside the distribution cabinet, and cold-side pressure difference can be set.

Parameters will revert to factory settings on the first boot. For modifications, maintenance personnel should assess potential issues before adjustment and confirm that changes will not affect system operation before making any parameter adjustments. This screen contains clock settings. You can calibrate the system time here. Please calibrate the system time to ensure the accuracy of operational data logging and fault time determination.

6) Alarm display interface

When the system is running, any faults in the system will be displayed on this screen.

After a fault occurs, the yellow alarm light will turn on, and the fault type will be shown on the "Alarm Display Screen". In this case, first analyze the cause of the fault, then troubleshoot it, and finally click "Reset" on the manual control screen.

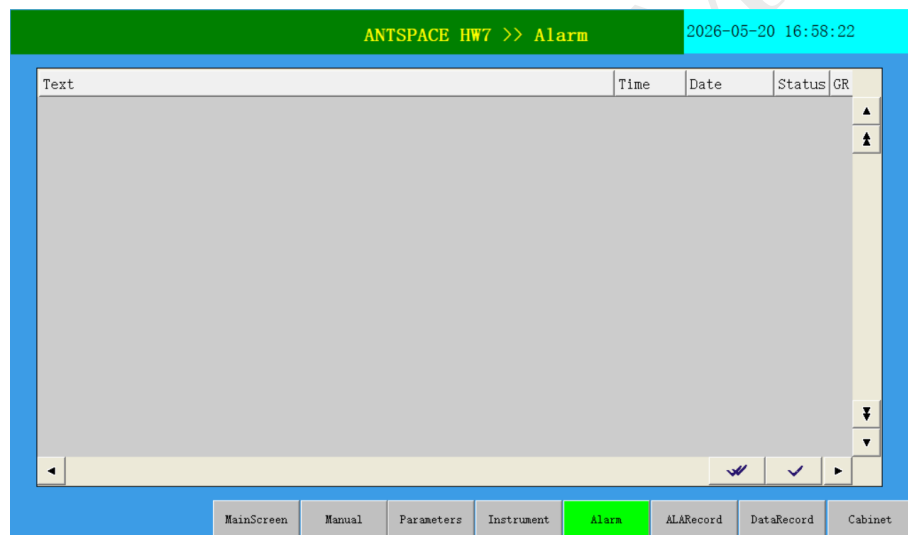


Figure 7.23 Alarm display screen

7) Historical Alarm Screen

Alarm information in the system will be recorded by time and stored on this screen, facilitating users to search for fault occurrence times.

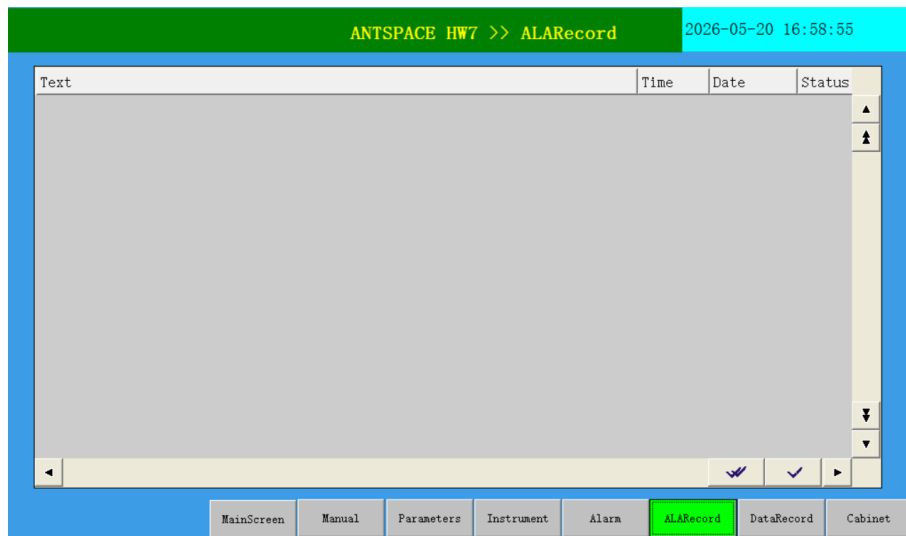


Figure 7.24 Example of historical alarm page (Figure)

8) Data Recording Screen

This interface features six sub-panels, each displaying temperature curves for supply and return fluids, pressure curves for supply and return fluids, and flow rate curves for supply fluids in Systems A and B. Each parameter corresponds to a distinct color.

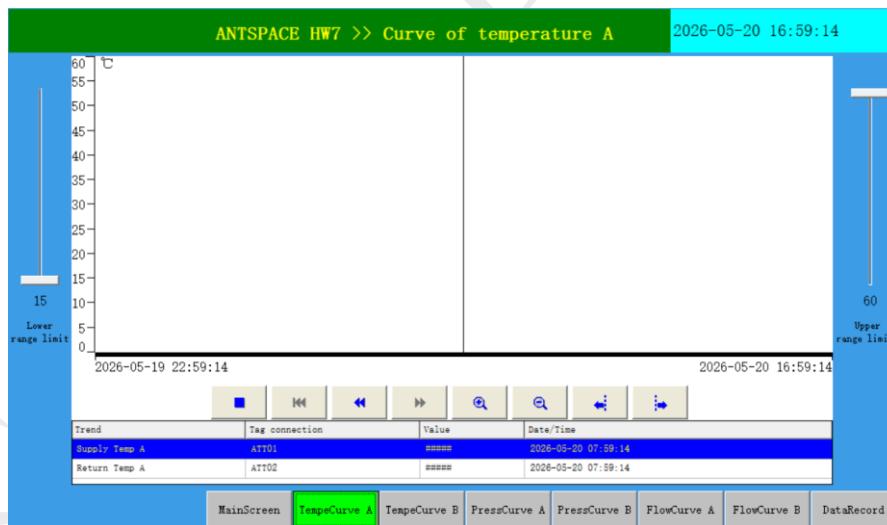


Figure 7.25 Temperature curve A

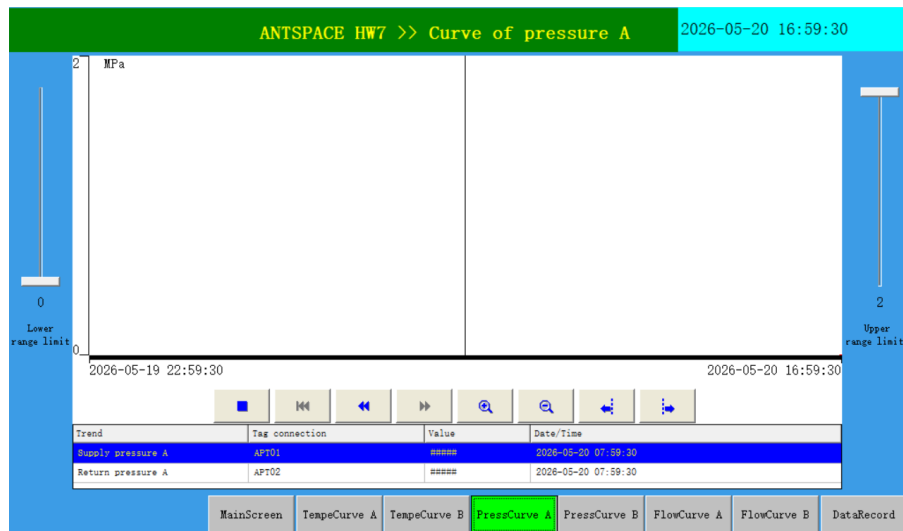


Figure 7.26 Pressure curve A

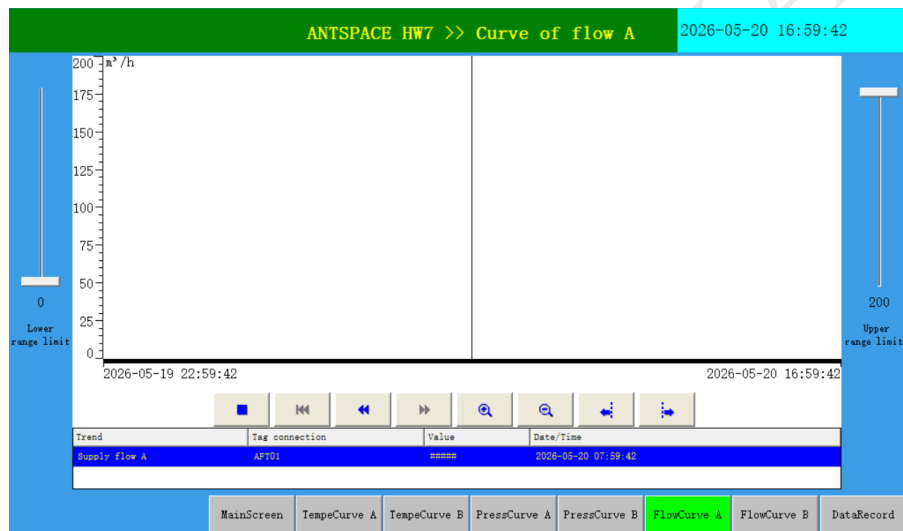


Figure 7.27 Flow curve A

9) Power and Positioning Screen

The screen can display the ambient temperature in three equipment cabinets, power quality information of 4 power circuits from two distribution cabinet. Among them, the power information are used for debugging and display, with a floating-point reading format.

