Installation, Operation, and Maintenance

# Thermafit™ Modular Water-Source Multipipe

Model MWS


**⚠ SAFETY WARNING**

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

June 2024

**ARTC-SVX011A-EN**

TRANE TECHNOLOGIES

# Introduction

Read this manual thoroughly before operating or servicing this unit.

## Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

| | |
|---|---|
| ⚠ WARNING | Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. |
| ⚠ CAUTION | Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices. |
| ***NOTICE*** | Indicates a situation that could result in equipment or property-damage only accidents. |

### Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants.

### Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

**⚠ WARNING**

**Proper Field Wiring and Grounding Required!**

**Failure to follow code could result in death or serious injury.**

**All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.**

**⚠ WARNING**

**Personal Protective Equipment (PPE) Required!**

**Failure to wear proper PPE for the job being undertaken could result in death or serious injury.**

**Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:**

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/ sleeves, butyl gloves, safety glasses, hard hat/ bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

**⚠ WARNING**

**Follow EHS Policies!**

**Failure to follow instructions below could result in death or serious injury.**

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

**⚠ WARNING**

**R-454B Flammable A2L Refrigerant!**

**Failure to use proper equipment or components as described below could result in equipment failure, and possibly fire, which could result in death, serious injury, or equipment damage.**

**The equipment described in this manual uses R-454B refrigerant which is flammable (A2L). Use ONLY R-454B rated service equipment and components. For specific handling concerns with R-454B, contact your local representative.**

**⚠ WARNING**

**Electrical Shock Hazard!**

**Failure to follow instructions below could result in death or serious injury.**

**Properly connect the system's oversized protective earthing (grounding) terminal(s).**

## Copyright



## Trademarks

All trademarks referenced in this document are the trademarks of their respective owners.

## Product Safety Information

This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.

Maximum altitude of use 3000 meters.

This appliance incorporates an earth connection for functional purposes only.

# Table of Contents

# Model Number and Coding

When contacting Trane for technical support, customer service, or parts information, be prepared to provide the model number and serial number of the modules in question. This information is located on the plastic nameplate that is affixed to each module.

## Multipipe Model and Serial Numbers

For future reference, record the model number and serial number for each module in the table below. Refer to the Trane nameplate on each module in the installed unit for the serial number and model number.

**Table 1. Multipipe reference data**

| Module | Model Number | Serial Number |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | | |

## Model Coding Key

Model numbers assigned to Trane systems provide a wealth of information about the features for a multipipe's as-built configuration.

# Multipipe Description

## Multipipe Capacities

Multipipe model is available in 30-, 40-, 50-, and 60-ton capacity modules. A minimum of 3 and up to 10 modules may connect together in a standard primary/secondary control arrangement. System consists of a primary module that contains the primary microprocessor controller, power distribution panel, and secondary modules. It is important to connect modules in the correct sequence as detailed in Handling of the Modules section of the Installation Mechanical chapter.

**⚠ WARNING**

**Hazardous Voltage!**

**Failure to disconnect power before servicing could result in death or serious injury.**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.**

The MWS multipipe uses a single refrigeration circuit in each module using fixed speed tandem scroll compressor set. The brazed-plate evaporator is typically made of SAE Grade 316 stainless steel and 99.9% copper brazing materials. Standard interconnecting headers are composed of carbon steel.

Water quality must be monitored and maintained by a water treatment professional familiar with the materials of construction and operation of the equipment. As required under Federal regulations, installation, initial start-up, and technical servicing should only be performed by fully qualified personnel.

## Component Description

### Tandem Compressors

For water-source multipipe units, the tandem scroll compressor is a state-of-the-art compressor with relay and overload monitoring capabilities designed to accommodate liquids (both oil and refrigerant) without causing compressor damage.

For select models, Copeland compressor uses CoreSense™ technology as a sensor to unlock advanced capabilities such as protection, diagnostics, communication, and verification. Technicians can make faster, more accurate decisions resulting in improved compressor performance and reliability.

### Evaporators, Condensers and Source/ Sink Heat Exchanger

Each single circuit, brazed plate evaporator, condenser and source/sink heat exchanger is constructed of 316 stainless steel plates and copper brazing and insulated with closed cell insulation. The fluid piping in each module uses an electronic two-way valve for selecting geothermal fluid or load hot or cold fluid depending on the building heating or cooling demands.

The supply and return fluid piping from each evaporator, condenser, and source/sink heat exchanger includes a manual and an electronic valve for servicing each module individually, while the remaining modules continue to operate. This allows for variable flow on each source/sink heat exchanger operating as a condenser, to control refrigeration head pressure. The fluid connections to each heat exchanger uses roll-grooved couplings for service convenience and ease of installation.

### Components Parts

The systems and subsystems of the water-source multipipe unit are configured and matched to enhance performance and operating efficiency:

### Frame

The water-source multipipe frame is constructed of formed sheet metal powder coated with an oven baked finish.

# Multipipe Description

## Cabinet

Cabinet panels are made of formed sheet metal powder coated with an oven baked finish. The cabinet service panels are easily removable for servicing via stainless steel fasteners and retaining clips.

## Strainers

A 40-mesh industrial grade filter strainer is factory installed between the header system and each evaporator, source, and condenser inlet. The strainer is serviceable by isolation valves that allow each strainer to be removed and cleaned without shutting down system flow and allowing the remaining modules to continue to operate..

## Refrigeration Controls

Mechanical controls on the refrigeration system are designed to provide safety for the major components and for proper operation of the system.

Pressure transducers convert pressure into an electronic signal that the microprocessor displays in pounds per square inch (psi). Transducers vary in pressure ranges that depend on the type of refrigerant used.

Temperature sensors transmit temperature data electronically to the microprocessor for display in either Fahrenheit (°F) or Celsius (°C).

## Electronic and Manual Isolation Valves

Each evaporator branch line includes a manual inlet and an electronic discharge butterfly valve that allows system to flow to each active module to match the cooling or heating requirements. By isolating individual modules that are not operating, the hydronic system can have variable primary flow to the water source multipipe modules. The valves open slowly - to minimize the sudden change in flow to the previously active modules and have a minimum opening cycle time of 30 seconds between the fully closed and open position. The valves have a minimum close off pressure of 75 psi and a maximum working pressure of 200 psi and have roll grooved connections. The actuators are rated for 24 VAC.

## Actuating Ball Valves

It is a flow control device that uses a hollow, perforated, and pivoting ball to control liquid flowing through it. It is open when the ball's hole is in line with the flow inlet and closed when it is pivoted 90-degrees by the valve handle, blocking the flow. The handle lies flat in alignment with the flow when open and is perpendicular to it when closed. This gives an easy visual confirmation of the valve's status. Open or close status of the valve is transmitted to the PLC via a signal.

## Refrigerant Piping

Piping is Type K seamless copper suction line covered in closed-cell foam insulation.

## Fluid Piping

The fluid piping is Schedule 10 steel covered in closed-cell foam insulation to prevent condensation and retain heat and cold. Each multipipe module is connected to the adjacent module using roll grooved steel couplings and neoprene gaskets on all joints.

## Electronic Expansion Valve

Electronic Expansion Valve (EXV) is a metering device that automatically controls the flow of refrigerant to the evaporator based on superheat. EXV allows operation at low condensing pressures/temperatures and saves energy by increasing the efficiency of the unit through precise superheat control.

## Flow Switch

A flow switch is wired into the low voltage control circuitry used to detect the flow of liquid throughout the closed loop piping system. Flow switches are found in each branch line to each brazed plate heat exchanger. Flow switches close when flow is detected allowing compressors to start. If there is no flow, compressors cannot operate.

**NOTICE**

**Proof of Flow Switch!**

**Failure to provide flow switches or jumping-out of switches could result in severe equipment damage.**

**Evaporator and condenser water circuits require proof of flow switches.**

- **Failure to include the proof of flow devices and/or jumping out these devices could cause the unit to stop on a secondary level of protection.**
- **Frequent cycling on these higher level diagnostic devices could cause excessive thermal and pressure cycling of unit components (O-rings, gaskets, sensors, motors, controls, etc.) and/or freeze damage, resulting in premature failure of the chiller.**

### Sight Glass

A sight glass is located in the liquid line of the refrigeration piping and is used to view the condition of the refrigerant. When a sight glass shows a green indicator, no moisture is present. When a sight glass shows a yellow indicator, moisture is present. If the liquid line has bubbles – there is a liquid/vapor mix.

**NOTICE**

**Equipment Damage!**

**Failure to remove moisture from system could cause corrosion within the components, and degrade performance.**

**Perform vacuum evacuation of system to remove moisture.**

### Phase Monitor


A phase monitor is used on three phase power to confirm that the electricity supplying the unit is configured appropriately. A phase monitor prevents a compressor motor from operating in reverse —if any of the three legs of power are landed incorrectly—and will shut the system down upon detection of a reversed phase condition.

# General Data

**Table 2. General data – Thermafit™ MWS water-source multipipe**

| Capacity (Tons) | 30 | 40 | 50 | 60 |
|---|---|---|---|---|
| **General Unit** | | | | |
| Refrigerant Type | R-454B | R-454B | R-454B | R-454B |
| Number of Independent Refrigeration Circuits | 1 | 1 | 1 | 1 |
| Refrigerant Charge (lbs/circuit) | 29 | 38 | 47 | 56 |
| Fluid Volume (gal/module) | 40.9 | 43.2 | 60.7 | 64.9 |
| Unventilated Room Area (sq.ft.) | 17366 | 29817 | 45613 | 64754 |
| **Compressor** | | | | |
| Type | Tandem Scroll | Tandem Scroll | Tandem Scroll | Tandem Scroll |
| Quantity | 1 SET | 1 SET | 1 SET | 1 SET |
| **Evaporator[a]** | | | | |
| Type | Brazed Plate | Brazed Plate | Brazed Plate | Brazed Plate |
| Quantity | 1 | 1 | 1 | 1 |
| Fluid Volume (gal) | 3.4 | 4 | 5.2 | 6.6 |
| Material | 316 SST | 316 SST | 316 SST | 316 SST |
| Minimum/Maximum Leaving Water Temperatures (°F) | 42-65 | 42-65 | 42-65 | 42-65 |
| Minimum/Maximum Leaving Brine Temperatures (°F) | 10-65 | 10-65 | 10-65 | 10-65 |
| Minimum Water/Brine Operating Pressure (psig) | 0 | 0 | 0 | 0 |
| Maximum Water/Brine Operating Pressure (psig) - Standard Option | 200 | 200 | 200 | 200 |
| Maximum Water/Brine Operating Pressure (psig) - Hi Pressure Option | 300 | 300 | 300 | 300 |
| **Condenser[b]** | | | | |
| Type | Brazed Plate | Brazed Plate | Brazed Plate | Brazed Plate |
| Quantity | 1 | 1 | 1 | 1 |
| Fluid Volume (gal) | 3.1 | 3.7 | 4.8 | 6.2 |
| Material | 316 SST | 316 SST | 316 SST | 316 SST |
| **Source/Sink Heat Exchanger[c]** | | | | |
| Type | Brazed Plate | Brazed Plate | Brazed Plate | Brazed Plate |
| Quantity | 1 | 1 | 1 | 1 |
| Fluid Volume (gal) | 3.4 | 4 | 5.2 | 6.6 |
| Material | 316 SST | 316 SST | 316 SST | 316 SST |

[a] Evaporator Fouling Factor is 0.0001.
[b] Condenser Fouling Factor is 0.00025.
[c] Source Fouling Factor is 0.00025.

