MBC VARIABLE CHILLER USER MANUAL

ABOUT THIS MANUAL

This manual provides comprehensive instructions for the correct installation of MBC Marine Variable Chilled Water Systems. It is crucial to follow these guidelines carefully, as improper installation can result in reduced system performance, premature equipment failure, and even serious injury or death. Be sure to read this manual thoroughly before starting any installation procedures.

Throughout this guide, you will encounter various symbols that indicate important information. Take a moment to familiarize yourself with these symbols and their meanings to ensure proper installation and safety.

SAFETY INFORMATION:

The manufacturer assumes no liability for any damage to the device in the following cases:

- Improper installation or connection of the system
- Damage caused by mechanical impact or overvoltage
- Unauthorized modifications made without the manufacturer's written consent
- Misuse or operation of the unit outside of standard guidelines

ELECTRICAL SHOCK WARNING:

Components of this unit are powered by 230 V AC during operation. Always disconnect the power supply at the main switchboard or power source before opening the unit box. Failure to do so could result in severe injury or death.
To minimize the risk of electrical shock, ensure the unit is properly grounded. This equipment meets relevant fire protection standards. Do not install the unit near gasoline engines, fuel tanks, LPG/CPG cylinders, or any other combustible materials.

SAFETY WARNING:

Do not install the air conditioning unit in any location where it could introduce carbon monoxide, exhaust gases, or other toxic substances into the vessel.

FIRE PROTECTION WARNING:

The installation and maintenance of this unit may be hazardous due to pressurized copper pipes and electrical components. Always follow safety precautions, including wearing protective goggles and work gloves. Keep a fire extinguisher nearby during installation and maintenance.

INTRODUCING THE MBC MARINE VARIABLE CHILLER SYSTEM

Thank you for choosing the **MBC Marine Variable Chiller System**, specifically designed to provide efficient cooling for multiple independent zones on your vessel. This advanced chilled water air conditioning system ensures optimal comfort and performance, featuring key components that work seamlessly together, including the chiller, air handlers, freshwater, and saltwater systems. Whether you're cooling or heating, the MBC Marine system offers superior climate control, tailored to meet the demanding needs of marine environments.

PRODUCT INTRODUCTION

To ensure a safe and successful installation, it is crucial to carefully read and follow the safety guidelines and instructions provided in this manual. If you have any questions or concerns, please reach out to MBC Marine Technical Service for assistance. Failure to comply with these warnings may result in system malfunction, serious injury, or even death.

MBC Marine is not responsible for damages in the following situations:

- Improper assembly or installation not in accordance with the manual.
- Damage due to mechanical impact or electrical overvoltage.
- Unauthorized modifications to the unit.
- Usage of the unit for purposes not specified in this manual.
- To ensure continuous improvement, MBC Marine reserves the right to modify system specifications and designs without prior notice.

KEY COMPONENTS

- **The Chiller** (HC): Contains the compressor, condenser, and evaporator or heat exchanger.
- **Air Handlers** (AH): Includes the blower and cooling coil.
- **Freshwater System**: Circulates freshwater from the chiller to each air handler and back.
- **Saltwater System**: Seawater passes through the condenser coil for heat exchange.

SYSTEM OPERATION

The system can be operated in two different modes.

Cooling Mode:

- The **blower** pulls warm, humid air from the cabin through the **air handler (AH)**.
- The air transfers heat to the freshwater circulating through the coil, cooling the air.
- The heated water is pumped back to the **chiller**, passing through the **evaporator**, where it transfers heat to the refrigerant.
- The refrigerant gas is compressed and passed through the **condenser coil**, transferring heat to seawater, which is expelled overboard.
- The chilled freshwater recirculates to the air handlers, continuing the cooling cycle.

Heating Mode:

- The process is reversed.
- The refrigerant flow is switched via a **reversing valve**, transferring heat from the freshwater system to the air handlers, providing heating.

GENERAL INSTALLATION GUIDELINES FOR CHILLER UNIT

Before starting the installation, carefully review these instructions and plan all necessary connections for the unit, including ducting, condensate drain line, seawater inlet and outlet hoses, electrical power supply, control panel placement, and seawater pump location. This planning will ensure easy access for installation and future maintenance of both the chilled water system and air handler units.

Working with this system involves potential hazards due to high-pressure components and electrical equipment. Always adhere to the safety guidelines outlined in the documentation, as well as the tags and labels on the equipment. Follow all safety regulations, wear safety goggles and work gloves, and keep a fire extinguisher nearby in the work area.

Unit Location:
The chiller unit is typically installed in the engine room. It must be placed on a stable, horizontal surface capable of supporting its weight when the boat is in motion. Ensure that the installation site is dry and allows for easy servicing. Maintain a clearance of 0.9 to 1.2 meters around the unit, with at least 0.9 meters of space above it.

Display Installation:
The digital control panel, should be installed on a dry, flat horizontal or vertical surface. Ensure easy access for installation and maintenance.

Electrical Connections:
Ensure proper grounding of the electrical connections, and always disconnect the power at the main switchboard before performing any maintenance work to avoid electric shock.

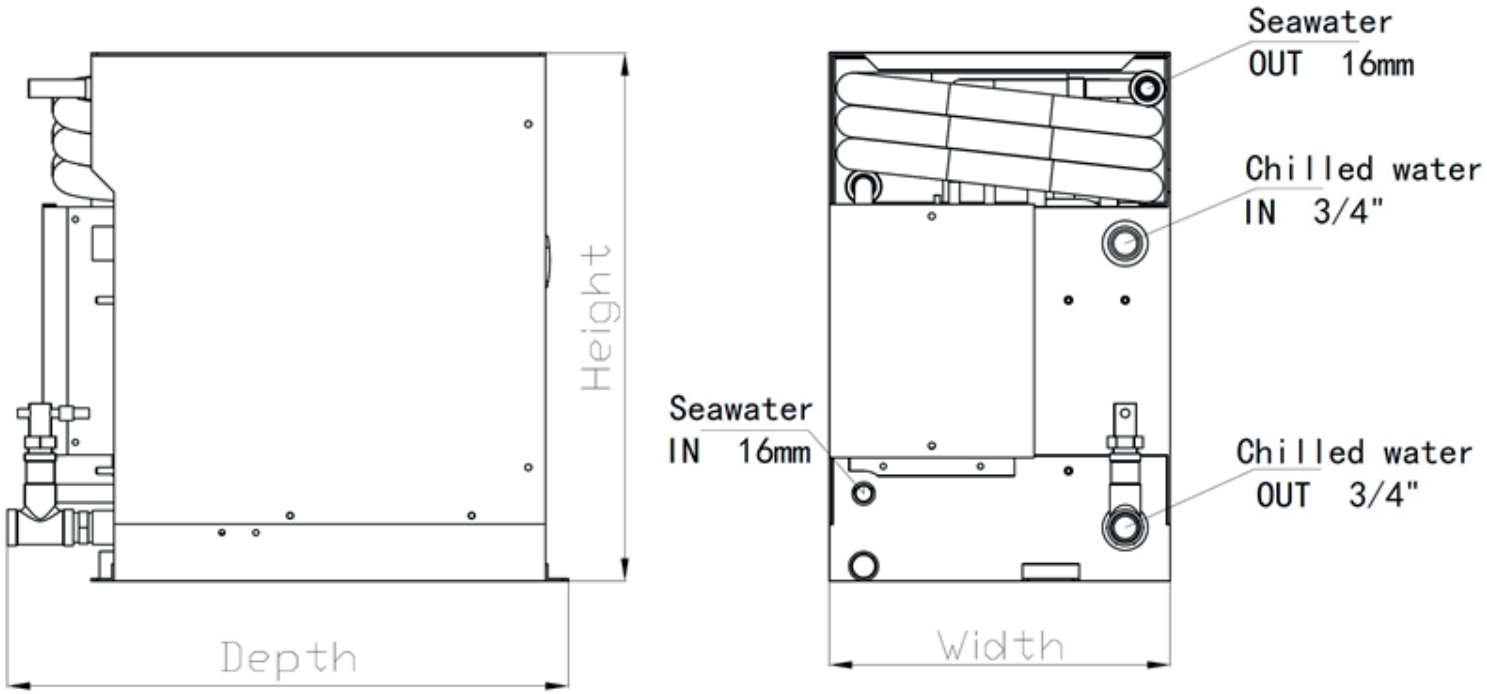
Condensate Drain:
Proper installation of the condensate drain connection is essential for the efficient operation of the system and to prevent water damage. Make sure the drain line is free of blockages and properly routed to avoid leaks.