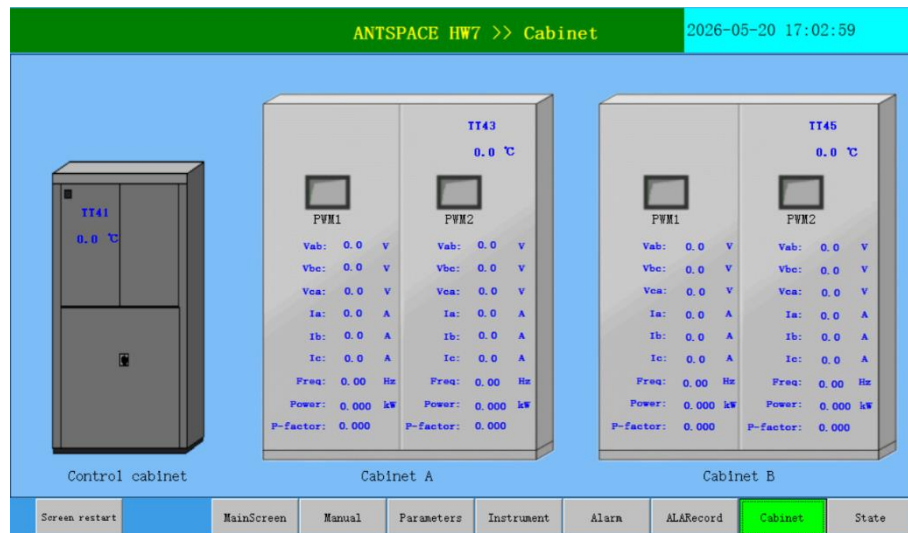
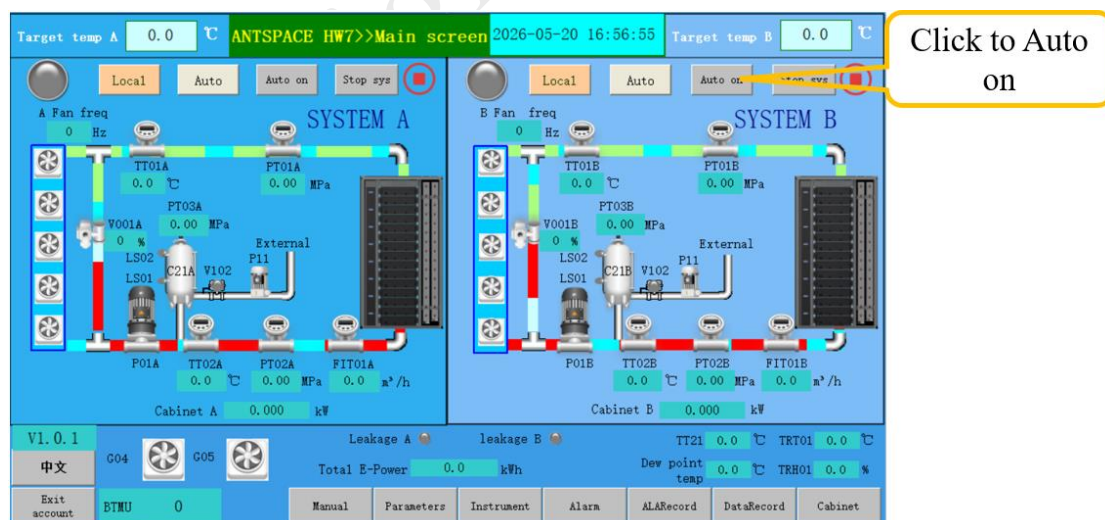


Figure 7.28 Power and positioning

10) Automatic Control Mode

When the A or B side system needs to run automatically, it is necessary to ensure that the pressure (PT01/PT02) in the system is higher than 0.05MPa, then set all parameters on the parameter setting screen. After that, click the "One-click Start" on the main screen, and the motors in the system will execute according to the automatic control logic sequence. To shut down, click the "One-click Stop" on the main screen.

Steps to switch from manual mode to automatic mode (taking System B as an example):



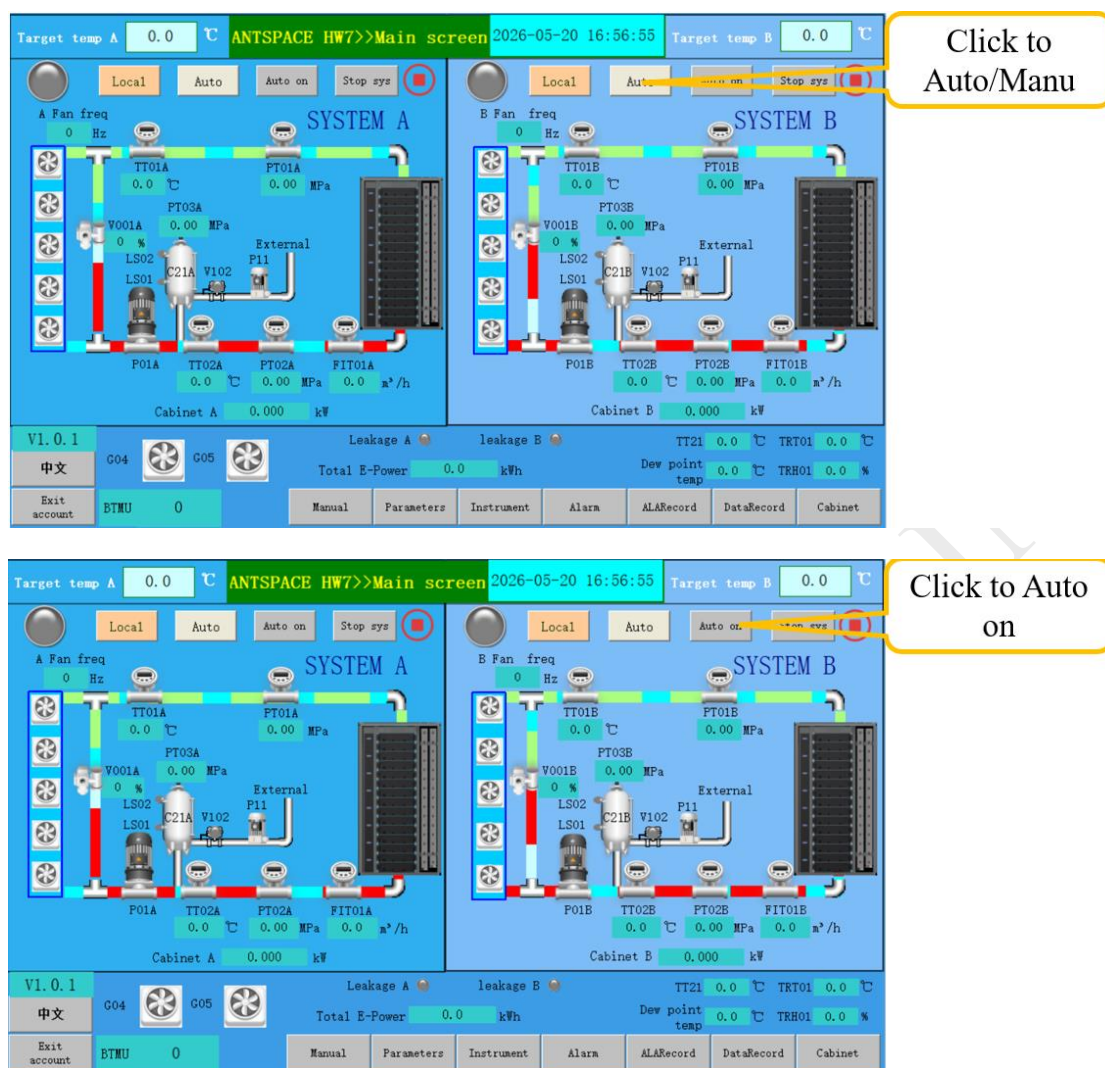


Figure 7.29 Manual mode to automatic mode operation procedure

7.7 On-site Installation Summary

1) On-site Installation Summary

After the equipment arrives at the site, the installation work should be carried out in the order specified in Table 7.5. Once the installation is completed, the control mode can be changed to "Automatic". By clicking "One-click Start", the system can run automatically.

Table 7.5 Summary of on-site installation steps

Serial Number	Steps	Remarks
1	Container and dry cooling tower on-site position positioning and hoisting	Remove the fan baffles of the container, the baffles around the dry cooling tower and the fan baffles. Position the

		installation location of the container and hoist it in place. With the pipeline connection as a reference, hoist the dry cooling tower to the top of the container and lock it with twist locks.
2	Installation of the connecting pipeline between the container and the dry cooling tower	Ensure the pipeline is installed correctly, well-sealed, and free of leaks.
3	Power distribution work for the container and the dry cooling tower	Route the wires reasonably, make connections in a standardized manner, calibrate the torque, and conduct a power-on inspection.
4	Container pressure testing operation	After 12 hours of air pressure test at 7 bar, conduct an air-liquid test at 7 bar for 90 minutes with no leakage. A pressure drop of no more than 5%.
5	Container liquid filling operation	Preparation work - system liquid replenishment - water tank liquid replenishment - regular liquid replenishment

2) On-site Installation Inspection

After the unit is installed, the following items need to be checked. The unit can be powered on and started only after all checks are completely qualified.