# Unit Dimensions and Weights

**Figure 1. Dimensions and weight – Thermafit MWS (30 and 40 tons module)**

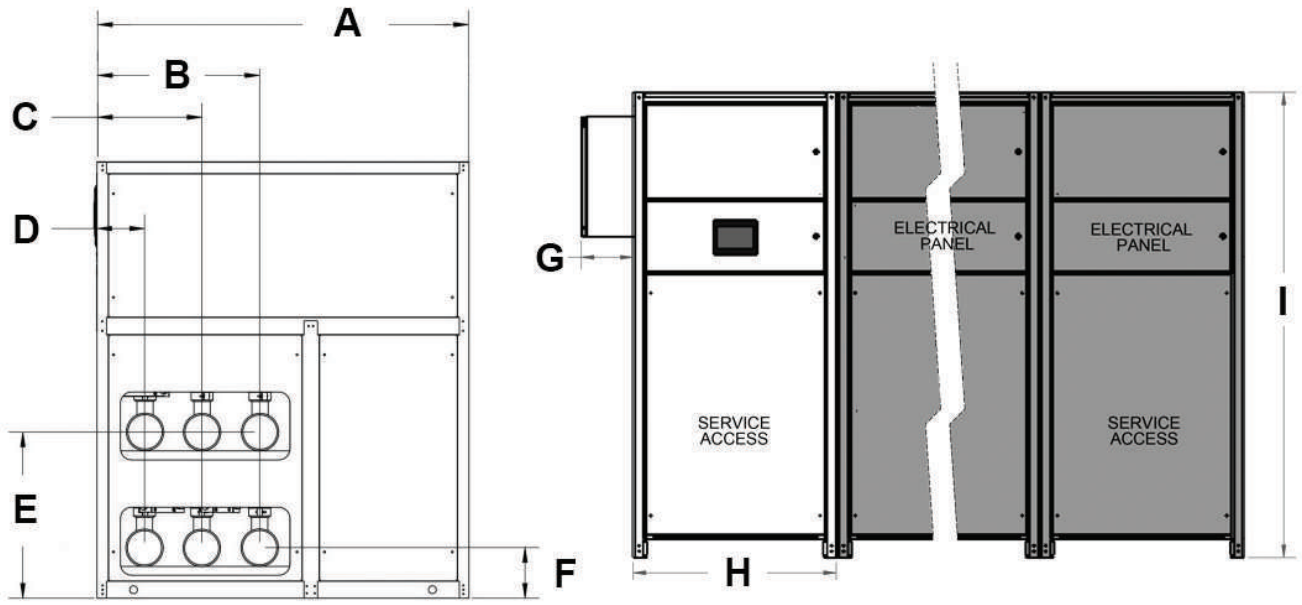



**Table 3. Dimensions and weight – Thermafit MWS (30 and 40 tons module)**

| Dim | 30 Tons | 40 Tons |
|---|---|---|
| **A** | 66 | 66 |
| **B** | 28.5 | 28.5 |
| **C** | 18.5 | 18.5 |
| **D** | 8.5 | 8.5 |
| **E** | 29 | 29 |
| **F** | 8.8 | 8.8 |
| **G** | 12 | 12 |
| **H** | 34 | 34 |
| **I** | 77 | 78 |
| **Wt (lbs)** | 1800 | 2000 |

**Figure 2. Dimensions and weight – Thermafit MWS (50 and 60 tons module)**

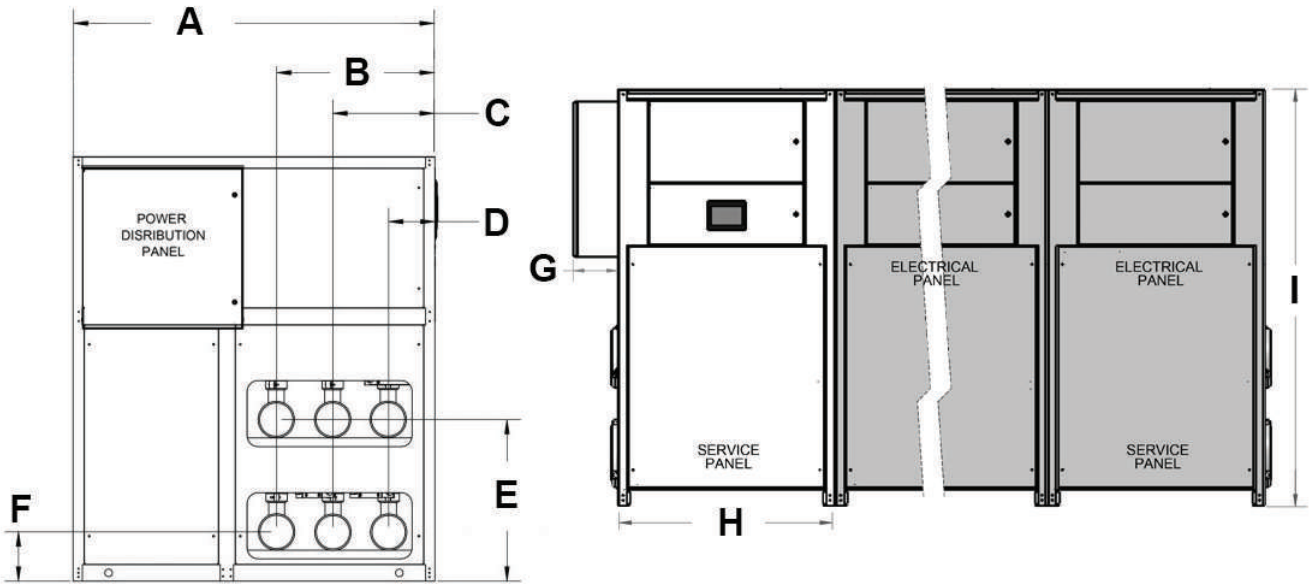



**Table 4. Dimensions and weight – Thermafit MWS (50 and 60 tons module)**

| Dim | 50 Tons | 60 Tons |
|---|---|---|
| **A** | 79 | 79 |
| **B** | 34.6 | 34.6 |
| **C** | 22 | 22 |
| **D** | 10 | 10 |
| **E** | 29 / 28.8[(a)] | 29 / 28.8[(a)] |
| **F** | 8.75 / 9.5[(a)] | 8.75 / 9.5[(a)] |
| **G** | 12 | 12 |
| **H** | 42 | 42 |
| **I** | 80 | 80 |
| **Wt (lbs)** | 2900 | 3100 |

(a) Source header dimensions only. The 50 ton and 60 ton modules have 8-inch headers.

# Pre-Installation

## Unit Connections

See “Connecting Module Power and Control Wires,” p. 24 to determine the method of the connection of this unit.

## Site Preparation and Clearances

Water-source multipipe modules must be installed on a level surface that has been checked by a qualified structural engineer to support the weight of the fluid-filled modules and the connective piping to and from the system. Installations must account for minimum service access clearance as may be practical or required by local building codes.

### Multipipe Clearances

The National Electric Code or local, state, and regional building codes may require greater clearance for the modular units than the figures listed in this publication. Always consult local regulatory agencies to confirm additional clearances are not required by building codes.

### Minimum Clearances

The unit must maintain a minimum clearance of 36 inches on all sides and a minimum clearance of 48 inches overhead for compressor removal. See Figure 3, p. 14.

***Note:*** *Each installation has specific considerations. Contact Trane for definitive guidance on a job-by-job basis.*

### Service Access

Maintain clearance between the module and any nearby wall/obstruction to provide sufficient room to open power distribution panel and electrical and control panel doors for routine maintenance and servicing. In general, 36 inches of space is required to allow panel doors to fully swing open and to meet local and national electrical codes. Compressors, filter-strainers, and liquid line shutoff valves are accessible on each side or end of each multipipe system.

## Mounting Rails

The water-source multipipe system must be positioned on a firm, level surface. All modules should be installed onto structural steel rails. The rails must be level and a minimum of 4-inches wide (preferably 6-inches wide).

Custom modules may have different requirements. Consult submittal drawings to confirm dimensions.

After setting and lubricating the mounting rails, begin installing the modules. All of the modules arrive with labels on the electrical and control panel. Review the installation drawings to determine which is the first, primary module. Typically the primary module also has the main power distribution panel attached to it.

For vibration isolation, spring isolators or rubber-in-shear isolator pads must be installed under the structural steel mounting rails.