Securing Piping:
All seawater and chilled water pipes should be securely fastened to prevent putting strain on the pump or other components. Avoid any loops or sharp bends in the pipes, as these can create air or water traps that may impede the system's performance.

Vibration Insulation:
It is recommended to use vibration-dampening materials to minimize noise and prevent vibrations from being transmitted to the boat's structure, which can reduce wear on the system and ensure smoother operation.

System Testing:
After installation, it is important to perform a pressure test on the system to ensure there are no leaks and that the system is operating within the proper parameters. This will help identify any issues before they become major problems.

Pressure Measuring Instrument
The pressure gauge on the MBC Variable Chiller unit is an essential tool for monitoring the system's operation. It allows for continuous tracking of the pressure within the chiller system and helps maintain the correct refrigerant levels.



CHILLED WATER SYSTEM

Guidelines and important notices

Critical Notice:
Failure to maintain proper glycol levels can cause system damage and will void the warranty on your MBC units.

Adding Ethylene glycol:
Glycol must be added to the water after the system has been bled and any leaks have been repaired. Any brand can be used, but you must follow the manufacturer's recommendations. We recommend a 20% concentration of non-toxic, inhibited propylene glycol.

Glycol Warnings:
Do not use automotive glycol as it often contains additives that are highly corrosive to copper components.

Maintaining Freeze Point:
Ensure that the freeze point is maintained below -7°C, and regularly check glycol levels, particularly after water is lost or added. A refractometer can be used to measure the glycol concentration. Check the levels at least once per year.

Piping Material Guidelines:
For systems with PVC piping, the glycol concentration should not exceed 30%. For CPVC piping, it should not exceed 25%, as higher concentrations can damage these materials.

Insulation of Fresh Water Pipes:
Ensure thorough insulation of all pipes in the system to prevent condensation, which is a common issue in chilled water systems. Condensation can go unnoticed until it causes water damage. Be sure to cover all exposed pipe ends, use tape when necessary, and ensure that the insulation is not damaged or pinched by supporting hardware.

Fresh Water System Installation:
The chiller unit is typically installed in the engine room.
Ensure the unit is mounted on a solid, horizontal surface capable of supporting its weight, especially when the boat is in motion. Choose a dry location that allows for easy servicing. Maintain at least 0.9 to 1.2 meters of clearance around the unit, with a minimum of 0.9 meters of vertical space above it for proper ventilation and accessibility.

Plumbing System:
The plumbing system is often the root cause of common issues in chilled water systems, so it is essential to give special attention to this section.

Automatic Fill and Bleeders:
If your plumbing system includes automatic bleeders, ensure an automatic fill system is also installed in the chilled water loop. Low water pressure can lead to pump cavitation, which shortens the pump's lifespan. The automatic fill valves should maintain the pump's inlet pressure between 0.7 and 1.0 bar and must include back flow prevention valves. Monitor the glycol concentration carefully when using an automatic fill system to avoid freezing and ensure smooth operation.

Pipe Installation:
Secure all piping using the correct fittings, and provide adequate support by attaching the piping to the boat's structure. Ensure that pipe insulation is not pinched by any supporting hardware, and verify that all connections and hose clamps are properly tightened and secure.

Service Valves:
Install service valves to facilitate future maintenance of the system. Only use full-flow ball valves. Unions or flanges may also be added, but it is important to leak-test them after installation.

Flow Rate:
The flow rate of the chilled water system is critical to the proper functioning of the chiller. Refer to the system's specifications to ensure the flow rate is within the required range.

For further questions or concerns regarding the installation or operation of your MBC Marine Variable Chiller System, please consult our Technical Service team.

INSTALLATION GUIDELINES FOR FRESH WATER SYSTEM

PREVENTING AIR AND WATER TRAPS

Typically, the circulating pump should be located at the lowest point in the water loop, followed by the chiller, and then the air handlers at the highest point. The ideal setup minimizes vertical direction changes, with air handlers containing built-in vents to bleed trapped air.

To avoid creating air or water traps, the piping should follow a consistent upward or downward slope. Any vertical reversal in the piping can create air or water traps, which may cause noise and hinder water flow. Additionally, such traps make it difficult to fill, bleed, or drain the system. To prevent air from getting trapped, vent valves (or "bleeders") should be installed wherever an air trap might form. For maximum effectiveness, the air handlers should be installed at the highest point in the system. If auto bleeders are used, they must be positioned above the air handlers. Water traps can prevent the complete draining of the system during maintenance or winterizing, so it's essential to install a drain at the lowest point of any water trap.

AIR BLEEDERS

It is essential to have a way to release trapped air from the system. All MBC air handlers and chillers are equipped with bleeder valves. In addition to these, a main bleeder should be installed at the highest point of the system and routed to a valve with a discharge in the engine room. This setup allows for easy filling and venting of the system simultaneously. Additionally, localized high points may require their own bleeder valves.

WATER FLOW DIRECTION

Pay close attention to the arrows on the unit indicating the direction of water flow. Reversing the flow can lead to various issues, such as malfunctioning of the flow switch. For most chillers, chilled water should enter via the upper copper connection and exit through the lower copper connection. In contrast, seawater enters at the lower port and exits through the upper port.

RETURN ABOVE SUPPLY

Always position the chilled water return lines (returning water to the chiller) above the supply lines (water flowing from the chiller). This arrangement allows air in the system to naturally rise and flow with the water.

CIRCULATION PUMP POSITION

The circulating pump should be installed as low as possible in the water loop. The chiller should be positioned above the pump, and the air handlers should be installed at the highest point.

IMPORTANT WARNING:
Do not operate the system without a water strainer! Running the system without a water strainer will cause the water pump to fail, which may lead to the complete failure of the system. Replace the plastic water strainer casing every 2 years. The water system must have the ability to be shut down in the event of a malfunction or for maintenance. Operating the system without a ball valve can be life-threatening.

STRAINER REQUIREMENTS

Strainers are essential in both the condenser/seawater circuit and the circulated water circuit. Failing to adhere to these guidelines will void the warranty.

The circulated water circuit should use a 20-mesh "Y-strainer", while the seawater circuit should utilize a 10-mesh strainer. While finer meshes may provide better filtration, they will require more frequent cleaning, which can become inconvenient. More open meshes must not be used, as they will not adequately protect system components.

Strainers must be serviceable and include an arrow indicating the correct direction of water flow. The arrow should follow the flow direction and may point horizontally or downwards, but never upwards. If installed horizontally, the basket should always be positioned below the pipe, never above.