Table 7.6 Installation completion checklist

Inspection items	Inspection content	Confirmation options
Container	The container should be installed in compliance with installation requirements and shows no tilting. The container should be laced on a horizontal hard ground with space reserved for installation and maintenance. Debris inside the container (such as cable ties and wire ends) has been cleared.	☐ Confirmed
Dry cooling tower	For the dry cooling tower, the cable connections of 22 fans have no error and the fans do not reverse. The cable connections of the water curtain are error-free.	☐ Confirmed
Sealing component	The sealing structural components and fixing parts inside and outside the container have been removed, and there is no debris inside.	☐ Confirmed
Rain cover	The rain cover is correctly installed above the inlet, and the rainproof cloth is properly installed.	☐ Confirmed
Pipeline connection	The clamps and pipe clips at the liquid replenishment port are securely fixed. The fixed connections of the circulation system pipelines are free of looseness. The pipeline connection between the dry cooling tower and the container is tight. The pipeline pressure drop meets the requirements.	☐ Confirmed
Circuit connection	The incoming line of the whole machine is connected to the distribution cabinet through the inlet under the rain cover, and the connecting bolts of the distribution cabinet are tightly fastened. The signal lines are correctly connected without misalignment, omission, etc.	☐ Confirmed
Water inlet and outlet pipes	The pipelines between the container and the dry cooling tower have been correctly connected.	☐ Confirmed

Inspection items	Inspection content	Confirmation options
Electrical inspection	The power supply voltage is within the rated voltage range on the equipment nameplate. The cables show no damage or other issues. There are no open circuits, short circuits, or incorrect connections in the system's electrical circuits. Ensure that all cables in the upper and lower electrical control boxes are properly connected. Check whether the rated value of the external main power breaker is correct with reference to the current value. All cable and circuit connections are tight, and the fixing screws are free of looseness.	☐ Confirmed

8 Common Faults and Troubleshooting Methods

8.1 Container Faults and Troubleshooting

Table 8.1 List of common faults and troubleshooting methods for equipment part

Fault Type	Reason Analysis	Solution	Remarks
Power failure	1: Phase loss	1.Check for phase loss in the main power supply.	
	2: Overvoltage	2.Turn off the upper-level air breaker QFWCU (in the main control cabinet), ensure the main control cabinet is de-energized, and use a flat-head screwdriver to increase the overvoltage value (factory setting: +5%).	The reason for this situation is that the overvoltage and undervoltage values of the power monitor were not adjusted before the equipment left the factory, or the set values do not match the actual on-site values.
	3: Undervoltage	3.Turn off the upper-level air breaker QFWCU (in the main control cabinet), ensure the main control cabinet is de-energized, and use a flat-head screwdriver to decrease the undervoltage value (factory setting: +5%).	
	4: Phase sequence error	4.Adjust the phase sequence of the power supply cables connecting the distribution cabinet to the main control cabinet.	
Liquid level low alarm	The water tank level in the container is low.	Refill the water tank in the container.	

Fault Type	Reason Analysis	Solution	Remarks
Circulating pump failure	The circulating pump is overcurrent due to water pump idling, undervoltage (low return liquid pressure), etc.	1.First turn off the air breaker (QFWCU) in the main control cabinet. 2.Reset the frequency converter (corresponding to number VF01) in the main control cabinet (manually press the RES button on the frequency converter). 3.Check if the system operating parameters are normal (pressure and flow alarms will appear first), and troubleshoot issues based on the alarm faults. 4.After troubleshooting, start the circulation pump again after a 2–3 minutes interval.	Warning: After the system is powered on, the circulation pump is prohibited from idling when there is no liquid in the system.
G03/G04 exhaust fan failure	The exhaust fan has excessive current, and there may be strip-shaped objects (caught) in the fan blades, hindering the fan operation.	1.First turn off the air breaker (QFWCU) in the main control cabinet. 2.If there is debris in the fan blades, clean it up first. If there is no debris and the fan fails, please contact the manufacturer. 3.Then reset the motor protectors in the main control cabinet (QFG04 corresponds to Exhaust Fan #1; QGF05 corresponds to Exhaust Fan #2) (manually turn the motor protector knob to the vertical position to close the breaker). 4.After troubleshooting, start the exhaust fan again after a 2–3 minutes interval.	

Fault Type	Reason Analysis	Solution	Remarks
Refueling pump failure	1.The Y-type filter of the liquid supply pump is dirty and blocked, causing overload.	1.Reset the variable frequency drive for the filling pump (part number VF03) in the main control cabinet (by pressing the RES button). 2. Turn off the circuit breaker (QFWCU) in the main control cabinet. 3.Clean the Y-type filter. 4.After troubleshooting, start the fluid replenishment pump again after a 2-3 minutes interval.	After the system is powered on, the fluid replenishment pump must not idle when there is no liquid in the system.
	2.The water inlet position of the liquid supply pump is too low, causing overload. Liquid leaks from the inlet and outlet of the computing power server to the floor, wetting the liquid leakage sensor.	1.Reset the variable frequency drive for the filling pump (part number VF03) in the main control cabinet (by pressing the RES button). 2. Turn off the circuit breaker (QFWCU) in the main control cabinet. 3.Ensure the external water intake is lower than the coolant drum. 4.After troubleshooting, start the fluid replenishment pump again after a 2–3 minutes interval.	After the system is powered on, the fluid replenishment pump must not idle when there is no liquid in the system.
Liquid leakage alarm	There is liquid leakage from the inlet and outlet ports of the computing power server onto the floor, wetting the leakage sensor.	1.Find the area on the floor with liquid. 2.Carefully check whether the inlet and outlet ports of the computing power server are leaking liquid directly above this area. 3.After identifying the leakage site, replace the quick-connect fittings or corrugated pipes, then clean the leakage site and dry the liquid leakage monitoring strip.	

Fault Type	Reason Analysis	Solution	Remarks
High liquid supply temperature alarm	1.The dry cooling tower cooling fan is not operating.	Check whether the dry cooling tower fan is operating normally and whether the rotation direction is correct. Inspect the power supply circuit of the fan for normality.	
	2.The temperature sensor is damaged.	Replace the temperature sensor; the high supply liquid temperature alarm value can be set on the screen as needed.	
High liquid supply temperature alarm	After the high supply liquid temperature alarm occurred, the operation and maintenance personnel failed to handle it in a timely manner, causing the supply liquid temperature to rise continuously.	Before identifying the cause, consider turning off some computing power servers to reduce the load, then investigate the cause of the high supply liquid temperature alarm. The high supply liquid temperature alarm value can be set on the screen as needed.	
High liquid supply pressure alarm	1.The filter is blocked.	Clean the filter element.	
	2.The supply and return liquid valves are faulty or not fully opened.	Open the supply and return liquid valves.	
	3.The pressure sensor is faulty.	Replace the pressure sensor.	
	1.The water tank is low on liquid.	Refill the water tank.	

Fault Type	Reason Analysis	Solution	Remarks
Low return liquid pressure alarm	2.The fluid replenishment pump is faulty.	Check the cause of the fluid replenishment pump failure.	
	3.The pressure sensor is faulty.	Replace the pressure sensor.	
	4.There is liquid leakage.	Inspect the system for leakage points.	
Low liquid supply flow alarm	1.The supply and return liquid valves are faulty or not fully opened.	Open the supply and return liquid valves.	
	2.The filter is dirty and blocked.	Clean the filter element.	
	3.The flow sensor is faulty.	Replace the flow sensor.	
	4.There is liquid leakage.	Check the system for leakage points.	
Condensation alarm	High environmental humidity	When on-site operation and maintenance personnel see this alarm message, they only need to increase the supply liquid temperature target value by 5°C to prevent condensation.	The logic set in the program is: when the dew point temperature value > the supply liquid temperature value - 5°C, the system will prompt a condensation alarm.
Fluctuating pressure display	1.There is air inside the system.	Please ask on-site operation and maintenance personnel to open the exhaust valve for venting.	

Fault Type	Reason Analysis	Solution	Remarks
	2.The system is short of liquid.	If the return liquid pressure is lower than the set value, the fluid replenishment pump will automatically replenish the system.	
	3.The sensor is damaged.	Replace the sensor.	
No pressure displayed	1.The sensor is damaged.	Replace the sensor.	
	2.The cable is loose.	Check the wiring circuit of the pressure sensor and fasten it.	
	3.PLC acquisition channel is damaged.	Replace the PLC module corresponding to the sensor.	
Pump running with insufficient flow	1.Air existing at the water pump suction port.	Use a wrench to open the exhaust port above the water pump suction port until uniform liquid flows out, and repeat 2-3 times.	
	2.The filter is blocked.	Clean the filter element.	
	3.The system is short of liquid (low return liquid pressure).	Replenish the system with liquid.	
Fan not operating	1.The motor is burned out.	Replace the fan.	
	2.The cable is loose.	Use a multimeter to check the fan's power supply when it is powered and tighten connections when power is off.	
	3.The air breaker trips.	Close the air breaker.	
Noise and abnormal sound	1.Water pump cavitation.	Detect the pressure on the water intake side (return liquid pressure or pressure gauge) and replenish liquid in a timely manner.	