**Figure 3. Recommended multipipe clearances**

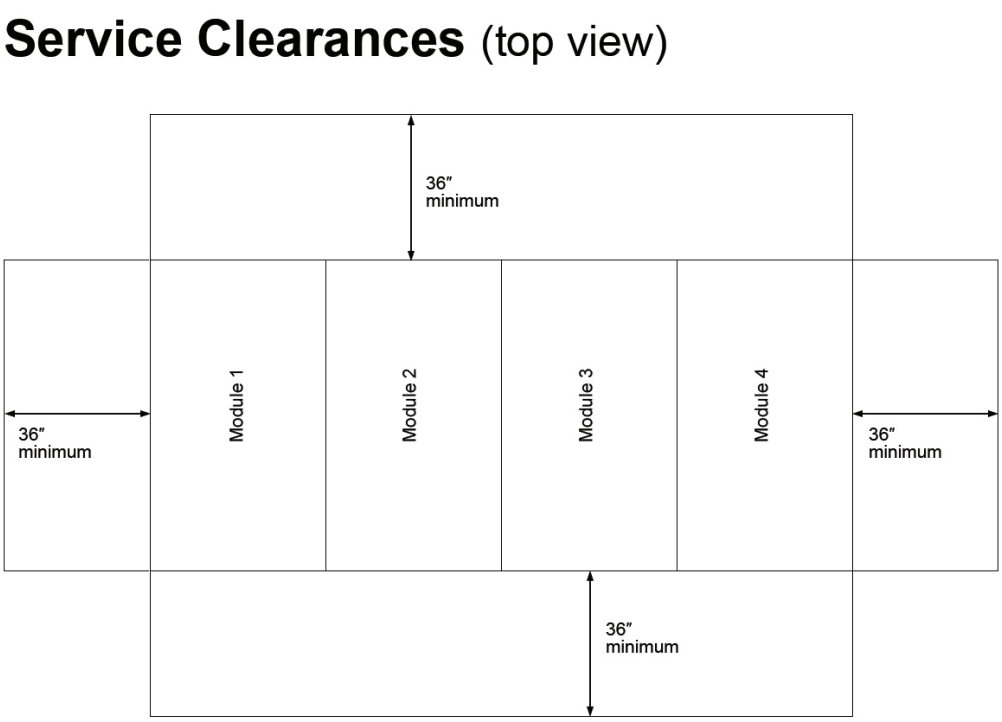
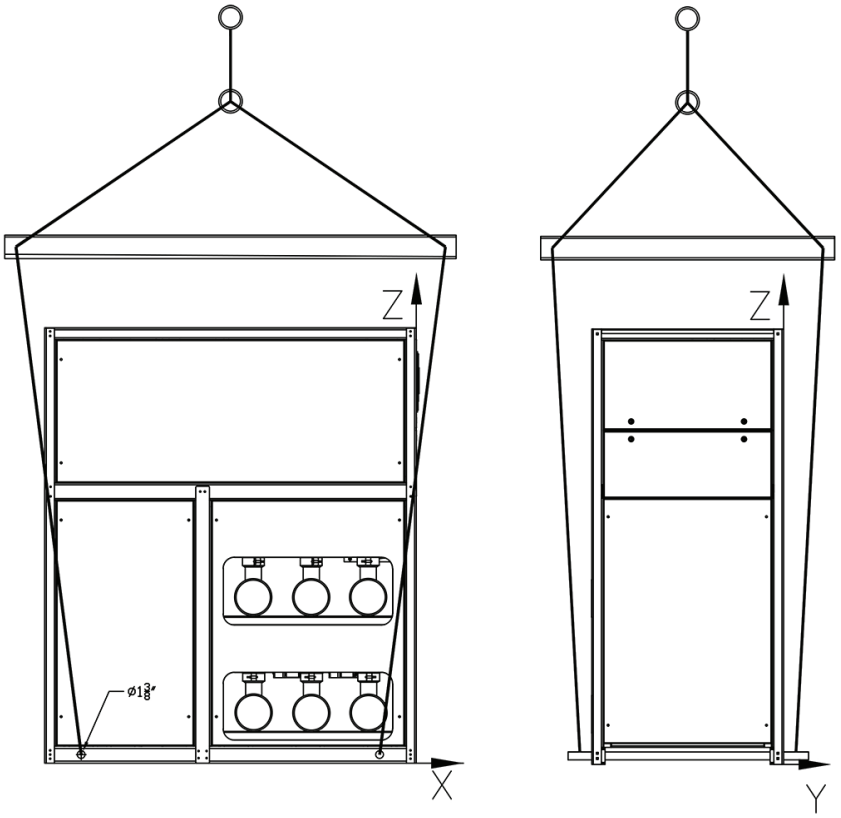


**Figure 4. Recommended water-source multipipe module rigging**




For modules mounted directly on concrete, vibration isolation pads can be installed under each module. After setting each module, remove front or rear access panels to improve access to components when making connections.

# Operating Principles

The Thermafit™ MWS water-source multipipe is a state-of-the-art six-pipe multipurpose system featuring independent water circuits to satisfy end user's requirements for heating and cooling year-round. It eliminates the need for duplicate equipment and significantly reduces space requirements by combining duties and reducing glycol requirements.

The multipipe is designed to operate with a fluid mixture to prevent rust, scaling, and organic growth.

The simultaneous heating and cooling system is designed to operate in heating mode, cooling mode, or simultaneous heating and cooling based on the system demand by opening and closing electronic diverting valves on the evaporators, condensers, and the source/sink heat exchanger and redirecting refrigerant flow to the operating brazed plate heat exchangers.

In cooling mode, the diverting valves direct the load cooling fluid to the evaporator and simultaneously direct the source/sink fluid to the source/sink brazed plate heat exchanger operating as a condenser.

In heating mode, the diverting valves direct the load heating fluid to the condenser and the source/sink fluid to the source/sink brazed plate heat exchanger operating as an evaporator.

In simultaneous heating and cooling mode, the diverting valves direct the load heating fluid to the condenser and the load cooling fluid to the evaporator.

Electronic valves on the brazed plate source/sink heat exchanger outlet modulate to control refrigeration head pressure. Electronic valves on the evaporator and condenser outlet also allow for variable flow.

# A2L Work Procedures

**⚠ WARNING**

**Risk of Fire — Flammable Refrigerant!**

**Failure to follow instructions below could result in death or serious injury, and equipment damage.**

- **To be repaired only by trained service personnel.**
- **Do not puncture refrigerant tubing.**
- **Dispose of properly in accordance with federal or local regulations.**

**⚠ WARNING**

**Refrigerant under High Pressure!**

**Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.**

**System contains refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.**

**⚠ WARNING**

**Hazardous Voltage!**

**Failure to disconnect power before servicing could result in death or serious injury.**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.**

The units described in this manual use R-454B refrigerant. Use ONLY R-454B rated service equipment or components with these units. For specific handling concerns with R-454B, contact your local Trane representative.

Installation, repair, removal, or disposal should be performed by trained service personnel.

At all times, Trane's maintenance and service guidelines shall be followed. If in doubt, contact Trane technical support for assistance.

## Servicing

Prior to initiating work on equipment, check the area with an appropriate refrigerant detector. Ensure the service personnel are properly trained regarding work in potentially toxic or flammable atmospheres. Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i.e. non-sparking, adequately sealed, or intrinsically safe. Be aware that the refrigerant does not contain an odor.

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available on hand. A dry powder or $CO_2$ fire extinguisher should be located adjacent to the charging area.

At all times, Trane's maintenance and service guidelines shall be followed. In in doubt, contact Trane technical support for assistance.

All maintenance staff and others working in the local area shall be instructed on the nature of the work being carried out. Work in confined spaces shall be avoided.

### Ignition Source Mitigation

Do not use any sources of ignition when working on the refrigeration system.

Keep all ignition sources, including cigarette smoking, away from the site of installation, repair, removal or disposal, during which refrigerant can potentially be released to the surrounding space.

Survey the area around the equipment before initiating work to ensure no flammable hazards or ignition risks are present.

"No Smoking" signs shall be displayed.

Do not use devices that can be a source of ignition to accelerate defrosting of components. Use only defrost and cleaning procedures recommended by Trane. Do not pierce or burn.

### Ventilation

Ensure that the area is in the open or that it is adequately ventilated before breaking into the system or conducting any hot work. A degree of ventilation shall continue during the period that the work is carried out. The ventilation should safely disperse any released refrigerant and preferably expel it externally into the atmosphere. If present, check that the ventilation system, including outlets, are operating adequately and are not obstructed.

### Refrigerating Equipment

Refrigerant piping or components should not be installed in locations where substances which may corrode them are present.

Check that equipment hazard markings are visible and legible. Replace them if they are not.

For equipment using secondary fluids, like water or glycol, check that refrigerant is not present in the secondary fluid loop before conducting any hot work.

### Electrical Devices

Do not apply power to the circuit if a fault exists which compromises safety. If the fault cannot be corrected

immediately, but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment, so all parties are advised.

Initial safety checks shall include:

- Cabling is not subject to wear, corrosion, excessive pressure, vibration, sharp edges, or any other adverse environmental effects. Account for the effects of aging or continual vibration from sources such as compressors or fans.
- Capacitors are discharged. This shall be done in a safe manner to avoid possibility of sparking.
- No live electrical components and wiring are exposed while charging, recovering, or purging the system.
- Verify continuity of earth bonding.
- Replace electrical components with Trane replacement parts, or those meeting the same ratings and qualified for flame arrest protection, UL LZGH2 category.

# Leak Detection

Never use an open flame to detect leaks. A halide torch should not be used. Use only approved leak detection methods per this instruction manual.

The following leak detection methods are deemed acceptable for all refrigerant systems.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of flammable refrigerants, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used. Leak detection equipment shall be set at a percentage of the LFL gas (25% maximum) is confirmed.

Leak detection fluids are also suitable for use with most refrigerants but the use of detergents containing chlorine shall be avoided as the chlorine may react with the refrigerant and corrode the copper pipe-work.

Examples of leak detection fluids are:

- Bubble method
- Fluorescent method agents

If a leak is suspected, all naked flames shall be removed/ extinguished.

If a refrigerant leak is found which requires brazing, all refrigerant shall be recovered from the system, or isolated (by means of shut off valves) in a part of the system remote from the leak.

# Refrigerant Removal and Evacuation

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for flammable refrigerants it is important that best practice be followed, since flammability is a consideration.

The following procedure shall be adhered to:

1. Safely remove refrigerant following local and national regulations.
2. Evacuate.
3. Purge the circuit with inert gas.
4. Evacuate (optional for A2L).
5. Continuously flush or purge with inert gas when using flame to open circuit.
6. Open the circuit.

Prior to refrigerant removal, open all appropriate valves, including solenoid and electronic expansion valves (EXVs). Use control settings, where available. When not available, manually open all electronically controlled valves using acceptable service procedures.

The recovery equipment shall be in good working order with instructions available. Equipment shall be suitable for the recovery of the flammable refrigerant. For specific handling concerns, contact the manufacturer. Ensure all hose connections are checked for tightness to avoid refrigerant leaks.

The refrigerant shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. Do not mix refrigerants in recovery unit and especially not in cylinders.

Refrigerant recovery unit should be purged with an inert gas after each use or before using with a different refrigerant Class – for example, A2L to A1.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant. The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.

The system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times. Compressed air or oxygen shall not be used for purging refrigerant systems.

The system shall be vented down to atmospheric pressure to enable work to take place.

The outlet for the vacuum pump shall not be close to any potential ignition sources, and ventilation shall be available.

# Refrigerant Charging

In addition to conventional charging procedures, the following requirements shall be followed.

- Ensure that contamination of different refrigerants does not occur when using charging equipment.
- Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.

- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the refrigerating system is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the refrigerating system.