The strainer must be installed upstream of the chiller to protect the heat exchanger from debris. Typically, the strainer is placed just before the pump, with the pump located upstream of the chiller. While it is acceptable to position the pump before the strainer, this is not recommended. There must be no air handlers between the strainer and the chillers.

Pressure gauges should be installed on both sides of the strainer to easily monitor when it requires cleaning. (Refer to the section on pressure gauges for further details.)

Ball valves should also be installed before and after the strainer, allowing for easy cleaning without excessive water loss.

CLEANLINESS

Strainers are not designed to catch fine particles, so it is crucial that the system is assembled using clean pipes and components. Failure to do so can result in dirt and debris accumulating in the evaporators, leading to system failure. **Frozen evaporators clogged with mud or debris are not covered under warranty**!

The key to preventing this is maintaining proper cleanliness. Thoroughly inspect pipes and components for cleanliness before installation. If any parts are dirty, clean them. Pipes that are stored should have their ends sealed to prevent dirt and debris from entering. Even a small amount of dirt, once spread throughout the system, can accumulate at the bottom of an evaporator and cause major problems.

While a mud separator can offer extra protection, it is unnecessary if the system is assembled with clean components and filled with clean water.

PIPE SIZE

The recommended pipe size should be based on the total water flow requirements to maintain stable pressure. Overly large pipes can be harmful and may lead to drastic changes in water velocity.

The pipe sizes recommended in Table 1 are designed to minimize pressure losses. However, the next larger pipe size should be considered if the capacity being served is near the upper limit of the range and any of the following conditions apply:

The pipe run includes numerous bends.

Exceptionally long distance.

There is potential for additional capacity in the future.

TABLE 1

Pipe Size (ID)	Capacity Range (BTU/hr x 1000)
3/4"	4 - 21
1"	24 - 45
1-1/4"	48 - 81
1-1/2"	84 - 129

It's important to note that significantly over-sizing pipes can also be detrimental. Sudden changes in water velocity can result in increased losses and noise within the system.

To determine the appropriate pipe size, add the total BTU rating of the air handlers served by the pipe. Chillers are typically sized to about 80% of the total air handler load, though smaller vessels may use a higher percentage, while larger vessels can often use a lower percentage.

The hose connecting to an air handler should match the hose barb provided with the unit. The ball valve for air handlers up to 24K BTU should be a 3/4" full port valve, while air handlers rated 30-36K BTU should use a 1" full port valve.

DROP WATER DRAIN

The unit produces condensate that collects in the drain pan. Choose the location of the air handler so that condensate drainage is always possible. The water collected in the drain pan must be routed through the drain discharge line to the boat's bilge, ideally near the automatic bilge pump.

If the air handler is installed in a location where direct drainage to the bilge is not possible, the water must be collected and pumped out. When installing a drain pump, ensure that the drain pump's outlet is not combined with the outlets of other systems.

INSULATION OF CIRCULATION SYSTEM

Pipe Insulation:
Insulate the straight sections of piping before conducting a leak test. Once the system passes the test, proceed to insulate the joints and fittings.

Insulation Material:
Use closed-cell insulation with a minimum thickness of 1.9 cm. In non-air-conditioned areas, thicker insulation may be required.

Supply and Return Pipes:
Both the supply and return water pipes should be insulated and clearly labeled to differentiate them.

Thorough Insulation:
Ensure all pipes are properly insulated. Condensation is a common issue in chilled water systems and can go unnoticed until water damage occurs. Cover all exposed ends, use tape for split-insulating, and ensure the insulation is not compressed or damaged by supporting hardware.

Use pump enclosures: Enclosing the pumps can further reduce the risk of condensation by providing an extra layer between the pump and the ambient air, which reduces the temperature differential.

FRESH WATER CIRCULATION

Pump Location, Pipe Length and Pressure Loss:
It is important to install the pump as close as possible to the chiller unit to minimize pipe length and reduce pressure loss. This ensures optimal water flow throughout the system.

Pump Size and Capacity: The pump should be sized based on the required flow rate and the pressure loss in the piping system to ensure efficient water circulation to all parts of the system.

Maintenance Access: The pump should be easily accessible for regular maintenance. Its location should allow for easy cleaning and inspection to keep the system in good working condition.

Vibration and Noise Reduction: Consider using flexible mounting solutions to reduce vibrations and noise from the pump during operation, enhancing overall comfort on the vessel.

Air Trap Prevention:
The pump discharge should be positioned vertically upward to prevent air from being trapped in the pump head, with a straight vertical pipe run leaving the pump.

Pipe Alignment:
Pipes connected to both the pump inlet and discharge should be straight for at least 30 cm to ensure a uniform water flow.

Vibration Isolation:
Use vibration isolation mounts to prevent vibrations from transferring to the boat's structure.

Service Valves:
Service valves should be installed at the pipe fittings connected to the pump to facilitate pump maintenance and removal.

Pressure Gauges:
A pressure gauge must be installed at the pump inlet, positioned for easy visibility when operating the fill valve. It is also recommended to install a pressure gauge at the pump discharge to assist in system filling and diagnosing flow restrictions.

Pressure Ports:
Install pressure ports immediately upstream and downstream of the circulating pump. These ports allow you to calculate the pump flow by comparing the pressure difference with the pump's performance curve.

Two-Pump System:
The two-pump system ensures efficient water circulation throughout the cooling system, significantly improving both performance and reliability.
One pump is responsible for circulating water to the air handler units, while the second pump manages water flow to the chiller units. A balancing pipe connects the two pumps, allowing them to function in harmony without the need for additional flow control devices.
In the event of a pump failure, a full-flow valve in the balancing pipe allows the remaining pump to supply the entire system, ensuring partial operation is maintained.
This configuration is particularly crucial for larger, multi-zone cooling systems, where optimal efficiency and reliability are key to effective operation.

Flow Control Valve:
Each MBC Air Handler is equipped with its own flow control valve. If the air handler's capacity exceeds 10% of the chiller's capacity, a bypass around the flow control valve may be necessary if the pump cannot force enough liquid through the chiller.

Chiller Capacity Adjustment:
If the chiller's capacity is more than 10% greater than the air handler's capacity, a bypass flow control may be required to balance the system and maintain proper liquid flow through the chiller.

Combined Heating and Cooling:
MBC fan coil units are equipped with an electric heating element, providing a combined heating and cooling solution. This is particularly useful in locations with varying temperature needs. These units consist of a fan-assisted heat exchanger and a built-in electric heater.

Expansion Tank:
The expansion tank should be connected to the inlet side of the circulating pump.
It is advisable to install a service valve at the expansion tank to facilitate future maintenance.
While the expansion tank can function in any position, it must not place stress on the pipe connection. Therefore, it is typically best to mount the tank vertically. Avoid installing the expansion tank (and its service valve) in a way that its weight creates leverage, putting strain on the pipe or its connection.

FILLING THE FRESHWATER CIRCUIT OF THE CHILLER SYSTEM

Proper filling of the freshwater circuit in the chiller system is essential for the system's efficient operation and long-term reliability. The following steps ensure that the system is properly filled, vented, and free from debris and air.

1. Use of Clean Water:
Always use clean, potable water to fill the freshwater circuit. Ideally, the water should be warm, as warm water dissolves less air, helping to reduce the risk of airlocks in the system.

2. Preparation and Inspection:
Before beginning the filling process, inspect the system to ensure all components are properly connected and there are no leaks. Check the main air vent, usually located at the highest point in the system.
If there is no main air vent, use the air vent on the highest air handler unit.