Fault Type	Reason Analysis	Solution	Remarks
	2.Pump shaft connection issues.	Check the mechanical connection of the pump shaft.	
	3.Insufficient lubrication of the motor shaft.	Add lubricating oil.	
	4.Safety valve activation.	Check if there is too much liquid in the water tank to release pressure in time, and discharge excess liquid from the water tank.	
Water pump shaft seal leakage		Replace the pump shaft seal.	

8.2 Conventional Faults and Troubleshooting Methods of Dry Cooling Towers

1) Fault Analysis and Handling of Dry Cooling Towers

Common fault phenomena and analysis and handling methods of the product are shown in Table 8.2.

Table 8.2 Fault analysis and handling of dry cooling towers

Fault Phenomenon	Possible Causes	Inspection or Maintenance
Fan fails to start	1.Motor burnout	Replace the fan.
	2.Loose cable	With power on, use a multimeter to check the power supply of the fan when it is powered and tighten it when power is off.
	3.Molded case circuit breaker tripped	Close the molded case circuit breaker (QFVFG1 for dry cooling tower on side A, QFVFG2 for dry cooling tower on side B).
	4.Inverter failure	1.Perform a reset operation on the frequency converters in the dry cooling tower control cabinet (VFG1 for dry cooling tower A and VF03 for dry cooling tower B) by manually pressing the RES reset button on the frequency converter.

		2. Check whether the system operating parameters are normal and troubleshoot issues based on alarm faults. 3. After troubleshooting, wait 2-3 minutes before restarting the fan.
	5. Fan overload	1. First, turn off the molded case circuit breakers in the main control cabinet (QFVFG1 for the dry cooling tower on side A and QFVFG2 for the dry cooling tower on side B). 2. Perform a reset operation on the motor protector in the dry cooling tower control cabinet (manually turn the knob of the motor protector to the vertical position, which means closing the breaker). 3. After troubleshooting, wait 2-3 minutes before restarting the fan.
Dry cooling tower loses network connection	Loose or damaged network cable plug disconnected	Check the network cable, tighten the network port plug or replace the network cable.
No cooling or poor cooling effect	Dirty and blocked heat exchanger fins	Clean the heat exchanger.
	Insufficient system flow	Clean the filter.

Caution

1. Certain circuits within the dry cooler system contain lethal high voltages and must only be serviced by qualified technical personnel.
2. When using jumper wires for troubleshooting, always ensure to remove all jumpers after the maintenance work is completed. Leftover jumpers may interfere with control functions and cause equipment damage.

Warning

The equipment contains high voltage. Always disconnect the power supply before performing any internal maintenance. Note that external power cables may remain energized even when the unit's main circuit breaker is turned off.

5) Anti-freezing maintenance in winter

In winter, when the temperature is low, dry cooling towers require special maintenance attention.

When the dry cooling tower is in a low-temperature environment where the ambient temperature is $\leq 5^{\circ}\text{C}$, if the circulating system does not use antifreeze (Depending on the low-temperature environment, ethylene glycol solutions of different concentrations can be selected) and the system is temporarily out of operation, it is necessary to manually open the drain valve at the bottom of the end header pipe of the dry cooling tower to empty the water in the heat exchanger, preventing the heat exchanger and pipelines from freezing and cracking. It is also recommended that after emptying the water in the pipelines, flush them once with antifreeze to ensure there is no residual water inside, guaranteeing that the pipelines will not freeze and crack due to ice formation. Meanwhile, in this temperature environment, the cooling medium used during system operation must be antifreeze to prevent the cooling medium from freezing.



Danger

If the entire unit is to be relocated from a high-temperature area to a low-temperature area, the drain valve located at the bottom of the end water collection pipe on the dry cooler must be manually opened to fully drain the liquid inside the unit. Failure to do so may result in the heat exchanger and piping freezing and cracking.

3) Replacement of dry cooling tower fans

The dry cooling tower fans must be replaced by qualified professional technicians, and the operation steps are as follows:

- a) Turn off the main power supply;
- b) Disassemble the junction box at the top of the fan and remove the power input cable of the fan;
- c) Remove the fastening bolts on the fan mounting plate;
- d) Maintain or replace the fan and mounting plate assembly;
- e) After maintenance, reinstall the fan in place according to the reverse steps. The installation torque is $23\text{N}\cdot\text{m}$;

- f) Connect the original fan power input cable to the junction box at the top of the new fan. The fastening torque of the junction box is $2.6\text{N}\cdot\text{m}$, and the torque of the corrugated pipe lock head is $4\text{N}\cdot\text{m}$;
- g) Power on again and check whether the fan rotates normally.

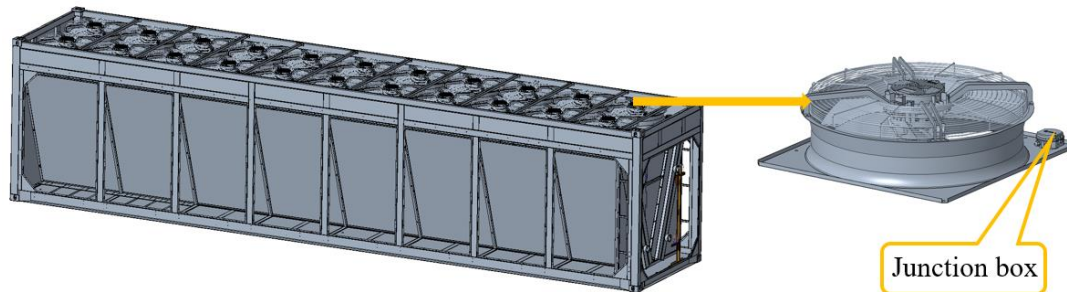


Figure 8.1 Schematic of dry cooling tower fan replacement

! Danger

Fan replacement constitutes working at height and requires valid high-altitude work certification. Appropriate ladders and protective equipment compliant with local regulations for working at height must be used during such operations.

4) Replacement of automatic exhaust valves

The automatic exhaust valve should be replaced by the following steps:

- a) Close the maintenance ball valve at the front end of the automatic exhaust valve;
 - b) Use tools to unscrew the automatic exhaust valve for maintenance or replacement. Ensure thread sealing for the valve connection;
 - c) After maintenance, reinstall the automatic exhaust valve in place according to the reverse steps. The torque for the exhaust valve is $4\text{N}\cdot\text{m}$;
 - d) Restart the equipment and check whether the exhaust valve can be used normally.
- If there is any leakage, reinstall it until no leakage occurs.

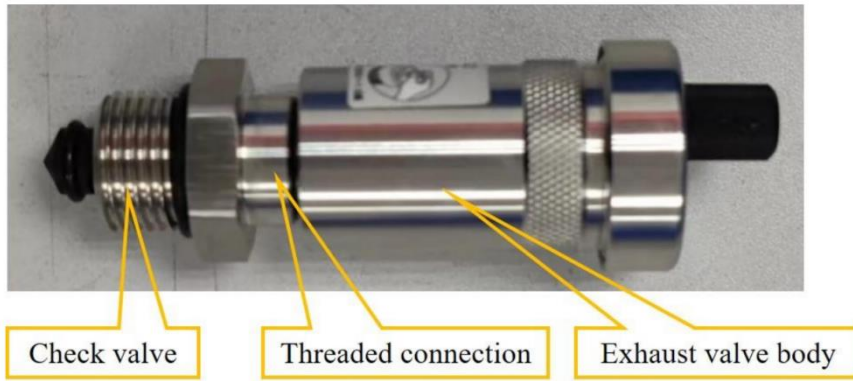


Figure 8.2 Schematic of automatic exhaust valve

9 System Maintenance

9.1 Overview

Preventive maintenance refers to maintenance implemented at predetermined time intervals or according to specified criteria to reduce product failure probability or prevent functional degradation. It mainly includes adjustments, regular inspections, and necessary repairs, etc. This enables equipment maintenance and operation personnel to become familiar with the product's performance, structural principles, usage methods, and precautions, so that the equipment can perform its intended functions.

Good maintenance ensures that the equipment remains in good working condition.

9.2 Preventive Maintenance

1) Operator Monitoring

When operating the equipment normally, operators shall monitor its status to detect potential faults.

Once a fault alarm is detected in the system, the operator shall promptly confirm and inspect the fault to identify its cause.

2) Usage Inspection

When operating the equipment normally, operators shall conduct regular inspections as planned to determine whether the product performs specified functions.

a) Check the integrity of supply/return fluid pipelines, power lines, and other connections

Inspection requirements: No leakage in pipelines and joints; no damage to cables.

Inspection method: Visual inspection.

b) Check whether the water level in the tank is too low or too high, and determine whether water needs to be added or drained

Inspection requirements: If the water tank level drops to the point where it triggers the low-level switch, water must be added; if the water tank pressure exceeds the high-level switch, water must be drained to reduce operational risks;

Inspection method: Visual inspection

c) Inspect the fluid supply system and record data such as temperature and pressure once every half day

Inspection requirements: Record supply/return fluid temperature, supply/return fluid pressure, and supply fluid flow data; observe whether the data remains stable over long-term operation.

Inspection method: Visual inspection and data comparison.

d) Check the system's fault alarms (e.g., temperature, pressure, flow, etc., displayed on the "Fault Alarm Screen" of the touchscreen) and record them once every half day

Inspection requirements: Investigate system alarm points and troubleshoot faults with reference to the manual.