Prior to recharging the system, it shall be pressure-tested with the appropriate purging gas. The system shall be leak-tested on completion of charging but prior to commissioning. A follow up leak test shall be carried out prior to leaving the site.

Prior to refrigerant charging, open all appropriate valves, including solenoid and electronic expansion valves (EXVs). Use control settings, where available. When not available, manually open all electronically controlled valves using acceptable service procedures.

# Decommissioning

Before carrying out the decommissioning procedure, it is essential that the trained service personnel is completely familiar with the equipment and all its details. It is recommended good practice that all refrigerants are recovered safely. Prior to the task being carried out, an oil and refrigerant sample shall be taken in case analysis is required prior to re-use of recovered refrigerant. It is essential that electrical power is available before the task is commenced.

1. Become familiar with the equipment and its operation.
2. Isolate system electrically.
3. Before attempting the procedure, ensure that:
    a. Mechanical handling equipment is available, if required, for handling refrigerant cylinders.
    b. All personal protective equipment is available and being used correctly.
    c. The recovery process is supervised at all times by a competent person.
    d. Recovery equipment and cylinders conform to the appropriate standards.
4. Pump down refrigerant system, if possible.
5. If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.
6. Make sure that cylinder is situated on the scales before recovery takes place.
7. Start the recovery machine and operate in accordance with instructions.
8. Do not overfill cylinders (no more than 80% volume liquid charge).
9. Do not exceed the maximum working pressure of the cylinder, even temporarily.
10. When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.
11. Recovered refrigerant shall not be charged into another refrigerating system unless it has been cleaned and checked. When equipment has been decommissioned, attach a signed label which includes the date of decommissioning.
12. When equipment has been decommissioned, attach a signed label which includes the date of decommissioning.

# Installation Mechanical

## Inspect and Report Damage

Upon receipt, inventory the shipment against the Trane bill of lading to confirm all modules and components have been delivered.

Inspect each package in the shipment for visible damage. Verify the correct model number and that all skids and cartons have been delivered. Any damage must be reported to the motor carrier and Trane within five days of receipt of the shipment.

Inspect all exterior components for concealed damage as soon as possible. Do not proceed with the installation of damaged equipment without prior approval of Trane.

Do not refuse delivery of damaged goods without prior authorization. Unauthorized refusal of the shipment will result in a 20% restocking charge to the customer.

The ownership of the equipment is transferred to the consignee at point of shipment. Refusal of delivery may impede recovery of damages.

It is the consignee's responsibility to accept delivery of damaged goods unless permission to refuse delivery has been granted by Trane.

### Inspection of Delivered Equipment

To report damage incurred in transit, complete the following:

1. Inspect each piece of equipment for visible damage before accepting delivery. Check for torn cartons, broken skids, bent metal and torn shrink wrap.
2. Confirm the delivery driver notes any damage on the bill of lading and completes a Carrier Inspection Report. Failure to comply may result in difficulties in resolving any claims for damage.
3. Inspect each piece of equipment for concealed damage before storage or as soon as possible after delivery.
4. In the event of suspected concealed damage, ask the driver to wait until you inspect the equipment. Concealed damage must be reported within five days of receipt of equipment.
5. If concealed damage is found, stop unpacking the shipment. Do not remove damaged material from the receiving location, take photos of the damage. The owner must provide reasonable evidence that the damage did not occur after delivery.
6. Notify the carrier of the damage as soon as possible. Request an immediate joint inspection by the carrier and consignee. A determination of responsibility will be made and the carrier will authorize repairs in the event of admission of fault.
7. Notify your local Trane CSO immediately. Trane will coordinate repairs with the owner and carrier. Do not attempt to make repairs locally without permission.

### Warranty Issues

Trane is not responsible for damages or for filing damage claims. It is the customer's responsibility to confirm that the necessary long term storage procedures have been completed and any deviations are reported to Trane immediately.

## Long Term Storage Requirements

Appropriate preparation and storage of Thermafit™ MWS Multipipe components during extended periods of dormancy is essential to confirm the equipment does not sustain damage or degradation due to inactivity and operates properly after installation.

The customer must notify Trane during the sales process that the multipipe system may be transported by ocean freight or placed in long-term storage under any of these conditions:

- The multipipe will not be placed into operation for a period exceeding six months after leaving the Trane factory. That is, the initial start-up date will not occur within a six-month maximum dormancy window.
- The multipipe will be shipped using ocean transit for all or part of the delivery process.
- Cold temperature storage conditions fall below -20 °F (-29 °C).
- Ambient temperature storage conditions exceed 150 °F (66 °C).
- The glycol should be removed from the multipipe unit if it is to be stored for extended periods.

### Factory Preparation

Upon confirmation of an order requiring long-term storage or protection against extreme environments, Trane will inspect and protect vendor-supplied components before installation.

Prior to shipment, Trane will prepare each multipipe system for long-term storage in coastal or tropical environments by:

- Placing silica gel packs in all electrical panels to prevent corrosion of electrical contacts and moisture from degrading sensitive controllers.
- Shrink-wrapping each unit using polyethylene film to limit environmental exposure and protect the system from damage during shipping.
- For multiple modular systems, assemblies shipped on a common skid, shrink wrap the entire skid rather than the individual modules.

Trane will document and photograph the status of the unit prior to shipment and carry out the instructions detailed in

the factory order regarding in-shop preparation of units for long-term storage.

### Customer Responsibilities

Upon receipt of a multipipe system, the customer must conduct thorough internal and external inspections, removing packaging material as needed for access to all components.

Visible damage must be noted on the signed and dated bill of lading. The customer may request a carrier inspection by telephone or in person, but any such request should be confirmed in writing. It is recommended that the customer request that the carrier inspect the damage within 72 hours of notification.

The customer must store the system in a dry, non-corrosive, dust- and vibration-free environment due to the exposure sensitivities of the microprocessor controllers and to prevent electrical terminations from deteriorating from non-use. Conditions in storage locations should not fall below -20 °F (-29 °C) or exceed 150 °F (66 °C).

Components sealed in plastic shrink-wrap are not exempt from these storage requirement. Moisture can potentially collect inside the plastic film, resulting in corrosion of the cabinet and electronic components. Any multipipe system packaging that is removed must be replaced with similar protective covering as soon as possible.

Failure to adhere to these long-term storage requirements may void the Trane warranty. Any component that is damaged or inoperable due to improper storage may have its warranty voided.

## Handling of the Modules

The packaging from the factory permits lifting with a suitable crane. Confirm straps are in good working condition and that they are rated for the weight of the machines. Spreader bars may be required for effective rigging and to avoid damage to the multipipe modules.

The modules arrive fully charged with refrigerant. As required under Federal regulations, installation, start-up and service should be performed by fully-qualified, factory-certified, personnel.

***Note:*** *Damage from improper handling will not be covered by warranty.*

**⚠ WARNING**

**Proper Field Wiring and Grounding Required!**

**Failure to follow code could result in death or serious injury.**

**All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.**

**⚠ WARNING**

**Electrical Shock, Explosion, or Arc Flash Hazard!**

**Failure to follow these instructions could result in death or serious injury.**

- **Install the product in an appropriate electrical/fire enclosure per local regulations. Do not install the product in hazardous or classified locations.**
- **Do not use the product for life or safety applications.**
- **Do not exceed the product ratings or maximum limits. Products rated only for basic insulation must be installed on insulated conductors.**
- **Current transformer secondaries (current mode) must be shorted or connected to a burden at all times.**
- **Remove all wire scraps, tools, replace all doors, covers and protective devices before powering the equipment.**
- **Unventilated area where the appliance using flammable refrigerants is installed shall be so constructed that should any refrigerant leak, it will not stagnate so as to create a fire or explosion hazard.**

## Rigging, Lifting, and Moving the Multipipe

Thermafit™ MWS water-source multipipe system is delivered to the customer's site as individual modules. Limitations on the methods and materials that can be used to rig, lift, or move a system or an individual module include:

- Maintain the module in an upright position at all times.
- Certain configurations of modules can be top-heavy. Considering each module's center of gravity, move modules slowly.

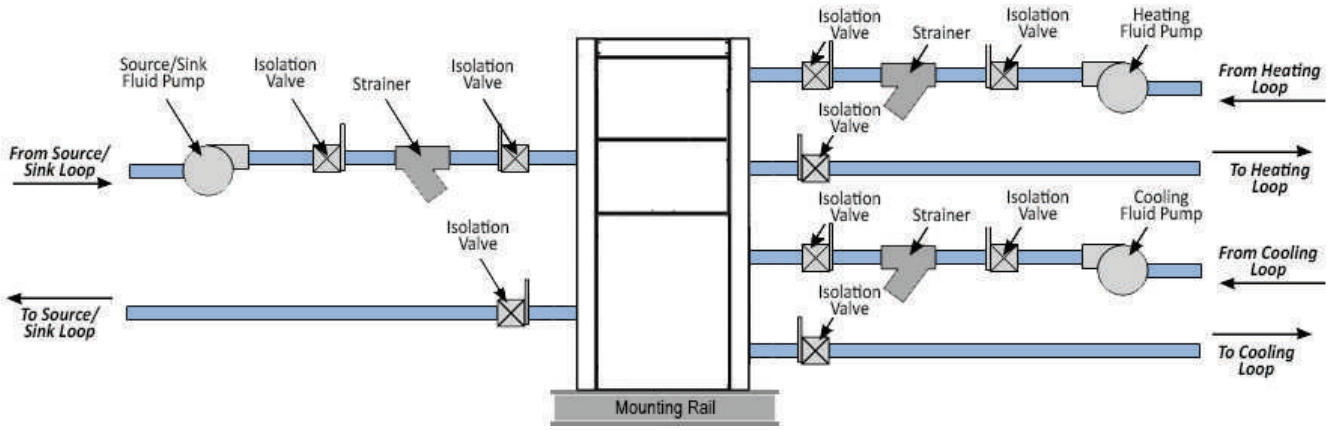
- Rig, lift, and move by strapping and lifting, by overhead means or using a properly configured floor jack or fork lift
- Position lifting beams or spreader beams to prevent lifting straps from rubbing or contacting module side panels or electrical boxes. Attach rigging bar on each end of module where 1 3/8 inch holes are provided.
- Do not use cables, chains, or any other type of metalized strapping to lift a module.
- Do not push a module along the floor using manual or mechanical means.

# Installation Piping

## Install Piping and External Components

Proper support of piping and pipe hangers must consider the weight of the piping as well as the water weight inside the pipes. A 40-mesh screen strainer must be installed in each water/liquid system piping inlet for proper filtration and protection of the heat exchangers. The following figure provides a recommended installation of components.