3. The Filling Process:
A. Initial Steps:
Open the main air vent, or if there isn't one, use the air vent on the highest air handler.
Open the fill valve and allow water to enter the system until water flows through the vent pipe without any air bubbles.
Close the air vent once the air has been released and only clean water is flowing.

B. Pressure Build-Up:
Allow the static pressure to build up until it reaches approximately **1.4 bar.**
Close the fill valve(s) once the pressure has reached this level.

C. Venting:
Begin venting the chiller and each air handler, starting from the lowest point and moving upwards.
If the pressure drops significantly during the venting process, more water will need to be added to maintain proper pressure.
After the initial venting is complete, open the fill valve again and refill the system to **1.4 bar**.

4. Pressure Test:
It is recommended to perform a **pressure test** after filling the system but before filling it with glycol to check for leaks.
During the pressure test, monitor the stability of the pressure. If the pressure drops, it may indicate a leak, which must be repaired immediately.

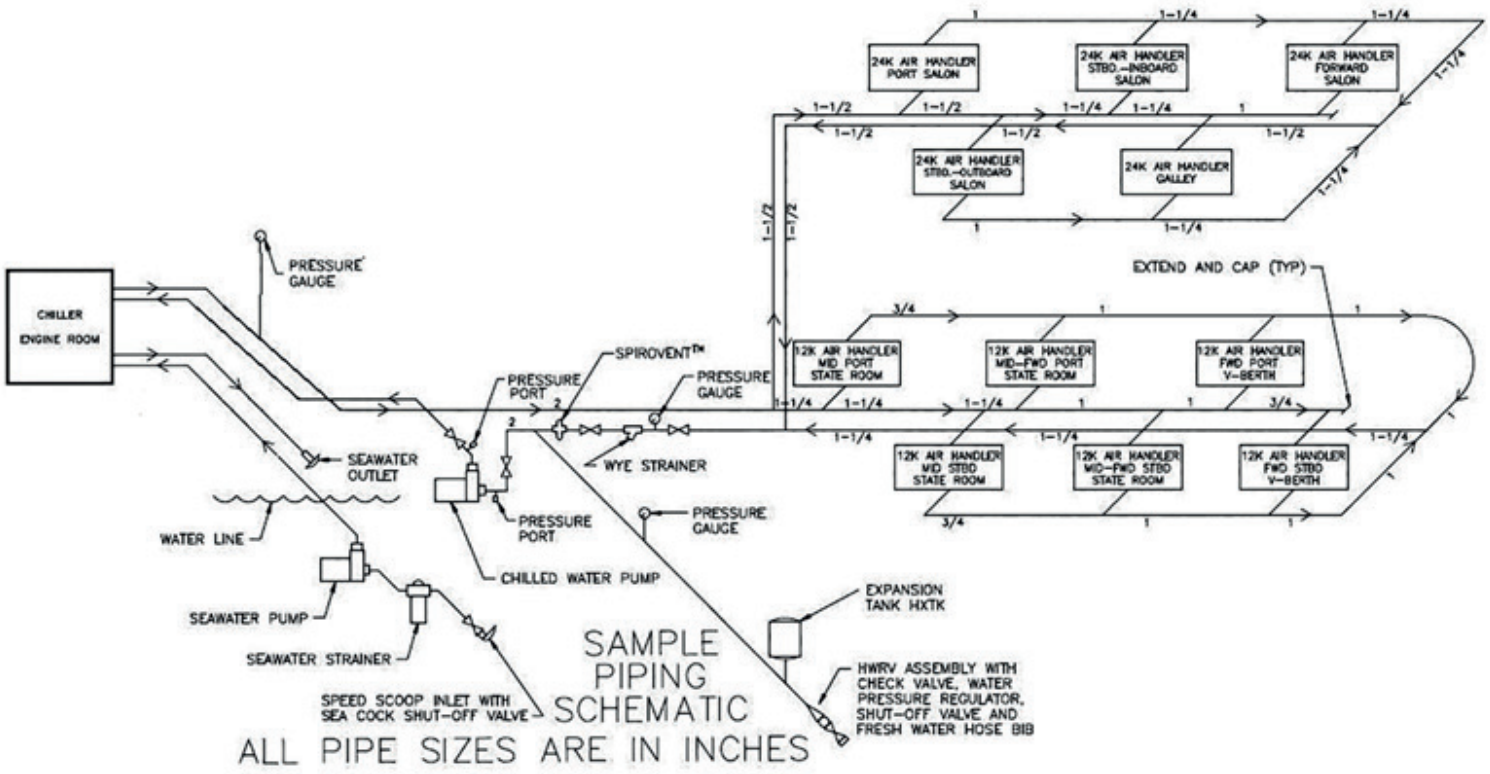
5. Second Venting:
After the system has been running for a while, turn it off and allow the water to settle.
Repeat the venting process, starting from the lowest point and moving upwards, to remove any remaining air from the system.

6. Temperature Setting and Testing:
Turn on the chiller system and adjust the cabin temperature controls. Ensure the circulation pump starts immediately, and the system reaches the desired temperature.

7. Cleaning the Strainer Basket:
During and after the filling process, regularly clean the **strainer basket** to remove any debris or particles that may have remained in the system after flushing.

8. Final Inspection:
After the system is operational, monitor the condition of the cooling water. The water should be clear and free of air bubbles, and there should be no air in the system, which could reduce efficiency.

Summary:
Filling and venting the freshwater circuit of the chiller system requires careful attention to ensure the complete removal of air and debris. A properly filled and vented system ensures efficient cooling system performance, prevents problems caused by airlocks, and helps to maintain long-term reliability.



INSTALLATION GUIDELINES FOR AIR HANDLER UNIT

MBC fan coil units feature an integrated electric heating element, providing a dual heating and cooling solution that is highly efficient in areas with fluctuating temperature demands. These units include a fan-powered heat exchanger along with a built-in electric heater, offering an additional boost in heating capacity when necessary.

Ducting and Airflow

For optimal system performance, the ducting must be installed as straight and smooth as possible. Avoid excessive bends or loops that could restrict airflow. Secure the ducting to prevent movement during operation, but take care to avoid compressing or pinching it, as this can reduce airflow.

Before installation (if necessary) set the fan in the direction which allows the most direct airflow through the air pipes. The air outlet direction of the unit's fan can be adjusted horizontally or vertically. Adjust the air outlet position by loosening the fixing screw and tightly fasten the fixing screw after positioning the outlet to the optimum position.

WARNING!

Systems are sensitive to air reductions, (e.g. from 150mm to 100mm) which result reduction of air flow efficiency.

During installation, avoid 90°-180° curves on the air duct because the bends are reduce the airflow by 25%)

WARNING!

The air outlet must not be directed towards the air intake as short circulating cycles can lead to a loss of performance!

MOUNTING THE AIR HANDLER AND THE ELECTRICAL BOX

Air Handler Placement:
The Air Handler Unit should be installed as low as possible (e.g., under a V-berth or at the bottom of a locker), while the supply air duct should be positioned as high as possible. This setup promotes optimal air circulation and helps prevent short cycling of the system.

Positioning the Air Handler:
Mount the unit directly behind the return air grill. If the air handler is placed near a bulkhead or other obstructions, ensure at least 76mm of clearance for proper air circulation.