Inspection method: Visual inspection, as needed.

e) After normal operations of the container, please check the reliability of cable connections in the A/B power distribution cabinets, main control cabinet, and dry cooling tower junction box. This inspection shall be done during the first operation after operation or relocation, and should be conducted every six months under normal operation.

Inspection requirements: Check whether the cable connection points are secure and whether there is abnormal temperature rise.

Inspection method: Visually inspect and use a handheld infrared detector to check whether the temperature at the connection points is abnormal. When the displayed temperature exceeds 70°C or is 30°C higher than the ambient temperature, the connection points need to be inspected and re-tightened.

Danger

If any abnormal temperature rise or other irregular phenomena are detected in the equipment, the unit must be immediately shut down for inspection. This is to prevent component overheating that could cause equipment damage or fire hazards. Restarting the unit before the issue is resolved is strictly prohibited.

9.3 Regular Inspection of Containers

1) Maintenance of Filters

The system uses coolant as the circulating medium, and a filter is installed to filter the circulation. The filter needs to be cleaned after the system has been in operation for a period of time.

The cleaning time requirements for the filter are as follows:

The circulation pipeline filter of the pump group liquid supply system is located at the liquid outlet of the dry cooling tower. It shall be cleaned once a month (or as needed). It is recommended to clean the filter once within 72 hours after the first commissioning to prevent impurities in the coolant and the system from blocking the filter.

The filter cleaning and replacement steps are as follows:

- a) Cut off the main power supply of the equipment;
- b) Find and close the maintenance butterfly valve in the system as shown in Figure 9.1, then open the drain ball valve below the pipeline filter assembly to partially drain the pipeline;

! Caution

The discharged coolant needs to be stored in a clean container, and the coolant discharge needs to comply with local emission standards. After the butterfly valves at both ends of the filter are closed, about 10L of coolant is discharged. A 20L container needs to be prepared. The discharged coolant cannot be directly added to the water replenishment tank for reuse without treatment.

- c) After locating the filter, open the manual exhaust valve and manual drain valve, remove the clamp connection, and take out the pipeline filter element from the handle;
- d) Remove the filter screen inside the filter for cleaning (or replacement), referring to Figure 9.2;
- e) Install the cleaned filter screen, tighten the clamp with a wrench, and close the valves;
- f) After reconnecting the power supply to the equipment, refill the coolant into the system reservoir.

! Caution

Coolant discharged from the strainer cannot be added directly to the make-up tank.

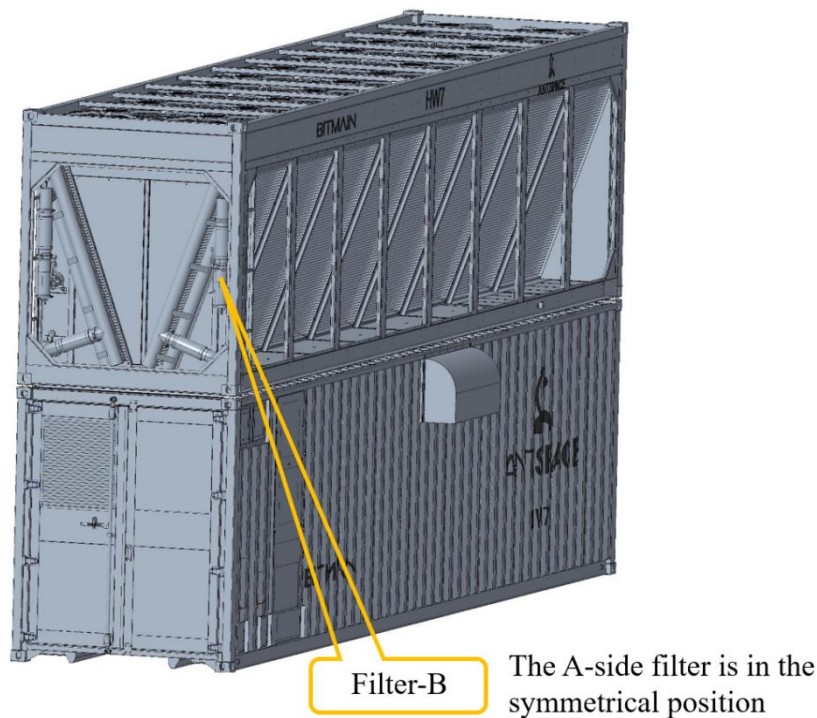


Figure 9.1 Location of pipeline maintenance butterfly valve and pipeline filter

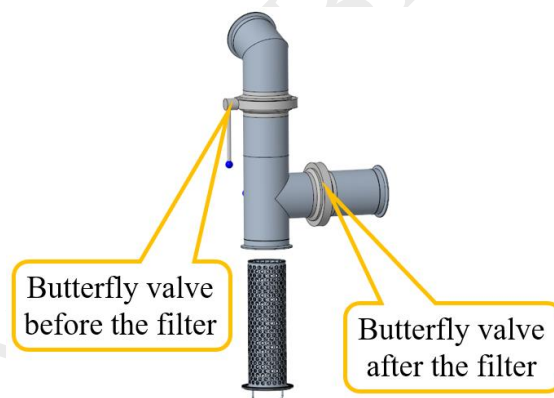


Figure 9.2 Schematic of pipeline filter dismantling and cleaning

2) Leak maintenance of pipelines

After the equipment has been in operation for six months, a semi-annual anti-leakage inspection of the pipeline network should be carried out. If any seepage or leakage is detected, the equipment must be shut down immediately for maintenance. During maintenance, the operation of the load devices at the user end should be stopped first, followed by stopping the equipment operation for repair. At the same time, after completing the leak detection, pay attention to replenishing the system with fluid.

3) Maintenance of electrical components

After the equipment has been in operation for six months, the wiring terminals and pressure screws on the electrical components of the main control cabinet inside the water pump cabinet must be inspected and maintained. This is to prevent loose wiring terminals and pressure screws from causing poor contact or damage to components, abnormal equipment operation, and thus affecting the operation of the entire liquid cooling container system.

 Caution

Daily operation check needs to pay attention to the system operation whether there is abnormal noise, abnormal reading display, system operation alarm message. If there are any abnormalities timely eliminated.

4) System Drainage

After the system and water tank have been in operation for 1-2 years, there may be some debris in the system pipelines. The system coolant should be drained and replaced in a timely manner.

 Caution

The system operates with about 3300L of coolant, so please prepare enough storage volume in advance.

The drainage steps are as follows:

- a) Locate the position of the liquid discharge ball valve (see Figure 9.3);
- b) Connect the liquid discharge hose to the liquid discharge ball valve and secure it with a hose clamp;
- c) Lead the hose outside the equipment, open the two liquid discharge ball valves (Figure 9.3), and then drain the system.

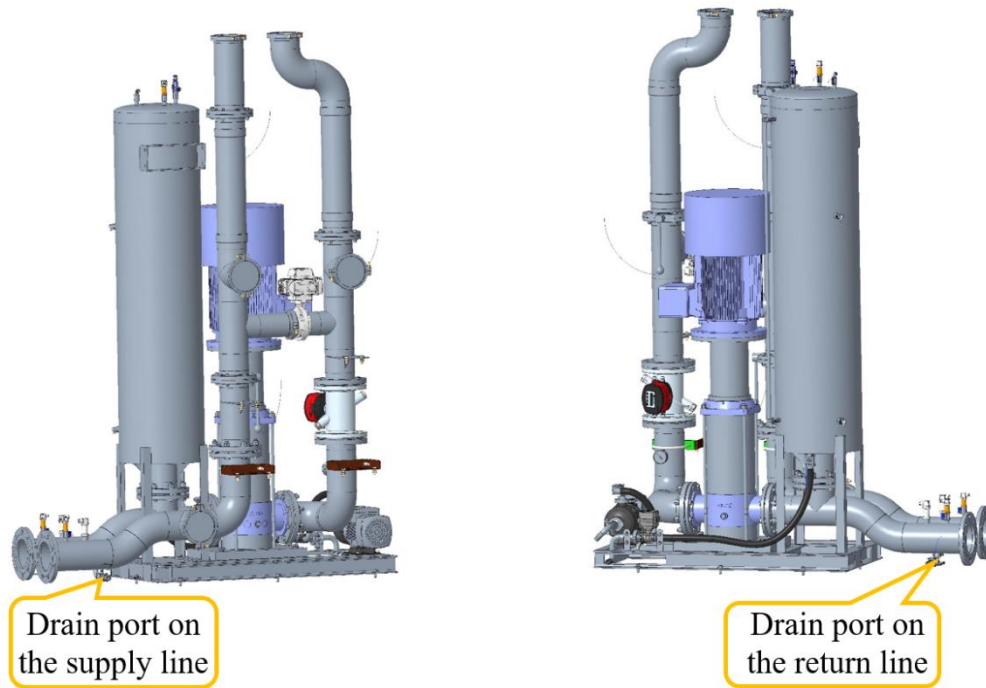


Figure 9.3 Position of the liquid discharge ball valve of the pump station

d) When draining the dry cooling tower, you should connect the hose to the drain outlet, open the drain ball valve (Figure 9.4), and then drain the dry cooling tower. There are a total of 4 drain valves in the dry cooling tower.