**Figure 5. Recommended polytherm piping**




***Important:*** *A control valve is a butterfly valve used on an evaporator when the fluid mixture flow is variable or to operate an 'N+1'multipipe module configuration. ('N+1' is a configuration whereby a spare module is brought on line should an operating module fail. The spare module's control valve opens, and the failed module's valve closes thereby keeping the pressure drop and flow through each evaporator in the system constant). Each valve has a 24 Vac power supply opening, closing or modulation by a 0 to 10 Vdc signal. A sensor in the water/glycol mixture header detects temperature or pressure via an electronic signal to the microprocessor that in turn controls the voltage to the valve actuator motor. The signal is either 0 or 10 volts.*

## Initial Flushing of Piping

After installation of system piping and before connection to the water-source multipipe system, it is important to clean and remove debris, weld slag, and other contamination deposited during fabrication of the piping system.

Typical flushing includes hot water with mild detergent followed by a dilute phosphoric acid solution until all visible residue is removed.

Only cleaning liquids, acids, and detergents compatible with SAE Grade 316 stainless steel, copper, and carbon steel should be used. Consult a professional water treatment specialist when in doubt.

Flushing should take place across a filter/strainer with a maximum 40–mesh screen and continue for a minimum of six hours with frequent removal of the screen to capture residue or until the strainer is clean.

After detergent and chemical cleaning, flush the water piping with fresh water for one hour to remove any remaining cleaning compounds.

### Fill with Water/Glycol Solution

The installing contractor is responsible for charging glycol into the multipipe hydronic system.

1. Mix the concentrate of propylene glycol in a tank or drum for transfer into the unit. See Table 10, p. 45
2. Mix the glycol and water externally before filling the multipipe unit to prevent clogging of the piping with a heavy concentrate.
3. Fill the tank using the manual fill port on the cabinet. Fill so that the mixture reaches near the top. Stop every so often so the fill level can be monitored.

***Note:*** *Do not use a glycol feeder pump to fill the multipipe loop. It is not designed for continuous use and will fail.*

Only after the above steps have been completed should the water piping be connected to the system.

### Dowfrost

***Important:*** *Dowfrost inhibited propylene glycol-based solution is listed as chemically acceptable by the US Department of Agriculture (USDA). The two ingredients in Dowfrost water/glycol mixture are generally recognized by the FDA as safe food additives under Parts 182 and 184 of the Food Additive Regulations.*

# Installation Electrical

## Wiring and Piping

Modules must be installed in accordance with the manufacturer's recommendations where shown on the drawings and other installation documents.

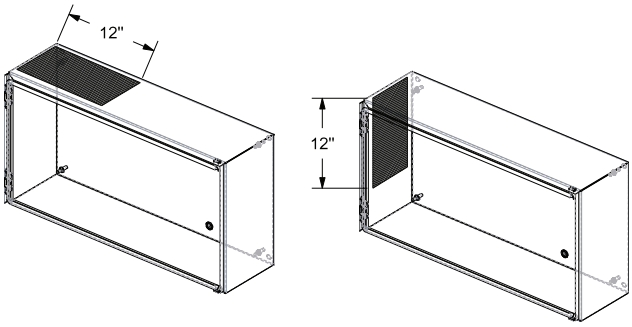
Each water-source multipipe module is shipped individually for field assembly. Field assembly of a multipipe system consists of the following minimum steps:

1. Connect chilled fluid/heating fluid piping with factory supplied roll grooved connections.
2. Insulate roll grooved connections after assembly.
3. Connect factory-supplied power supply wiring harnesses to the power distribution panel. Install wires to the proper terminals for proper phasing. The panel is wired for A, B, C phase right-to-left in the power distribution panel. Each wire on the wire harness is identified as to its respective phase.
4. Connect each module microprocessor to the Ethernet switch to form the local communication network. Ethernet cable Cat-5e must be used for all communication connections.

## Connecting Module Power and Control Wires

Connections are made at the primary module that typically contains the power distribution panel or individually on each module at high voltage panel depending on option(s) selected. Connection entries must be made in the upper left corner of the panel(s) as shown in Figure 6, p. 24.

**Figure 6. Electrical supply connection location(s)**




Labeled control and communication cables are coiled inside each module and are connected to an Ethernet switch. The Ethernet cable turns from the switch to each module's microprocessor controller at the **J30** connector.

**⚠ WARNING**

**Proper Field Wiring and Grounding Required!**

**Failure to follow code could result in death or serious injury.**

**All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.**

This unit is equipped with a flow switch. It will not run unless the pump is circulating water through the system.

Customer-installed incoming disconnect switches should be designed for all pole disconnection and should be able to disconnect during overvoltage category III.

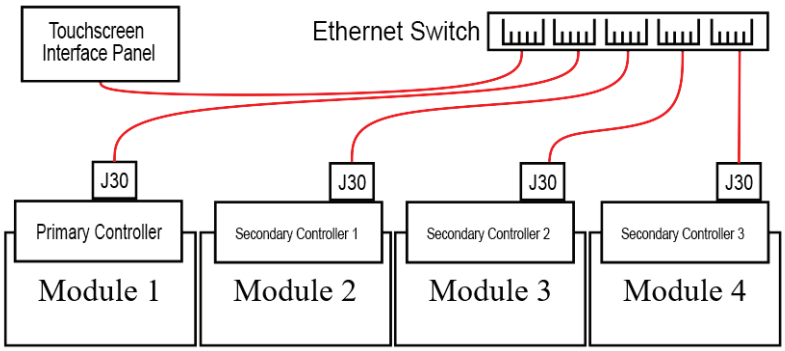
### Module Main Power

Modular systems feature single-point power connection from the utility service to the power distribution panel on the primary module as standard. Main power phases A, B, and C are connected to terminals A, B, and C respectively from left to right. (Some custom systems may have individual power supplied to each module in lieu of single point power.)

### Module Control Wiring

The primary controller communicates with each secondary controller via an Ethernet cable wired back to the Ethernet switch on the primary microprocessor controller. See the following figure.

**Figure 7. Typical controller network**




## Phase Monitor Installation

The water-source multipipe unit is equipped with a phase monitor on the power distribution panel. It is connected to the corresponding microprocessor controller digital input. Confirm that the wiring from the primary microprocessor controller and terminal blocks to the phase monitor are connected and secure.

The phase monitor continuously monitors each of the three phases. The microprocessor receives input from the phase monitor indicating whether the voltage is within acceptable values. The phase monitor design protects against under-voltage, voltage unbalance, phase loss, and phase reversal.

Set voltage adjustment knob at the desired operating line voltage for the equipment. This adjustment automatically sets the under-voltage trip point. Check the phase monitor after initial start-up. If it fails to energize, (the LED glows or blinks red) check the wiring of all three phases, voltage, and phase sequence. If phase sequence is incorrect, the LED flashes green/red. To correct this, swap any two line voltage connections at the mounting socket. No further adjustment should be required.

# Optional Disconnect Switch

Some water-source multipipe systems are optionally equipped with a panel-mounted disconnect switch installed on the outside of the power distribution panel. The disconnect switch must be turned to the off position before the panel can be opened for service.

**⚠ WARNING**

**Hazardous Voltage!**

**Failure to disconnect power before servicing could result in death or serious injury.**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.**

## Single Point Connections

1. Open the power distribution panel. Power cable holes are accessible from inside module.
2. Remove cable strain relief from back of cabinet, feed cable end through strain relief.
3. Feed cable end through left most open cable access hole.
4. Push conduit sleeve to engage strain relief. Re-attach strain relief and tighten.
5. Attach and tighten cable ends to its numbered breaker. Each wire is labeled 1, 2, and 3.
6. After installing the cable, attach conduit to a frame member near the coil using a wire tie.
7. Attach ground to lug/bar inside cabinet. Tighten after all grounds have been run.
8. Control wires are in series. Attach the control wires to the correct module microprocessor.
9. Feed control wire through rear of cabinet of the next module control cabinet. Note labels.
10. Connect the Ethernet cable to the J30 port on the microprocessor.

# Operating Procedures

## Operator Interface

All water–source multipipe units, whether they are composed of a three modules (minimum) or up to 10 modules, are automated systems that use a touchscreen interface panel to monitor, report, and modify critical system functions.

### Multipipe Power Panels

There are two different electrical panels used in the multipipe. The main power distribution panel receives power from the building source and distributes it to individual modules. The electrical and control panel receives power from the power distribution panel and provides power to the individual electrical components in that module.

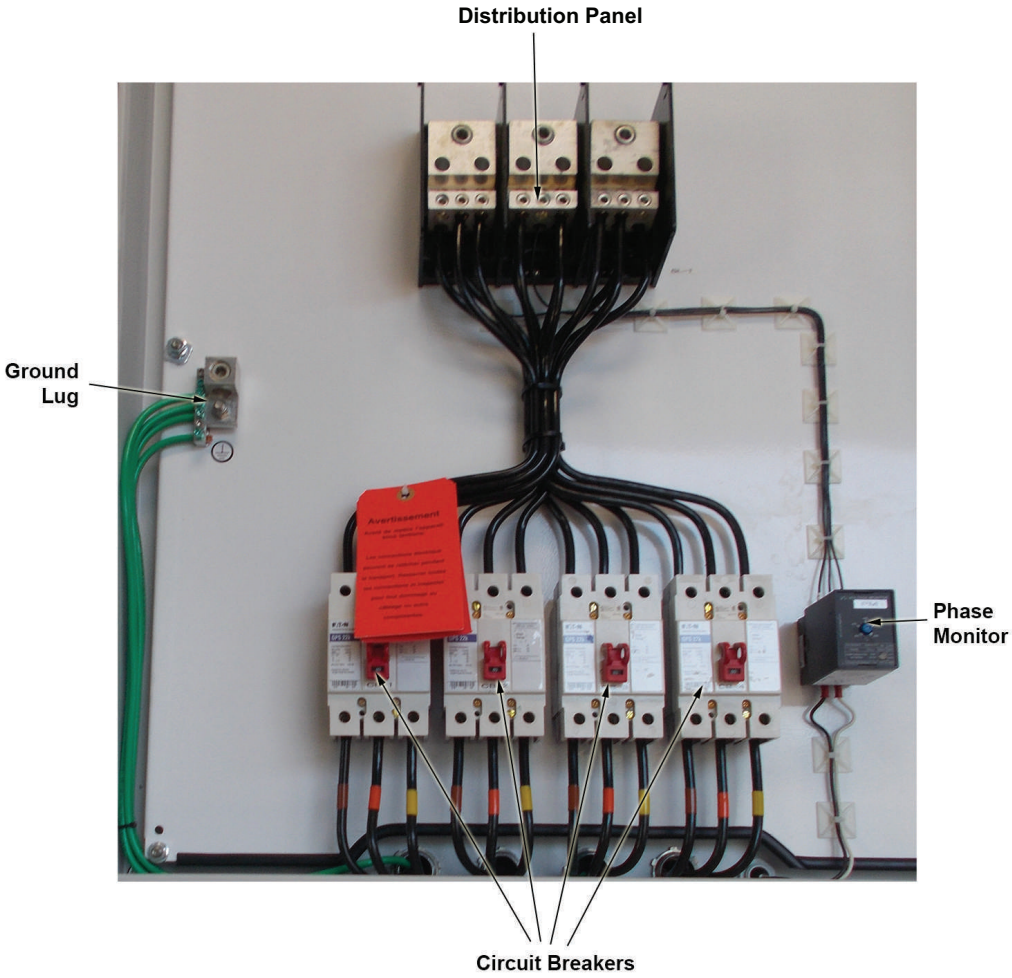
### Panel-Mounted Disconnect Switch

Some water–source multipipe systems are optionally equipped with a panel-mounted disconnect switch installed on the outside of the power distribution panel (or on each module's electrical and control panel if the system has power supplied to each individual module). The disconnect switch must be turned to the OFF position before the panel can be opened for service. When the panel door is open, the power is disengaged.