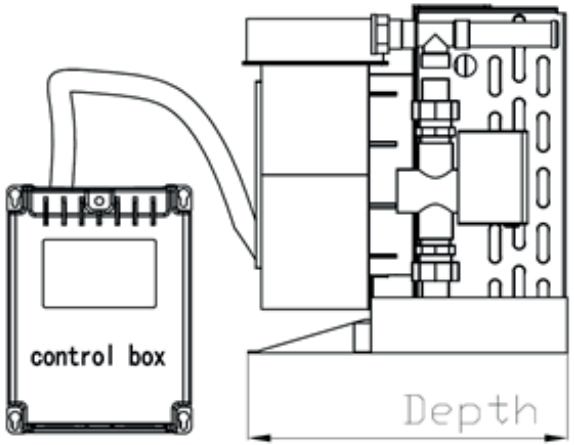
Electrical Box Installation:
The electrical box for the Air Handler, which contains the start capacitor for the blower fan, should be installed remotely on a bulkhead or a sturdy frame.

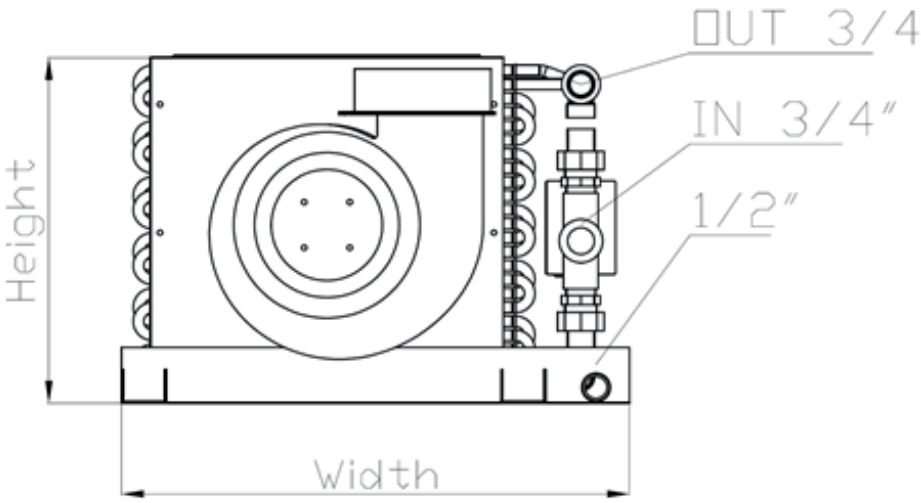
Vibration Reduction:
Use the included non-slip isolator tape to reduce vibrations caused by the operating unit. Securely apply the tape to the base of the air handler.

Mounting Brackets:
Four mounting brackets are provided and should be spaced evenly around the edge of the drain pan. Use these brackets to secure the air handler to a flat, level surface. The necessary hardware, such as screws, bolts, and washers, must be supplied by the customer.

Blower Adjustment:
If needed, loosen the lock screw on the blower to adjust its position for the most direct airflow. Once the blower is in the optimal position, securely tighten the screw.

Note that the air handling units are not electrically connected to the chiller or panel control.





UNIT PARAMETERS		CFPG08	CFPG10	CFPG12	CFPG16	CFPG24
Cooling capacity	BTU/hr	8000	10000	12000	16000	24000
Power source				230V/50Hz		
Operating Current	A	0,4 A	0,5 A	0,8 A	0,9 A	1,1 A
Input power	W	100 W	120 W	150 W	200 W	220 W
Sea Water Connection size		1/2"	1/2"	1/2"	1/2"	1"
Drain Water Connection size		DN15	DN15	DN15	DN20	DN20
Chilled Water Flow	L/min	6,5 L/min	9,5 L/min	11,5 L/min	16,5 L/min	23,5 L/min
Chilled Water Connection Size		3/4"	3/4"	1"	1"	1"
Dimension of Unit	Width	380	440	440	500	560
	Height	261	310	310	355	430
	Depth	277	318	318	346	373
Net Weight (kg)		8,5 kg	10,5 kg	11,6 kg	15,5 kg	21 kg

SEAWATER SYSTEM INSTALLATION INSTRUCTIONS

Water Intake Placement:
Install the water intake fitting as deep and as close to the keel as possible to ensure proper water flow. Ensure the water intake fitting is easily accessible. Use the correct drill size when drilling the hull to avoid damaging the material.

Through-Hull Fitting Installation:
A separate inlet fitting and seacock must always be used for the air conditioning seawater pump. Careful consideration must be given to the location of the inlet fitting. The dedicated through-hull for the air conditioning system should be positioned within 15 cm of the keel and ahead of the engine intake fitting.
Do not attempt to pull seawater from the engine or generator intake.
For most installations, especially on faster vessels, a scoop-type inlet is recommended. This fitting should face forward and be located near the keel or centerline to ensure it remains submerged while the air conditioner is running. Be mindful of how the boat's motion can affect the fitting's position relative to the waterline.
In sailboats, special attention is needed due to the steep heel angles they may experience, which can cause the through-hull fitting to rise above the water, resulting in an air lock in the pump. Seal the water inlet with a **marine-grade sealant** suitable for underwater use, and always follow the manufacturer's instructions for the sealant.

Ball Valve Installation:
Install a ball valve to the water inlet fitting and secure the bronze hose connector to the valve. The use of a ball valve in the seawater system is mandatory for safely shutting off the water flow when necessary.
Failure to install a ball valve can be life-threatening and poses significant safety risks.

Water Strainer Positioning:
Place the water strainer in a location that allows easy access for cleaning. Ensure that the flow direction aligns with the markings on the water strainer.

Connecting the Water Pipes:
Connect the water pipe from the water intake fitting to the water strainer.
Next, connect a pipe from the water strainer to the pump, and from the pump to the lower condenser input (marked with an arrow) on the marine A/C unit.
Finally, connect the water pipe from the condenser outlet to the water outlet fitting.

Electrical Wiring:
The only wires to be connected to the pump are the power wires from the output of the pump relay or control panel. Pay close attention to the wiring schematic label located on the side of the pump motor.
Determine the correct supply voltage, and connect the pump accordingly. Incorrect wiring can result in motor damage.
Ensure that the pump is rotating in the proper direction, typically indicated by an arrow on the pump head. All field wiring should be performed by qualified personnel, and the correct wire size and proper terminals must always be used.

Sea water Pump Relay
By using a Pump Relay Box, you can efficiently manage multiple air conditioning units.
This Relay Box guarantees that the pump only operates when any of the connected air conditioning units are running.

Make sure the selected pump is capable of handling the combined seawater flow requirements of all air conditioning units. Refer to the system specifications for the flow rate requirements of each unit.

Sacrificial Anode:
It is recommended to install a **sacrificial anode** (zinc or aluminum) upstream of the seawater pump to protect the system, particularly the condenser, from corrosion. **MBC Marine assumes no liability** for any damage caused by electrolysis or corrosion if no sacrificial anode is installed in the system.

Pump Installation:
The seawater pump should be installed **below the waterline** and positioned close to the chiller unit. The centrifugal pump is not self-priming, so it requires a **free flow of water**. Air in the seawater system can lead to air locking, particularly in sailboats when heeling, so special measures may be needed to prevent this.
The pump head must always discharge **upward**, with a straight vertical pipe leaving the pump. This setup helps prevent air from becoming trapped in the pump head, a common issue that can disrupt water flow and damage the pump.
Ensure the pump is securely bolted to a **horizontal surface**, with the discharge connection positioned as the highest point. Use **resilient mounts** to minimize vibrations being transferred to the boat's structure. The pump should be easily accessible for maintenance, in a location where it won't be stepped on or struck by moving machinery.
The pipe leading to the pump's inlet should be **straight for at least 30 cm**, ensuring a uniform flow of water into the pump. Do not install check valves in the seawater system, as this can cause air locking if any air enters the system. **Running the pump dry** will lead to partial or complete failure.