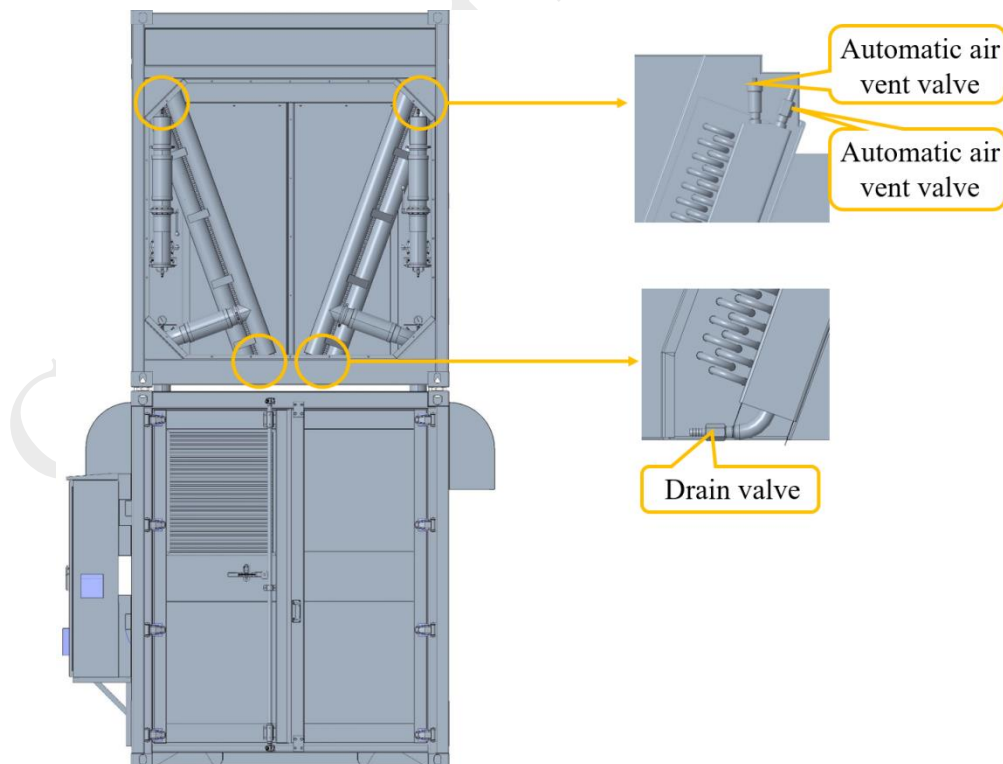


Figure 9.4 Position of the liquid discharge ball valve of the dry cooling tower

e) Draining the Water Curtain

Since the water curtain is an open system, prolonged inactivity can lead to the growth of algae or other microorganisms. When the water curtain is not in use, open the drain valve in the water curtain tank to drain the liquid from the tank. The location of the drain valve is shown in the figure.

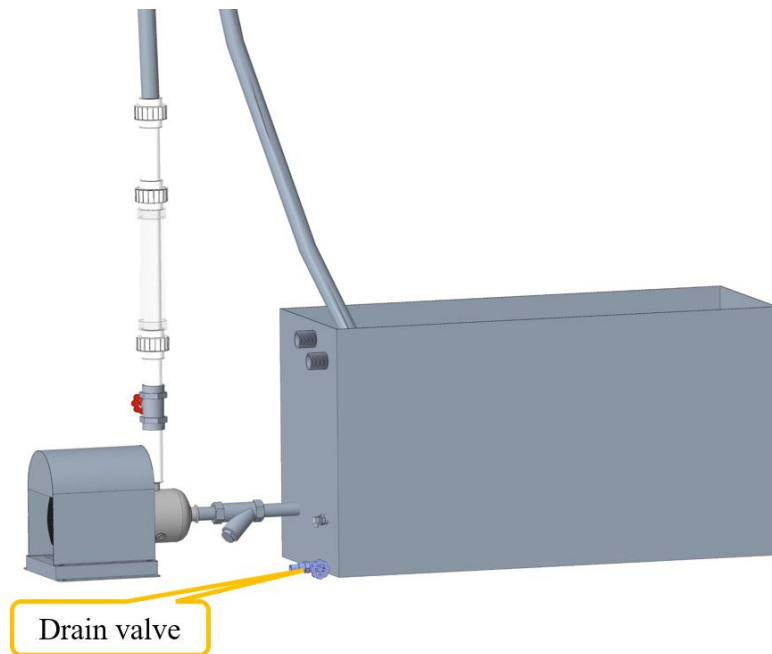


Figure 9.5 Location of the ball valve for draining the water curtain tank

5) Water Tank Liquid Level Inspection

There are monitors for liquid levels of two water tanks (System A and System B). When the liquid level of a water tank is lower than the required value, the system touchscreen will alarm to prompt a low water tank level, and at this time, the fault should be checked promptly and the liquid should be replenished. However, even if there is no alarm for the water tank level, regular inspections should still be carried out: after the stable operation of the water tank in the container, the liquid level should be checked once a week. Once the water level in the tank inside the container has stabilized, check it once a week. If the water level is low, top it up promptly.

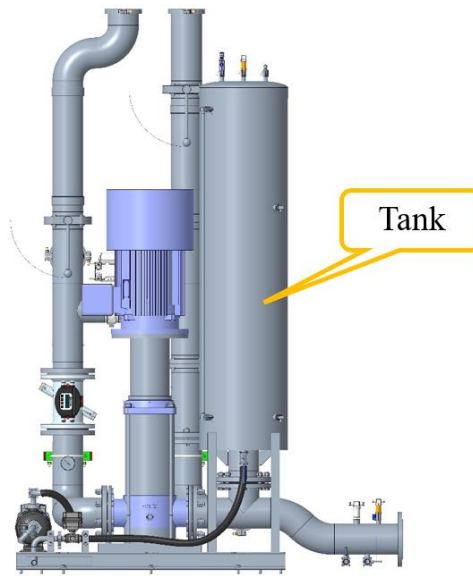


Figure 9.6 Container water tank

6) Coolant Maintenance

When purchasing coolant, pay close attention to the relevant parameters listed in Tables B.1, B.3 and B.4 of Appendix B based on the type of coolant used. If the requirements are not met, consider topping up or replacing the coolant as appropriate.

As a core component of the container liquid-cooling system, the coolant should be tracked, tested, and recorded on a regular basis. Testing frequencies for different types of coolant are as follows:

Deionized water: weekly testing is recommended, with a focus on pH, conductivity, chloride, and total bacteria count. If the pH falls below 6.2 or rises above 9, the water is not recommended for further use and must be replaced immediately. For newly commissioned systems or after fluid replacement, testing should be intensified during the first month: test once before commissioning, once after 24–72 hours of operation, once after 7 days, and once after 30 days. Once the system is confirmed stable, weekly testing may resume. If two consecutive test results are within the normal range with no unidirectional drift trend, the testing interval may be relaxed to once every two weeks. For specific parameters, refer to Table B.4 of Appendix B.

Corrosion-inhibited coolant: testing once every two months is recommended, with a focus on pH and reserve alkalinity. For the testing intervals and methods of specific parameters, refer to Table B.3 of Appendix B. If the pH falls below 6.2 or rises above 9, further use is not recommended. If Bitmain corrosion-inhibitor products are used, after-sales service may be contacted, together with other parameter readings, for replacement recommendations.

Antifreeze coolant: testing once every two months is recommended, with a focus on pH, reserve alkalinity, and ethylene glycol concentration. For the testing intervals

and methods of specific parameters, refer to Table B.3 of Appendix B. If the pH falls below 6.2 or rises above 9, further use is not recommended. If Bitmain antifreeze products are used, after-sales service may be contacted, together with other parameter readings, for replacement recommendations.

If any of the following abnormalities is found during coolant testing, handle it as follows:

If the pH is outside the specified range, re-test first to confirm the result and rule out measurement error; at the same time, check the make-up water source and whether the coolant has been contaminated. Replace or partially replace the internal circulation coolant if necessary.

If the conductivity rises rapidly or deviates from the baseline value by more than 25%, do not condemn the coolant on this basis alone. Test chloride, sulfate, and total iron simultaneously, and use the combined data to determine whether corrosion, contamination, or make-up anomalies exist.

If chloride, sulfate, or total hardness exceeds the specified limits, do not continue adding water from the same batch. Investigate the water source, perform a partial or complete water replacement if necessary, and re-test after replacement to confirm compliance.

If the turbidity is abnormal or impurities are visually observable, check whether the filter differential pressure is abnormal and assess the risk of flow-path clogging; perform filtering, draining, or water replacement, and clean the system piping if necessary.

If the total bacteria count exceeds the specified limit, perform biocide treatment or replace the coolant; operation may resume only after a passing re-test. If exceedances recur, investigate the system sealing, make-up water source, and coolant storage conditions.

If total iron or total copper exceeds the specified limit, investigate possible corrosion of metallic piping components, check for contact between dissimilar metals or heat exchanger contamination, and comprehensively assess, based on leakage, system pressure drop, and pH changes, whether a shutdown for inspection is required.