### Power Distribution Panels

The power distribution panel receives power from the building source and distributes it to individual modules. It also houses a circuit breaker for each module, a phase monitor, and an optional main power disconnect switch. See the following figure.

**Figure 8. Power distribution panel**



## Module Electrical and Control Panel

The electrical and control panel receives power from the power distribution panel and provides power to the individual electrical components in that module. Each module has its own high voltage electrical panel and low voltage control panel that distributes electricity to individual components. It also has fuses and breakers, compressor switches, and the microprocessor controller.

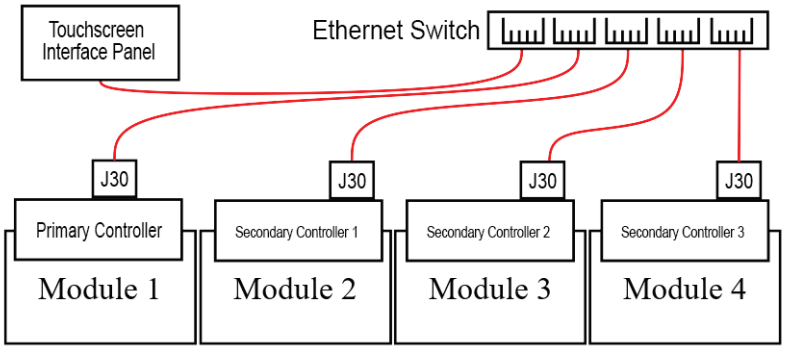
Each module has its own control panel that houses the microprocessor controller. It also has relays, an expansion board, an electronic expansion valve controller, and low-power terminal blocks.

## Electronic Control

Water–source multipipe models use Carel c.pCO series microprocessor controllers to monitor and report critical operating parameters. A main controller is used to control and coordinate the functioning of all modules that make up the multipipe unit. For units consisting of more than a single module, each module has its own controller. See the following figures below.

**Figure 9. c.pCO primary controller**


**Figure 10. Typical controller network**




## Operating the Microprocessor

The touchscreen interface panel is ready to use when it is connected to the Ethernet switch and system's power is ON.

There are five BMS communication options:

***Note:*** *BMS is not included as standard, but available as an option.*

1. BACnet® MS/TP - Connection through built-in BMS2 port.
2. BACnet IP - BACnet router is used.
3. Modbus® RTU - Connection through built-in BMS2 port.
4. Modbus IP - Modbus router is used.
5. LonWorks® - LonWorks router is used.

## Controllers

The distributed primary microprocessor control system enables all secondary modules to operate independently in the event that the primary microprocessor controller fails. All multipipe safeties including temperature set point, refrigerant pressures, and freeze protection are preserved.

In a normal configuration, a secondary controller controls the single module to which it is dedicated.

The secondary controller monitors key performance parameters for its module and sends real-time information to the primary controller. The primary controller monitors the performance of the system, activating and deactivating modules as needed to maintain the leaving water temperature.

See the following figure for a simplified example of a typical microprocessor controller network.

Upon initial start-up, the status line will indicate that the unit is OFF. Press On/Off button on the touchscreen home screen to enable System On/Off control pop-up screen. Next, turn multipipe on or off manually or switch over to BMS control.

## Microprocessor Functions

For practical purposes, all essential control information and operator actions are read and responded to using the touchscreen interface panel. The touchscreen interface panel is connected to the primary microprocessor controller and is the only way to access many primary controller functions.

**NOTICE**

**Component Damage!**

**Failure to follow instructions could damage sensitive electronic components beyond repair.**
**To prevent arcing or surges of electrical current, do not use wires or cables to jump components or bypass the manufacturer's safety systems.**

## Password Protection

There are three levels of access to the functions displayed on the interface. The basic level, ‘user,’ does not require a password. The higher access levels are the technician (‘tech’) and administrator (‘admin’) levels that can only be accessed by Trane technical personnel. Contact Trane technical support regarding the possibility of any potential issues involving the higher-level functions.

## Operator Control

A touchscreen interface panel is the primary means for the operator or maintainer to monitor and modify a host of functions involving temperatures, pressures, set points, alarms, operating schedules, elapsed operating hours, etc. This touchscreen interface panel can be located within proximity of the primary microprocessor controller. It is typically located in the primary module.

The touchscreen interface is connected to and communicates with all module controllers via the Ethernet switch. It accesses overall multipipe system functions and settings as well as individual module settings.

In this manual, all functions, procedures, checklists, system information, and changes in system parameters like set points, alarms, and primary controls are written assuming the operator is using the touchscreen interface panel.

When connected to the Ethernet switch, the touchscreen interface panel displays current, real-time, information about the multipipe, as well as the status of critical parameters within each module of the multipipe system.

## How to Use the Touchscreen Interface Panel

The touchscreen interface panel is used to adjust set points, clear alarms, and perform detailed setup of the microprocessor controllers.

The touchscreen interface panel displays information on its touchscreen whenever specific keys and buttons are pressed by the operator (See the following figure).

Basic operator tasks are described in the following sequence of illustrations that comprise a controller tutorial.

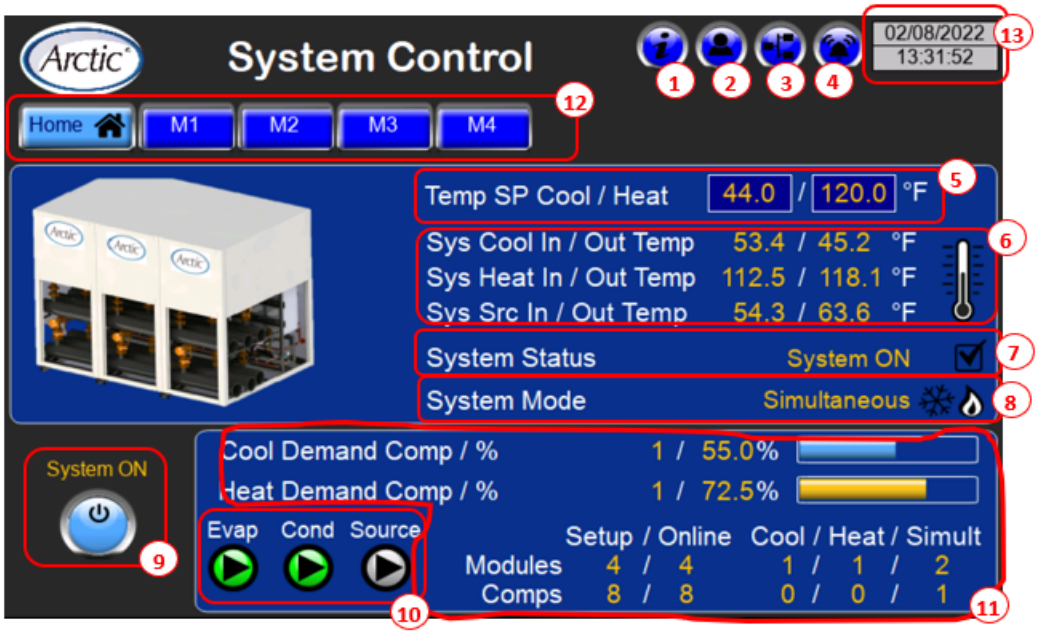
**Figure 11. Touchscreen interface panel**

# Touchscreen Interface Tutorial

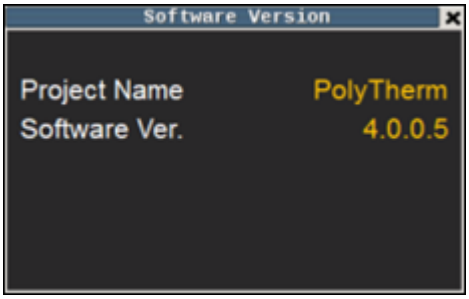
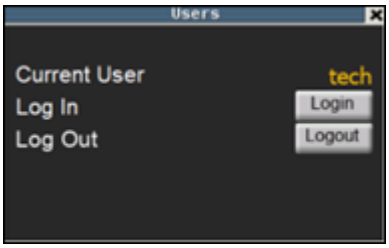
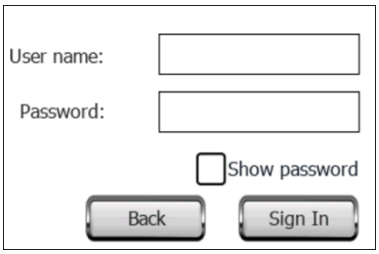
This section consists of a tutorial that first-time personnel can use to navigate through the various functions and features that are available in the interface.

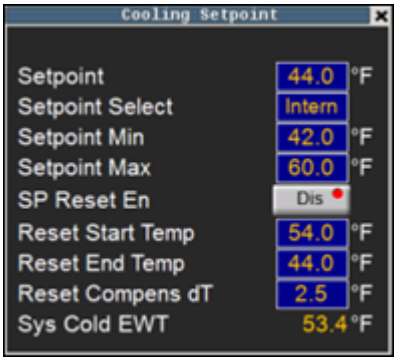
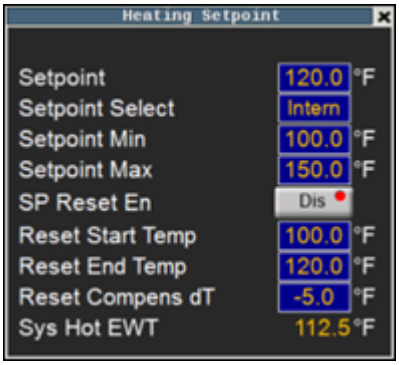
Each of the main screens in the interface contains active hot spots to activate virtual buttons and switches by simply touching the screen.