Bends and Loops on Pipe System:
During water pipe installation, avoid sharp bends, loops, and 90° angles, which can restrict water flow and create pressure losses. Where changes in direction are necessary, use smooth curves or **45° fittings** to minimize disruption to the water flow.

Thread Sealing:
Use **thread sealing cord** (e.g., Loctite 55) or an approved **pipe thread sealant** for all metal-threaded connections to ensure a watertight seal and prevent corrosion in the threaded joints. Avoid using Teflon tape, as it may not provide the same level of sealing for metal threads in marine environments.

Grounding Metal Parts:
Connect a **grounding wire** to all metal parts that come into contact with seawater, including the seawater inlet, pump, and air conditioning unit. This is essential to prevent electrolysis and corrosion caused by stray electrical currents. The grounding wire should be connected to the boat's **common grounding system** to ensure protection.

Leak Check:
Once the installation is complete and the boat is placed in the water, carefully inspect all fittings, connectors, and seals for any signs of leakage. Pay special attention to the areas around the pump, water inlet, and air conditioning unit, as leaks in these areas can lead to significant water damage over time.

Grounding Reminder:
Note: All metal components that come into contact with seawater **must be connected** to the boat's grounding system. These components include:

- The water inlet fitting
- The pump (via the ground wiring harness)
- The air conditioning unit

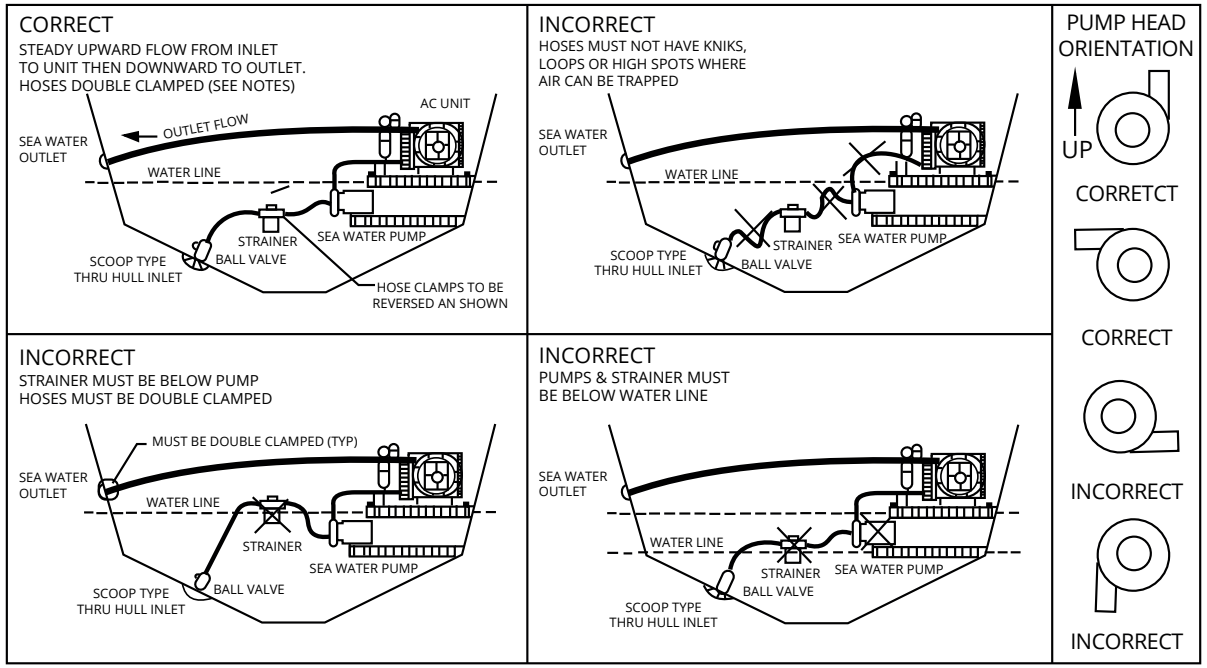
Proper grounding will help prevent damage caused by electrolysis and prolong the life of the components.

Final Check:
Before starting the unit, carefully inspect the entire water system for leaks. Ensure all connections are tight and secure, and that no water is seeping from any joints. Conduct a pressure test if possible to ensure the system can handle the expected water pressure without leaking.

Extreme seawater temperatures can impact Marine A/C performance.

In **cooling mode**, optimal efficiency is achieved when seawater temperatures are below **27°C**. As the water temperature rises above this point, the system's cooling capacity gradually decreases. However, it will still provide cooling at seawater temperatures up to **40°C**, though with significantly reduced efficiency.

In **heating mode**, the opposite occurs. As seawater temperatures drop below **13°C**, the heating capacity diminishes. Nonetheless, the unit can continue to produce heat at seawater temperatures as low as **7°C**, albeit with reduced efficiency.
Note: The system must not be operated at seawater temperatures below 7°C.



Follow the guidelines below to properly install the water system of the marine air conditioner unit.See pictures below:

BEFORE THE FIRST START

As a condition of the warranty, the installer is required to provide clean circulating water in the system. If this is not done, dirt can accumulate in the evaporators, causing them to freeze and rupture. Additionally, dirt can clog the air handler valves and other components, which may damage these elements.

Therefore, it is crucial that the system operates with clean water to avoid malfunctions and damage to the system.

Highly recommend to make a leak test the fresh water plumbing throughout the installation of the system, as well as after the installation is complete. This is especially important when joints will be concealed and therefore very difficult to get to in case of a leak.

A simple procedure of pressurizing the pipes with air will indicate whether that section of plumbing is sound. The piping system should be able to hold 5 bar over a 12 hour period (minimum).

It is very important to use **clean components** during assembly. However, the assembly process itself can introduce debris into the system, such as remnants of thread-sealing tape or pipe sealant. Therefore, it is recommended to thoroughly **flush the system** before the initial filling.

Do not operate or allow water to enter the chiller or air handlers until the circulated water system has been thoroughly flushed. The best method to ensure clean, debris-free circulation is to flush the entire internal chiller system with clean water before the first glycol fill. Observe the water during the draining process by collecting a small amount in a bucket for inspection.

It is recommended to perform a **pressure test** after flushing and before filling with glycol to ensure the system is leak-free. During the process, clean the strainer basket until no debris remains.

Before use, the cooling water must be **clear and free of air bubbles**.

MAINTENANCE

To ensure optimal performance and longevity of the cooling system, it is recommended to create an air conditioning system maintenance log. This log will help you track all activities starting from the system's initial start-up. Make sure that all maintenance operations are recorded in detail.

DAILY

Seawater Filter

- Check the seawater filter daily.
- Inspect the filter for debris and remove any accumulated materials, such as seaweed, shells, or other obstructions.
- Important: Never run the seawater pump while the filter is removed, even for a short time. If debris such as shells or other obstructions are picked up by the pump, they can become lodged in the condenser, potentially causing system failure.

MONTHLY

Air Filters

- Dirty filters reduce airflow and system performance. Check the dust filter or the filter behind the return air grille, or at the front of the air handler, at least once a month. Replace or clean the filter if necessary.