Coolant sampling can be performed at the system drain valve. Refer to Figure 9.3 for the location of the drain port. Preferably, sample from the return line drain port to ensure the sample is representative. The specific procedure is as follows:

- a) Sampling preparation: Prepare a clean, dry sampling container (a plastic or glass bottle with a lid is recommended). Safety goggles must be worn, and protective rubber gloves should be worn if necessary to avoid direct contact with the coolant;
- b) Verify system status: Ensure the system is in normal operation or has reached a stable circulation state; avoid sampling immediately after refilling or when the system is shut down;

- c) Sampling procedure: Connect the drain hose to the outlet of the drain valve. Slowly open the drain valve to allow the coolant to flow steadily. First, drain a small amount of fluid (approximately 50–100 mL) to flush the hose and the interior of the valve. Collect the sample in the prepared container to prevent external contamination;
- d) Sample Sealing and Labeling: Immediately seal the container after sampling. Label the container with the sampling time, sampling location (e.g., return port), and the container number of the shipping container;
- e) Precautions: Avoid introducing impurities or dust during sampling. Sampling at the fluid replenishment port or in stagnant areas is not recommended to prevent affecting the accuracy of the test.

7) Maintenance of Water Pump

Maintenance Instructions for the Bearings of Water Pump Motors Supporting Water-Cooled Container Products: In order to maintain the original performance of rolling bearings and ensure they can be used in good condition for as long as possible, it is necessary to inspect and maintain the bearings at specified intervals. This helps prevent failures, ensure reliable operation, and improve efficiency and effectiveness. For the three-phase asynchronous motors supporting the water pumps of water-cooled container products, the maintenance of motor bearings should be carried out in accordance with these instructions.

Bearing models of the motors supporting the circulating pump products in the current system are shown in the following table:

Table 9.1 Bearing models

Main Pump Mode	Brand	Bearing	Refueling cycle confirmation	Grease Model
			Number of Pole Pairs: 2P	
BL120-2-1	Shimge	DE:7312B	2000h	Mobilith SHC 220
		NDE:6312Z		

Taking the water pumps of Shimge Pump Industry Co.,Ltd as examples, specific refueling and maintenance shall be confirmed with the manufacturer before implementation.



Figure 9.7 The Pictures of bearings

! Danger

This system uses 2F-grade main pumps, with a lubrication interval of 2000 hours. Bearing grease must be replenished after approximately 83 days of continuous operation, or more frequently as needed.

For the lubricating grease filling method of New Territories water pump bearings, please refer to the following video link:

Enter the website URL: http://100gs.shimge.com/wap/blbxgdjlxbwh_8/2.html;

For bearing replacement, please refer to the following video link:

Enter the website URL: http://100gs.shimge.com/wap/blbxgdjlxbwh_8/216.html

! Caution

Mixing greases of different brands or grades can significantly alter their consistency. The use of different grease brands in combination is strictly prohibited. If a different brand of grease is to be used, the motor bearings must be removed and thoroughly cleaned of the original grease to prevent the risk of motor bearing failure.

9.4 Dry Cooling Tower Maintenance and Upkeep

1) Overview of Routine Maintenance

Routine maintenance is a preventive measure where maintenance personnel periodically inspect and maintain equipment during its normal operation to promptly identify and eliminate alarms and potential faults.

The purpose of routine maintenance is to ensure the long-term stable operation of equipment. Through routine maintenance:

- a) Identify critical faults in equipment operation in a timely manner to prevent them from escalating and ensure stable equipment operation;
- b) Potential faults can be identified in a timely manner to nip them in the bud and avoid economic losses from shutdowns after faults occur;
- c) Operational trends of equipment can be identified to implement targeted optimization and improve equipment operational efficiency.

Key precautions for routine maintenance are as follows:

- a) Before operations, please carefully read safety precautions and product documentation. Comply with local safety codes and laws and regulations to avoid accidents. The "Notes, Warnings, and Dangers" in each manual do not represent all safety matters to be observed but only supplement the safety precautions for various operations. Therefore, personnel responsible for installing and maintaining the company's equipment must possess basic safety operation knowledge, undergo strict training, master correct operation methods, and have corresponding job qualifications;
- b) When doing various operations on the company's products, please strictly adhere to the relevant equipment precautions and special safety instructions provided by the equipment company. The safety warnings listed in the manual only represent part of what the equipment company knows, and the equipment company shall not assume any liability for losses caused by violations of general safety operation requirements or safety standards for equipment design, production, and use;
- c) Most maintenance work must be carried out after the equipment is powered off, and the power supply must not be connected during maintenance. For certain maintenance tasks that require operation (such as measuring current, pressure, temperature, etc.), ensure that all equipment connections are complete before powering on, and disconnect the power supply immediately after maintenance;
- d) Take protective measures during electrical maintenance, including but not limited to wearing insulating gloves and insulating shoes, while complying with local regulations;
- e) Exercise caution when performing professional maintenance, and consult the customer service center for specific details.

! Danger

All working-at-height operations must comply with applicable local safety regulations.

2) Maintenance of Dry Cooling Tower Heat Exchanger Fins

Table 9.2 Monthly maintenance items for heat exchanger fins

Serial Number	Inspection Content	Specific Operations	Exception Handling
1	Whether the heat exchanger fins are dirty or blocked	Inspect the surface condition of the fins (it is recommended to inspect once a month)	If the dust accumulation is not serious, please clean it with an air gun. If the dirt and blockage are severe, flush with clean water using a high-pressure water gun.

Cleaning methods for heat exchanger fins:

- Cut off the power supply of the dry cooling tower;
- Before cleaning the heat exchanger fins, debug the professional cleaning machine to ensure the normal progress of the cleaning work;
- Please adjust the water gun of the professional cleaning machine to a water column shape, and gradually rinse the heat exchanger fins from top to bottom from the outside of the dry cooling tower until the dust and dirt on the surface of the dry cooling tower are completely rinsed off.



Figure 9.8 Schematic of cleaning heat exchanger fins

Caution

When cleaning finned tubes, rinse from the upper section downward to the lower section to ensure thorough cleaning.

Danger

Water used for high-pressure water jet cleaning must be either clean water or clean water mixed with specialized additives designed for air conditioning outdoor unit cleaning.

3) Maintenance of Drainage at the Top of Dry Cooling Tower

Table 9.3 Seasonal maintenance items for dry cooler top drainage

Serial Number	Specific Operations	Exception Handling
1	Confirm that the top drainage holes are not dirty or blocked	Clean up debris such as leaves accumulated on the top of the dry cooling tower.

Danger

All working-at-height operations must comply with applicable local safety regulations.

4) Fan Maintenance

Danger

The main power supply must be disconnected before performing any fan maintenance.

Table 9.4 Monthly maintenance items for fans

Serial Number	Specific Operations	Exception Handling
1	Ensure there is no foreign matter inside the fan.	Clean up foreign matter.
2	Confirm that the fan blades are free from damage.	Repair the blades; if repair is not possible, replace the fan.
3	Check that the fan operates without abnormal sounds, such as metal rubbing noises or harsh noises.	Clean up foreign matter and confirm that the fan fixing bolts are tightened.

Serial Number	Specific Operations	Exception Handling
4	Verify that the installation and fixing screws of the fan are not loose or deformed.	Re-tighten or replace the screws.
5	Make sure the wiring terminals are not loose.	Re-tighten according to the specified torque.

5) Maintenance of Other Systems

To ensure normal operations and service life of the system, it should be inspected at least once a year.

Caution

It is recommended to increase the frequency of inspection if the product is working in a harsh environment.

9.5 Maintenance of Dust Filters

Multiple filter screens are installed within the container. The intake vents for the container door, power distribution cabinet, and control cabinet require regular inspection and cleaning to prevent clogging by dust. This prevents excessive temperature buildup inside the container and electrical cabinets, which could cause malfunctions.

The filter mesh on the container door can be removed. Position it at the downwind vent on the exterior of the container and first blow it clean with compressed air. If there is excessive dust, use a compressed air gun to wash it. If the filter screen is damaged, it needs to be replaced. For spare parts, please consult Bitmain after-sales personnel.

The intake air filters for distribution cabinets and control cabinets also require regular cleaning. From the exterior of the intake vent, use a screwdriver or similar tool to press down on the bottom clips. After prying open the plastic frame, the dust filter can be removed. When cleaning the filter, position yourself downwind outside the container. First, blow it out with compressed air. If there is excessive dust, use a compressed air gun for cleaning. After cleaning, place it back in the original orientation. If the filter screen is damaged, it must be replaced. Replacement parts must meet flame-retardant requirements. For spare parts, please consult Bitmain after-sales personnel.

The cleaning frequency depends on the dust level in the ambient air. It can also be determined based on the temperature difference between the electrical cabinet and the ambient temperature (TT43/TT44/TT45-TT21). If this temperature difference exceeds 5°C compared to the initial operating temperature difference, the filter mesh must be cleaned or replaced. It is recommended that mines record this temperature difference from the start of operation and maintain regular logs to facilitate determining the cleaning frequency of the filter mesh.



Figure 9.9 Diagram of replacing the filter mesh

10 Safety Instructions

Danger

For extended periods of non-use, the container liquid cooling system's main power must be turned off. After a prolonged power outage, the system must be powered on following the standard startup procedures.

10.1 Maintenance

Only qualified and authorized personnel are permitted to perform maintenance and other operations on the electrical system.

10.2 Operation

Before starting the cooling system in the container, fire extinguishers should be equipped. It is recommended to uniformly place the fire extinguishers on the left side outside the door of the distribution cabinet and make obvious marks. ABC dry powder fire extinguishers or dry ice fire extinguishers are recommended, and the fire extinguishers should comply with local fire protection requirements.