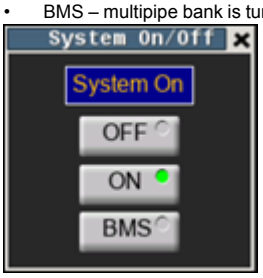
**Figure 12. HMI home screen**

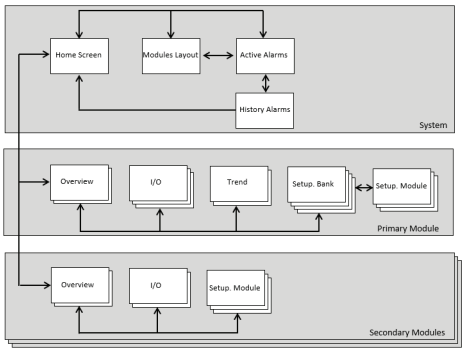
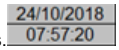


# Home Screen Features

| Feature | Description |
|---|---|
| **1 - HMI Software Version** | Calls up the pop-up window. See figure below.<br>• Project Name: HMI software project name<br>• Software Version: HMI software version<br>• Consists of 4 two-digit numbers<br>– First two numbers stand for major and minor software revision.<br>– Third number stands for special software revision. If any project has the special software, this number would be different from '00'.<br>– Fourth number stands for beta software revision.<br>**Figure 13. Software version**<br>  |
| **2 - HMI User Management / Login** |  <br>• Current User: indicates which user is currently logged in. There are three users for the HMI: 'user', 'tech', and 'admin'. See figure below.<br>– user - (default user) has access to viewing data mostly. The only allowed controls for this user are: turning multipipe bank on/off and turning compressors on/off (described below). There is no password for this user;<br>– tech - higher access than user but still limited. Beyond 'user' 'tech' can adjust cooling / heating setpoints, turn separate modules on / off and has access to some machine basic temperature control settings (described below).<br>– admin - full access to all the settings.<br>• Log in: Calls up user logging screen where user name and password have to be entered<br>• Log Out: unhidden for 'admin' and 'tech' users only. It logs out from 'admin' or 'tech' user to a default user, which is 'user.'<br>***Note:*** *If current user is 'admin' or 'tech' and none of the HMI buttons are pressed for 30 min, it automatically logs out to a default user, which is 'user'. This is the HMI access safety feature.*<br>**Figure 14. User logging screen**<br>  |
| **3 - Module Layout Access** | The module layout access button provides fast access to the module layout screen. |
| **4 - Active Alarm Access** | The active alarm access button provides fast access to a list of currently active system alarms. Flashing red bell icon indicates that there are some unacknowledged/active alarms in the HMI. Otherwise, it's static black. |

| Feature | Description |
|---|---|
| **5 - Setpoint** | Calls up cooling/heating setpoint pop-up screens respectively depending on the mode – accessible for 'tech' only. These dialog boxes display the resulting cooling/heating setpoint used for machine temperature control.<br><br>**Figure 15. Cooling setpoint**<br>  <br><br><br>**Figure 16. Heating setpoint**<br>  <br><br><br>***Note:*** *Each control box calls up numeric keypad (if corresponding user can access it) where modified value can be entered. For text boxes, selection list is called up.*<br><br>  <br><br>  <br> |
| **6 - System Temperature Sensors Reading** | System Temperatures Sensors for all three loops: Cold Water, Hot Water and Source. |

| Feature | Description |
|---|---|
| **7 - System Status** | Possible Options:<br>• System ON – system is operational and is not off by any of the conditions listed below.<br>• Phase Alarm – system is off by Phase Alarm if common Phase Monitor is used per multipipe.<br>• OFF by DI – system is off by opened state of primary PLC DI1 if corresponding option applies.<br>• OFF by Switch. System is off by software switch. It can be turned on / off either from Home Screen which all users have access to. It can also be turned on / off from BAS (Building Automation System).<br>• Off by switching to Simultaneous Mode – multipipe bank is switching over to Simultaneous Mode.<br>• OFF by switching to Heating - system is off and is switching over to Heating Mode.<br>• OFF by switching to Cooling - system is off and is switching over to Cooling Mode.<br>• OFF by BMS - system is off by Building Management System. |
| **8 - System Mode** | Indicates thermal mode: Simultaneous, Cooling, or Heating. |
| **9 - Power ON/OFF** | The multipipe on and off options are as follows:<br>• OFF – turn off multipipe bank.<br>• ON – turn on multipipe bank<br>• BMS – multipipe bank is turned on/off by BMS.<br>  |
| **10 - Pumps Operation States** | Evaporator/Condenser/Source Pumps operation state - green LED indicates that corresponding set of pumps is enabled; otherwise, pumps are disabled. |
| **11 - Module/Compressor Status** | **Cool/Heat Demand Comp%**<br>• Cooling/Heating Demand value in number of requested compressors as well as continuous value in %. There is also a bar graph representation of Cooling / Heating Demand beside the % value.<br>**Modules**<br>• Setup - number of multipipe modules set up.<br>• Online - number of multipipe modules currently communicating with Primary PLC including Primary Module.<br>• Cool/Heat/Simult - number of modules currently running in Cooling, Heating, or Simultaneous Mode.<br>**Comps**<br>• Setup - number of compressors.<br>• Online - number of operating compressors.<br>• Cool/Heat/Simult - number of compressors currently running in Cooling, Heating, or Simultaneous Mode. |

| Feature | Description |
|---|---|
| **12 - Module Access** |  <br>There are buttons to access all modules screens individually. Number on the button “M(X)” stands for the module number in the bank. Buttons are viewable (modules accessible) for modules that communicate to HMI only. Each module menu includes the following set of screens:<br>• Overview - overview of main multipipe module refrigeration parameters and status of its components: refrigeration circuit, heat exchangers, compressors, and module itself.<br>• I/O - state and description of module PLC digital/analog inputs and outputs including expansion IO (Inputs Outputs) module.<br>• Trend - trending curves for Cooling/Heating Demand as well as Simultaneous/Cooling/Heating Compressors are displayed (detailed below); applies to Primary Module only.<br>• Setup - setup screens contain all the settings applied to system and available for Primary Module only as well as module settings. All Setup screens are available for “admin” user only.<br>**Figure 17. Interface navigation scheme**<br>  |
| **13 - Date/Time** | Current HMI date/time as set up in HMI system settings.  |

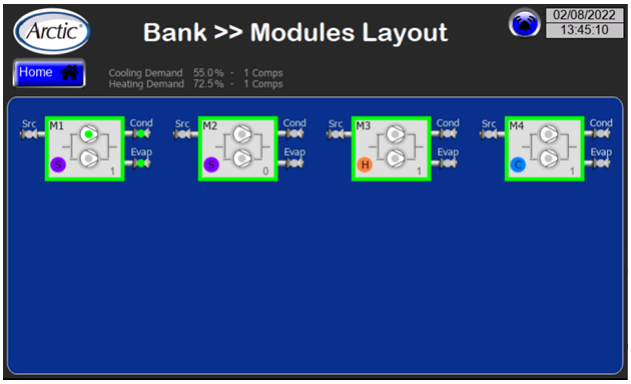
# Modules Layout Screen

The multipipe can be composed of up to a maximum of ten modules. Pressing the LAYOUT button displays the screen showing the status of compressors and valves in each module.

This screen is a graphical representation of modules available in the system. Only modules that communicate to HMI are visible.

Each module diagram is a set of symbols and colors that show the real-time status of compressors, refrigeration circuit, isolation valves, and overall module. See the following figure.

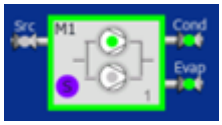
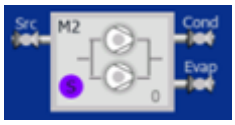
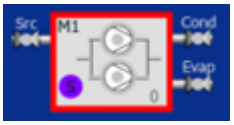
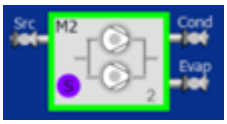
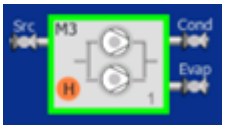
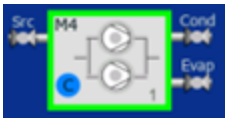
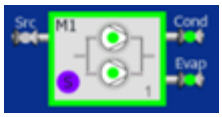
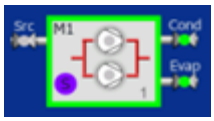
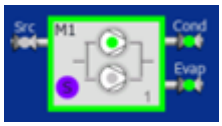
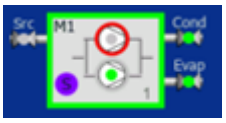
**Figure 18. Modules layout screen showing eight compressors on four modules**




## Module Layout Screen Status Conditions

Each module picture is a set of images that show real-time color-coded state of compressor, refrigeration circuit, isolation valves and module.

**Table 5. Module status conditions**

| | | |
|---|---|---|
|  <br>Module is available |  <br>Module is unavailable |  <br>Module turned off by alarm and unavailable |
|  <br>Module in Simultaneous Mode |  <br>Module in Heating Mode |  <br>Module in Cooling Mode |
|  <br>Refrigeration circuit in normal state |  <br>Refrigeration circuit in alarm state |  <br>Isolation Valves:<br>- Valve LED is green = valve is open<br>- Valve LED is gray = valve is closed |
|  <br>Compressor 1 is ON; Compressor 2 is OFF |  <br>Compressor 1 in Alarm; Compressor 2 is ON | |

## Active Alarms Screen

The active alarms screen lists all active (triggered) and non-active alarms in tabular form. See the following figure.

**Figure 19. Active alarms screen**

## Select

This column indicates if the alarm is selected or unselected for acknowledgment or resetting.

## Action

This column gives alarm details if applicable

## Name

This column gives alarm name.

## Status

This column displays the alarm state. There are five possible states for any alarm:

- Triggered Not Acked – Alarm triggered (active) but not acknowledged.
- Triggered Acked – Alarm triggered (still active) and has been acknowledged.
- Not Triggered Not Acked – Alarm no longer appears (inactive) but not acknowledged.
- Not Triggered Acked – Alarm no longer appears (inactive) and acknowledged.
- Not Triggered – Alarm no longer appears (inactive), acknowledged and reset (removed from Active Alarms list).