Run the System

- It is recommended to operate the cooling systems regularly. Refrigerators and air conditioners on ships that are not in use should be turned on for 30-60 minutes once a month.
- Additionally, the systems should be switched to reverse mode (from cooling to heating or from heating to cooling). This helps preserve pump seals and internal mechanical components, while also reducing marine growth fouling in the seawater circuit.

THREE MONTHS

Fresh Water System Pressure

- Check the pressure at the pump inlet while the water is cold, the air handlers are off, and the circulation pump is running. If the system pressure drops below the normal level, additional water must be added.
- When opening the air handler vent, water or air should be expelled.
- Be cautious not to overfill the system, as this can prevent the expansion tank from functioning properly.
- If the system pressure frequently drops, it is likely that a leak needs to be identified and repaired.

Condensation Drainage

Check that the condensate drains from the air handler and refrigerator are not blocked by pouring a few liters of water into the air handler unit pan. If the water does not drain completely within 30 seconds, ensure that the drain holes are not obstructed.
Note that the system has two drains, one at each end of the unit.

Electrical Connections

Electrical connections should be inspected and tightened as necessary. Heat and vibration can cause connectors to loosen, leading to poor contact, voltage drops, or arcing, which can result in component malfunction, loosening, or premature failure. When servicing electrical components:

- Disconnect power before repairing or replacing parts or wiring.
- Tighten any loose connections at the terminal strip and components.
- Inspect connectors for burn marks, frayed wires, or other damage. If issues are found, the connector or connection should be repaired or replaced.
- To ensure adequate power supply, regularly measure the voltage of the equipment.

SEAWATER CONNECTIONS

Verify that all seawater connections are tight, and check for water flow from the overboard discharge.

YEARLY

REFRIGERANT

The MBC Marine variable chiller unit is pre-charged with refrigerant gas at the factory and is adequate for the life of the system. Routine "seasonal" charging of the system is not necessary. If the refrigerant charge is low, there is a leak which should be fixed before resuming operation.

Proper winterization of the chiller units is essential to protect the system from freezing and ensure a long service life. Follow the steps below to correctly winterize the system before cold weather arrives:

Drain the Fresh Water System:

- Open all valves, including the lowest drain points, to completely drain the fresh water from the system. Pay particular attention to areas where water might collect. Winterization of the fresh water system is only necessary if the system is not filled with glycol (a common antifreeze solution).

Drain the Seawater System:

- Open the valve lock and any drain connections in the seawater circuit. Ensure that all water is drained from the seawater pump, heat exchanger, and piping.

Flushing the System:

- Fresh Water Circuit: After draining, flush the fresh water circuit with clean water to remove any residual dirt or contaminants.
- Seawater Circuit: Similarly, flush the seawater circuit with clean water to remove salt, dirt, and debris that could cause corrosion or blockages.

Dosage of Antifreeze:

- Choose the Right Antifreeze: Use a non-toxic, propylene glycol-based antifreeze that is safe for marine environments. The antifreeze must be suitable for the lowest expected winter temperatures.

Protection of the Seawater Side:

- Application of Antifreeze: If the chiller system operates in an area where seawater may freeze, consider introducing antifreeze into the seawater side as well, especially if there is a risk of freezing.
- Seawater System: Alternatively, you can completely drain the seawater circuit and ensure there is no water left in the pump, heat exchanger, or pipes. Keep the valve closed to prevent water from flowing back into the system.

Inspection of Insulation:

- Check Insulation: Ensure that all piping, especially parts exposed to cold air, are properly insulated to prevent freezing. Repair or replace any damaged insulation.
- Pump Covers: If pumps are exposed to cold temperatures, consider covering them or adding additional insulation to prevent freezing.

Final Check of the System:

- Depressurization: Make sure the system is completely depressurized before closing and winterizing the chiller. Ensure all valves are closed and there is no water remaining in low points of the system.
- Visual Inspection: Conduct a final inspection of all system components, including the chiller, pumps, and piping, to ensure no water remains in areas where it could freeze.

PUMPS

Remove oil, dust, dirt, water, and chemicals from the exterior of the motor and pump. Ensure that the air inlet and outlet openings of the motor are unobstructed. Blow out the interior of open motors using clean, low-pressure compressed air. Inspect the pump housing and impeller cover for excessive wear. Worn or damaged impellers reduce water flow and should be replaced. Excessively worn or corroded housings can cause leaks. Any signs of corrosion should be treated immediately.

AIR HANDLING VALVES

The air handling motor water valves should be inspected for corrosion that could impede the gear mechanism.

- All bleeder valves should be checked regularly and replaced if necessary.
- With the air handler turned off, open the water valve and remove the motor housing. Inspect the gears and clean off any deposits from the motor gear and/or valve gear.
- Thoroughly dry all parts and coat them with silicone spray or an equivalent product.
- Before reassembling, manually test the actuator by using the lever on top of the valve.

SENSORS

All control probes and sensors should be checked to ensure they are in the correct position and properly secured. Improperly positioned or loose probes can lead to inaccurate readings and system failures.

- Check all temperature probes and sensors on the chilled water unit.
- Probes inserted into the circulating circuit must be fully inserted into the well, filled with thermal paste for efficient heat transfer, and the end should be insulated to hold the probe in place and prevent condensation.
- Externally attached probes on coils, tubes, etc., should be securely fastened with hot glue between the contact surfaces, and insulated if necessary, for accurate readings.
- Inspect the location of all sensors on the air handlers. Water sensors should be securely fixed and insulated on the water inlet of the air handler. If you are not using the built-in air sensor on the controller display panel, remote air sensors in the return air stream should be placed as close to the cabin area as possible, avoiding contact with hot or cold surfaces.
- All sensors must be securely attached.

CLEAN SEA WATER CIRCULATION

Condenser coils and seawater lines located below the waterline can become fouled over time due to marine growth and deposits within the coils. This obstructs water flow and prevents proper heat transfer, causing the compressor to operate continuously at high pressure, temperature, and current. Condenser coils and seawater hoses can be flushed and cleaned by connecting a closed-loop system and circulating a descaling solution.

TROUBLESHOOTING

The PCB controller will display if there is any error during the system operation. Please follow the troubleshooting guidelines below. The troubleshooting and error codes are grouped into four categories: unit-resumed protection, system-resumed protection, serious unit fault, and serious system fault.