Caution

Due to transportation and regulatory restrictions, the system is not shipped with a fire extinguisher. Prior to operation, please equip the system with a fire extinguisher that complies with local project regulations. The fire extinguisher bracket must be securely mounted on-site at the left side of the equipment entrance, as indicated by the label.

The equipment must have reliable grounding at more than two locations (There are four grounding points on the exterior of the container). The protective grounding resistance should be verified to ensure continuity and should be less than 0.3Ω ; otherwise, dangerous situations that may cause personal injury or death may occur.

Equipment can only be cleaned after shutdown and power-off; otherwise, electric shock or injury may occur. Do not clean the equipment with water, as this may cause electric shock.

Before starting the machine, be sure to check whether the valve (if available) is open.

Safety regulations for operation of the power distribution cabinet and main control cabinet:

Before operating the power distribution cabinets A/B and the main control cabinet, please ensure that the cabinet doors are locked to prevent personal injuries such as electric shock, and avoid salt spray, moisture, dust in the air, or other conductive substances from entering the interior of the power distribution cabinet and main control cabinet.

When powering on, please do not touch internal components of the cabinet such as circuit boards, cables, terminals, modules, or sensors to avoid safety accidents.

In case of malfunctions, unusual odors, or abnormal noises, turn off the five main breakers (MCB-A1, MCB-A2, MCB-B1, MCB-B2, QFWCU) of the three electrical cabinets, or press the emergency stop button on the container door; failure to do so may lead to electric shock or fire accidents.

When there is a risk of rapid freezing in the container system under abnormal operating environments, the cooling water inside the system must be drained as soon as possible using an air pump, with reference to the recommended models in Section 7.2.

10.3 Danger

1) Unqualified and non-professionally authorized personnel can not open the power distribution cabinet door.

2) The power distribution cabinet door can only be opened when the main breaker is in the OFF position.

Danger

When the main circuit breaker is in the OFF position, the terminals upstream of the breaker may still be energized. Unauthorized and unqualified personnel are strictly prohibited from removing the protective covers.

Please read this manual carefully before using the equipment. If you have any difficulties or questions, please seek help from the manufacturer's authorized personnel.

Appendix A: List of Maintenance Tools for the HW7 Liquid cooling container

Table A.1 List of Maintenance Tools for the HW7 Liquid cooling container

No.	Name	Description	Quantity	Function	Notes
1	Crane	$\geq 20t$	1	Lifting a Container	
2	Forklift	$\geq 5t$	1	Movement of large components, including coolant, etc.	
3	Ladder	$\geq 6m$	1	Inspection and maintenance at height	
4	Safety helmet		1	Personal Protection	The quantity depends on the number of people present
5	Safety harness for working at heights		1	Personal Protection	The quantity depends on the number of people present
6	Air Compressor/Nitrogen Cylinder	The air pressure must be capable of reaching 10 bar or higher	1	Pressure Maintenance	Connects to OD10 PU tubing

No.	Name	Description	Quantity	Function	Notes
7	PU tubing	30m	1	Pipe Connections	Related to the distance from the site
8	Self-priming pump	Suction lift of 5 m or more, flow rate of 4 m ³ /h, head of 20 m or more, equipped with barbed fittings and clamp connections	1	Media Filling	Connects to a hose line with an inner diameter of 25 mm
9	Supply line	Inner diameter: 25 mm; requires a 10-meter connection to the pump and the liquid supply/discharge line	1	Media Filling	
10	Multimeter	FLUKE	1	Voltage and resistance testing	
11	Clamp-on ammeter	FLUKE	1	Current check	
12	Insulation Resistance Tester		1	Resistance check before power-on	
13	Earth Resistance Tester		1	Grounding check before power-on	

No.	Name	Description	Quantity	Function	Notes
14	Wrench Set	Hex wrench M6/M8/M10/M 12/14/M16	1	Screw fastening	
15	Ratchet Wrench Tool Set	Ratchet Wrench Set M6/M8/M10/M 12/14/M16	1	Screw fastening	
16	Screwdriver Set	Flathead and Phillips screwdrivers Set of large and small screwdrivers	1	Screw fastening	
17	Allen Wrench Set		1	Screw fastening	
18	Electric wrench	A socket is required	1	Screw fastening	
19	Wire strippers		1	Stripping	
20	Scissors		1	Maintenance and Use	
21	Voltage tester		1	Check for power	
22	Router		1	For debugging purposes	
23	Ethernet cable	5m、10m、 15m	1	For debugging purposes	
24	Ethernet cable crimper		1	Connect the RJ45 connector	
25	Electrician's Insulated Gloves and Rubber Boots		1	Safety Protection	
26	Insulating tape		5	Wiring	

No.	Name	Description	Quantity	Function	Notes
27	Flashlight		2	Lighting	
28	Tape measure	0-10m	1	Measure the dimensions	
29	Pliers		1	Tools	
30	Needle-nose pliers		1	Tools	
31	Hoist	≥500kg	1	Repair	
32	Lubricating oil	SHC220	1	Pump lubrication and screw lubrication	
33	Sealant		1	External seal	
34	Hemp gloves		10	Safety Protection	
35	Dishcloth		5	Cleaning	
36	Broom		2	Cleaning	
37	Mop		2	Cleaning	
38	Rolling-type outlet	Cable length: 50 m	2	On-site electricity	
39	Bucket		2	On-site Leak Collection	
40	Tank	medium	2	Holding medium	
41	Teflon tape / Thread sealant		1	Threaded seal	
42	Stretch mark	14"	1	Pump Repair	
44	Snap Ring Pliers (Expansion Type)		1	Pump Repair	

Appendix B: Requirements for Internal Circulation Coolant

Table B.1 Recommended standards for antifreeze liquids

Item	Indicator		Recommended Inspection Reference Standards
Color	Distinctive color		Visual inspection
Appearance	No peculiar smell, no precipitation, no suspended matter		Visual inspection
pH Value	7-9		PH Meter
Reserve alkalinity	≥ 1.5 mL (Organic formula)		Titration Kit
Total Hardness	<120 mg/L		
Freezing Point	<Local minimum freezing point temperature		
Boiling Point	108°C (low-temperature type)		
Main Element Content	B	<20mg/kg	An ISO/IEC 17025-accredited international third-party testing laboratory (such as SGS, Intertek, ALS, etc.) / Returned to the supplier for testing
	Si	<20mg/kg	
	P	<20mg/kg	
	Mo	<20mg/kg	
	Ca	<20mg/kg	
	Al	<50mg/L	
	Fe	<50mg/L	
	Cu	<50mg/L	
	Cl ⁻	<50mg/L	
	SO ₄ ²⁻	<50mg/L	

Table B.2 Concentration - freezing point chart of ethylene glycol refrigerant

Ethylene Glycol Concentration		Freezing Point °C
Mass concentration %	Volume concentration %	
0	0.0	0.0
5	4.4	-1.4
10	8.9	-3.2
15	13.6	-5.4
20	18.1	-7.8
25	22.9	-10.7
30	27.7	-14.1
35	32.6	-17.9
40	37.5	-22.3
45	42.5	-27.5
50	47.6	-33.8
55	52.7	-41.1
60	57.8	-48.3

Table B.3 Recommended Standards for Corrosion-Inhibiting Coolants

Item	Parameter		Testing Frequency	Testing Method
Color	Optically transparent; slight yellowing is normal.		Test once every two months	Visual inspection
Appearance	No peculiar smell, no precipitation, no suspended matter			
pH Value	7-9			PH Meter
Reserve alkalinity	≥1mL (Organic formula)			Titration Kit
Freezing Point	<Local minimum freezing point temperature		Test every six months	An ISO/IEC 17025-accredited international third-party testing laboratory (such as SGS, Intertek, ALS, etc.) / Returned to the supplier for testing
Boiling Point	100°C (low-temperature type)			
Active ingredients in corrosion inhibitors	≥80%			
Bacterial community	<1000CFU/mL			
Turbidity	<20NTU			
Total hardness	<120mg/L			
Major Element Content	B	<20mg/kg		
	Si	<20mg/kg		
	P	<20mg/kg		
	Mo	<20mg/kg		

Item	Parameter		Testing Frequency	Testing Method
	Ca	<50mg/kg		
	Al	<5mg/L		
	Fe	<5mg/L		
	Cu	<5mg/L		
	Cl ⁻	<50mg/L		
	SO ₄ ²⁻	<50mg/L		

Table B.4 Recommended standards for deionized water

Indicators	Parameter
pH	7-9
Sulfides	$\leq 1\text{mg/L}$
Sulfates	$\leq 10\text{mg/L}$
Chlorides	$\leq 5\text{mg/L}$
Bacterial community	$\leq 100\text{CFUs/mL}$
Total hardness (As CaCO_3)	$\leq 20\text{ mg/L}$
Conductivity	$\leq 20\text{uS/cm}$ (reference value, not mandatory), trend change $\leq 25\%$
Residue on evaporation	$\leq 50\text{ mg/L}$
Turbidity	$\leq 5\text{NTU}$
Iron content	$\leq 0.1\text{mg/L}$
Copper content	$\leq 5\text{mg/L}$
Aluminum content	$\leq 1\text{mg/L}$