Code	Meaning	Description	Solution
E1:01	Freshwater Return Water Temperature Sensor Malfunction	The freshwater return line temperature sensor is malfunctioning, preventing the system from receiving accurate data on the return water temperature.	Check the sensor and cables for physical damage. If the sensor is faulty, replace it.
E1:02	Freshwater Forward Temperature Sensor Malfunction	The freshwater forward line temperature sensor is malfunctioning, which may cause issues with system control.	Check the sensor and associated connections. If the sensor is not providing accurate data, replace it.
E1:03	Seawater Return Temperature Sensor Malfunction	The seawater return temperature sensor is malfunctioning, which may affect the operation of the entire cooling system.	Inspect the sensor and wiring. Replace the sensor if necessary.
E1:04	Seawater Forward Temperature Sensor Malfunction	A failure in the seawater forward temperature sensor is causing the error, which may disrupt the proper operation of the seawater cooling cycle.	Check the sensor for physical damage. Inspect cables and connectors. Replace the sensor if necessary.
E1:05	Compressor Forward Temperature Sensor Malfunction	The compressor forward-side temperature sensor is malfunctioning, which may lead to overheating or other compressor-related issues.	Inspect the sensor and cables. Replace the sensor if it is faulty. Check the compressor's cooling system and ensure proper refrigerant flow.
E1:06	Compressor Return Air Temperature Sensor Malfunction	The compressor return air temperature sensor is malfunctioning, which may hinder efficient operation of the system.	Check the sensor and connections. If the sensor is faulty, replace it. Ensure proper ventilation of the compressor.
E1:07	Low Pressure Sensor Malfunction	The low-pressure sensor is malfunctioning, affecting the regulation of refrigerant pressure.	Check the sensor and wiring. Replace the sensor if necessary. Check refrigerant levels and system pressure by reading the pressure gauge.
E1:08	Insufficient Freshwater/Glycol Flow	The flow of freshwater/glycol in the system is insufficient, which may cause overheating or other issues.	Check the water pump and filters. Ensure there are no blockages in the system. Inspect the water pipes and water level. Check for bubble-free water flow in the system. Check the water level in the system
E1:11	High Voltage Alarm	The system has detected overvoltage, which may damage electronic components.	Check the input voltage. Ensure the system is properly grounded. Use surge protection if necessary.
E1:13	Protection Against High Freshwater Outlet Temperature	The freshwater outlet temperature is too high, which may lead to overheating.	Check the temperature sensor and water flow. Inspect the system's cooling performance. Replace the sensor or repair the water pump if needed. In heating mode, the system will restart automatically

Code	Meaning	Description	Solution
E1:14	Protection Against Low Freshwater Outlet Temperature	The freshwater outlet temperature is too low, which may lead to freezing or other system issues.	Check the temperature sensor. Ensure the water in the system has not frozen (due to an improper glycol mix). Increase the refrigerant flow if necessary.
E1:15	Protection of Freshwater Inlet and Outlet Temperature Difference	The temperature difference between the freshwater inlet and outlet has exceeded a safe threshold, indicating inefficiency in the cooling system.	Insufficient water flow due to clogged filters or pump malfunction. Faulty heat exchanger preventing efficient heat transfer. Leaks or air bubbles in the system reducing flow. **Solution:** Check and clean the water filters and pump. Inspect the heat exchanger for proper function. Bleed the system to remove air bubbles.
E1:17	Protection Against High Compressor Forward Temperature	Excessive rise in the compressor forward temperature indicates a system malfunction, overload, or condensation issues.	Insufficient refrigerant. Faulty evaporator or condenser. Overloaded compressor. Inadequate ventilation around the compressor. **Solution:** Check refrigerant levels and refill if necessary. Inspect and clean or repair the evaporator and condenser. Reduce the compressor load if needed. Ensure proper ventilation for the compressor and check fans

Code	Meaning	Description	Solution
E1:18	Compressor Controller Communication Failure	Communication between the compressor controller and the central control system has failed, hindering proper control and monitoring.	Damaged or loose communication cables. Faulty compressor control unit. System software or firmware issues. Power failure to the control unit. **Solution:** Check communication cables and connections. Inspect the compressor control unit and replace it if needed. Perform a system restart or software update. Check the power supply to the control unit.
E1:33	IPM Overcurrent Protection	The IPM (Intelligent Power Module) has detected overcurrent, indicating excessive current draw by the compressor.	Compressor motor overload. Short circuit in the wiring. Faulty IPM module. Mechanical blockage in the compressor. **Solution:** Check the compressor's current draw and inspect the wiring for shorts or damage. Ensure there are no mechanical obstructions. Replace the IPM module if necessary.

Code	Meaning	Description	Solution
E1:34	Compressor Drive Failure	The compressor drive has failed, likely due to a motor fault or control issue.	Faulty compressor motor. Defective drive electronics. Control circuit malfunction. Wiring issues or poor connections. **Solution:** Check the compressor drive system, motor, and control circuit. Replace faulty components if needed.
E1:35	Compressor Phase Electric Current Fault	The compressor phase current is too high or unstable.	Imbalanced phase currents. Phase loss or voltage fluctuations. Wiring issues or internal motor fault. **Solution:** Check the phase currents and wiring. Ensure connections are secure and stable. Inspect the compressor motor for defects.
E1:36	Input Voltage Phase Loss	One phase of the input voltage is lost.	External power grid issues. Faulty input transformer or wiring. **Solution:** Check the power supply and ensure all phases are connected.
E1:37	Phase Current Sampling Fault	The phase current sampling is faulty.	Defective current sensors. Wiring or control unit issues. **Solution:** Check and replace faulty sensors or control units.
E1:38	Abnormal Communication with Upper Computer	Faulty communication with the upper-level control system.	Communication protocol or cable issues. **Solution:** Inspect and replace faulty communication components.

Code	Meaning	Description	Solution
E1:39	EE Fault (EEPROM Memory Fault)	EEPROM memory fault where system parameters are stored.	Corrupted or malfunctioning EEPROM. **Solution:** Reprogram or replace the EEPROM.
E1:40	DC Bus Overvoltage/ Undervoltage	The DC bus voltage is too high or too low.	Faulty power supply or voltage regulation. **Solution:** Check the power supply and regulation systems.
E1:41	AC Input Overvoltage/ Undervoltage	The AC input voltage is outside normal operating limits.	External power grid fluctuations or surges. **Solution:** Check the AC power supply and correct any grid issues.
E1:42	AC Input Overcurrent	Overcurrent detected on the AC input.	Short circuits or system overload. **Solution:** Inspect and replace malfunctioning components.
E1:43	Input Voltage Sampling Fault	Faulty input voltage sampling.	Defective voltage sensors or control circuits. **Solution:** Replace faulty sensors.
E1:44	Radiator Temperature Sensor Malfunction	The radiator temperature sensor is malfunctioning.	Sensor degradation or loose wiring. **Solution:** Inspect and replace faulty components.
E1:45	Overvoltage (Ov) Sensor Malfunction	The overvoltage sensor is malfunctioning.	Sensor failure or damaged wiring. **Solution:** Replace the overvoltage sensor.
E1:46	OHB (Overheat Block) Sensor Malfunction	The OHB sensor is malfunctioning.	Improper installation or wiring damage. **Solution:** Replace the OHB sensor.

Code	Meaning	Description	Solution
E1:48	Input Current Sampling Fault	Faulty input current sampling.	Defective current sensors or wiring. **Solution:** Replace faulty sensors or control components.
E1:49	Compressor Overcurrent Alarm	Overcurrent detected in the compressor.	Compressor motor overload or mechanical issues. **Solution:** Inspect and reduce the load on the compressor.
E1:50	Compressor Weak Magnetic Protection Alarm	The compressor's magnetic protection is activated, usually indicating overload.	Overload or magnetic coil issues. **Solution:** Reduce load or replace faulty components.
E1:51	IPM Overheat Alarm	The IPM module is overheating.	Insufficient cooling or high ambient temperature. **Solution:** Improve the cooling system and ventilation.
E1:52	AC Input Undervoltage Alarm	The AC input voltage is too low.	Power grid issues or poor wiring. **Solution:** Check and stabilize the power supply.
E1:53	AC Input Overcurrent Alarm	Overcurrent detected on the AC input.	Short circuits or overload. **Solution:** Replace faulty components and ensure proper load distribution.
E1:54	EEPROM Fault Alarm	The EEPROM memory has failed.	Corruption or hardware failure. **Solution:** Reprogram or replace the EEPROM.
E1:57	IPM Overheating Shutdown	The IPM module has overheated, causing a system shutdown.	Insufficient cooling or overload. **Solution:** Improve cooling or replace defective components.

WIRING DIAGRAM AND INSTALLATION SCHEME