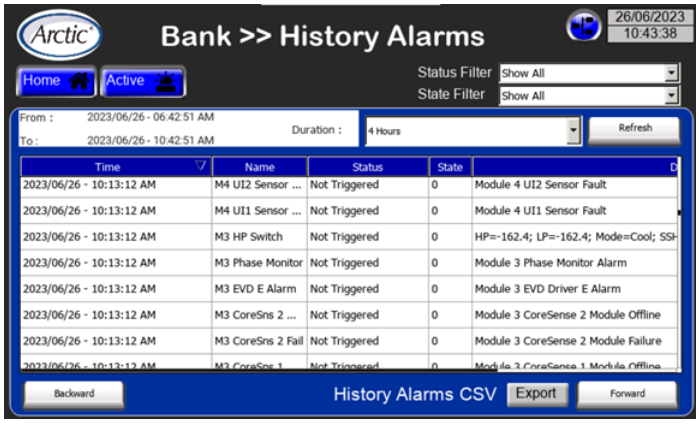
## State

Alarm is Active (Triggered) if State Value = 1 (still active in the PLC).

Alarm is Not Active (Not Triggered) if State Value = 0 (can be reset using Reset button).

Both Active and Non Active alarms can be acknowledged. When a Non Active alarm is acknowledged, it can be reset which will remove it from the list to show only Active alarms in the list.

**Figure 20. Alarm history screen**




The alarm history screen displays the history of alarms recorded by the primary microprocessor.

## Time

This column is the date-time stamp indicating exactly when the alarm occurred.

## Description

This column provides alarm description or for certain alarms, snapshots of module parameters values.

## Check / Uncheck All

This button is used for selecting and deselecting all listed alarms with a single action.

## Filter

Drop-down menu is used to either list all the alarms both Active and Not Active or Active ones only (default selection).

## Reset PLC

This button is used to reset Active alarms in the PLC, so they could be further acknowledged/reset on the HMI.

## Save

Pressing this button saves the changes made to the active alarms list. Any changes that are made without saving will be lost.

# Alarm History

On the active alarms screen, pressing the alarm history button displays the alarm history screen.


## Sorting

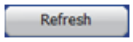
The alarm history list can be sorted by any column in ascending or descending order by tapping the corresponding column heading. The triangle that appears

next to the heading indicates which column is being sorted and the direction of sorting.

Sorting is applied to the alarm time column in ascending order by default, which is indicated when the triangle is pointing up. Ascending order for the alarm time column requires that earlier records appear on the list first. For all other columns, alphabetical sorting applies.

## Duration

Allows the selection of the time period for which the alarm history is displayed. Once the selection is made from the drop-down menu, pressing the REFRESH button updates the list and then 'From' and 'To' timestamps get updated accordingly.




## Time

This is the time stamp that is displayed when the alarm state changes.

## Status

This column displays the alarm state. There are five possible states for any alarm:

- Triggered Not Acked – Alarm triggered (active) but not acknowledged
- Triggered Acked – Alarm triggered (still active) and has been acknowledged
- Not Triggered Not Acked – Alarm went away (inactive) but not acknowledged
- Not Triggered Acked – Alarm went away (inactive) and acknowledged
- Not Triggered – Alarm went away (inactive), acknowledged, and reset (removed from Active Alarms list)

## State

Alarm is Active (Triggered) if State Value = 1 (still active in the PLC)

Alarm is Not Active (Not Triggered) if State Value = 0 (can be reset using Reset button)

Both Active and Non Active alarms can be acknowledged. When a Non Active alarm is acknowledged, it can be reset which will remove it from the list to show only Active alarms in the list.

## Description

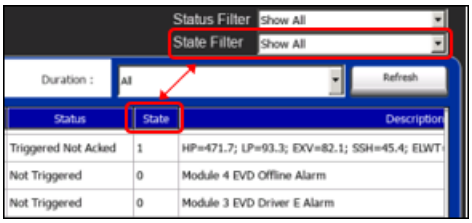
This column provides alarm description or for certain alarms, snapshots of module parameters values.

## History Alarms CSV Report

This generates a history alarms log as CSV file that can be stored.

## Alarms Filtering

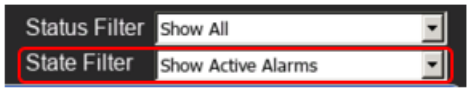
State Filter applies to Alarm State.




Alarm State '0' – Alarm is inactive.

Alarm State '1' – Alarm is active (even if it has been acknowledged).

When Show Active Alarms is selected from the State Filter drop-down list, inactive alarms (State = '0") will be hidden on the list, and only active alarms (State = "1") will appear.



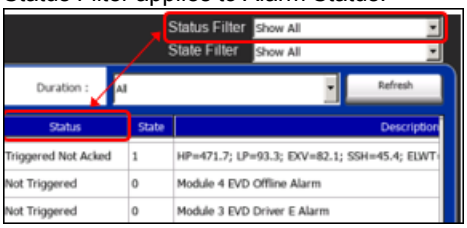

For example: High Pressure switch alarm records *before* filter is applied.

| Time | Name | Status | State | Des |
|---|---|---|---|---|
| 2021/11/15 - 09:22:20 AM | M1 HP Switch Ckt1 | Not Triggered | 0 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |
| 2021/11/15 - 09:22:05 AM | M1 HP Switch Ckt1 | Not Triggered Acked | 0 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |
| 2021/11/15 - 09:21:56 AM | M1 HP Switch Ckt1 | Triggered Acked | 1 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |
| 2021/11/15 - 09:21:48 AM | M1 HP Switch Ckt1 | Triggered Not Acked | 1 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |

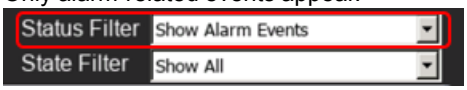
High Pressure switch alarm records *after* filter is applied.

| Time | Name | Status | State | Des |
|---|---|---|---|---|
| 2021/11/15 - 09:21:56 AM | M1 HP Switch Ckt1 | Triggered Acked | 1 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |
| 2021/11/15 - 09:21:48 AM | M1 HP Switch Ckt1 | Triggered Not Acked | 1 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |

Status Filter applies to Alarm Status.




When Show Alarm Event is selected from the Status Filter drop-down list, any non-alarm events pertaining to user action (acknowledgement and reset) is filtered off the list. Only alarm-related events appear.




For example: High Pressure switch alarm records *before* filter is applied.

| Time | Name | Status | State | Des |
|---|---|---|---|---|
| 2021/11/15 - 09:22:20 AM | M1 HP Switch Ckt1 | Not Triggered | 0 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |
| 2021/11/15 - 09:22:05 AM | M1 HP Switch Ckt1 | Not Triggered Acked | 0 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |
| 2021/11/15 - 09:21:56 AM | M1 HP Switch Ckt1 | Triggered Acked | 1 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |
| 2021/11/15 - 09:21:48 AM | M1 HP Switch Ckt1 | Triggered Not Acked | 1 | HP1=189.1; Amb=78.8; CEWT=0.0; CLWT |

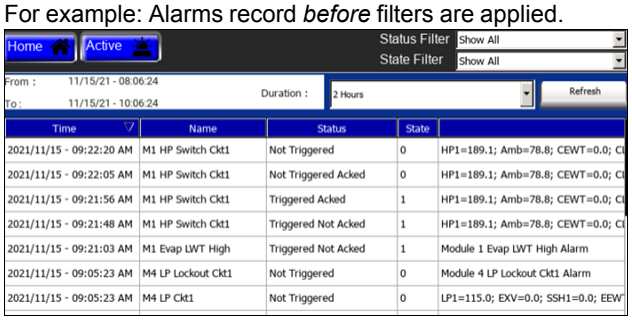
High Pressure switch alarm records *after* filter is applied.

| Time | Name | Status | State | |
|---|---|---|---|---|
| 2021/11/15 - 09:22:05 AM | M1 HP Switch Ckt1 | Not Triggered Acked | 0 | HP1=189.1; Amb=78.8; CEWT=0.0; CL |
| 2021/11/15 - 09:21:48 AM | M1 HP Switch Ckt1 | Triggered Not Acked | 1 | HP1=189.1; Amb=78.8; CEWT=0.0; CL |

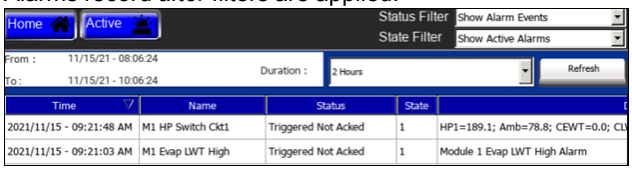
Combining both State Filter and Status Filter can enhance alarms viewing even more.

For instance, one needs to view only events when alarms occurred and hide all other ones (aka one alarm event for each alarm).

For example: Alarms record *before* filters are applied.




Alarms record *after* filters are applied.




## Module Access

Buttons to access all modules screens individually. Number on the button “M(X)” stands for the module number in the bank. Buttons are viewable (modules accessible) for modules that communicate to HMI only. Each module menu includes the following set of screens.

- Overview - overview of the main multipipe module refrigeration parameters and status of its components: refrigeration circuit, heat exchangers, compressors, and module itself.
- I/O - state and description of module PLC digital/analog inputs and outputs including expansion IO (Inputs Outputs) module.
- Trend - trending curves for Cooling or Heating Demand as well as Simultaneous/Cooling/Heating Compressors are displayed. This applies to Primary Module only.
- Setup - setup screens contain all the settings applied to system and is available for primary module as well as module settings. All setup screens are available for ‘admin’ user only.

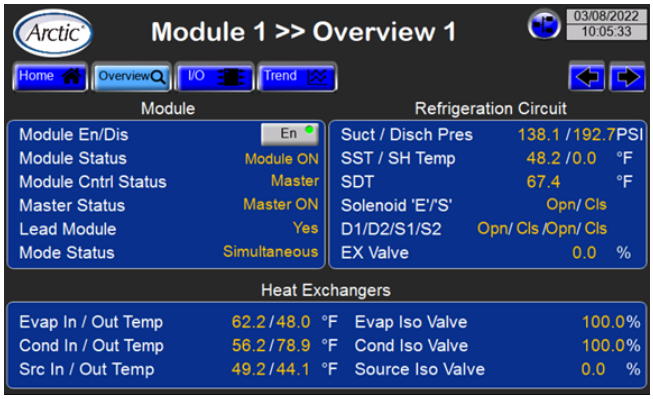
## Overview Module Screens

On the home screen, pressing the **M1** button displays the Module #1 (primary module) screens.

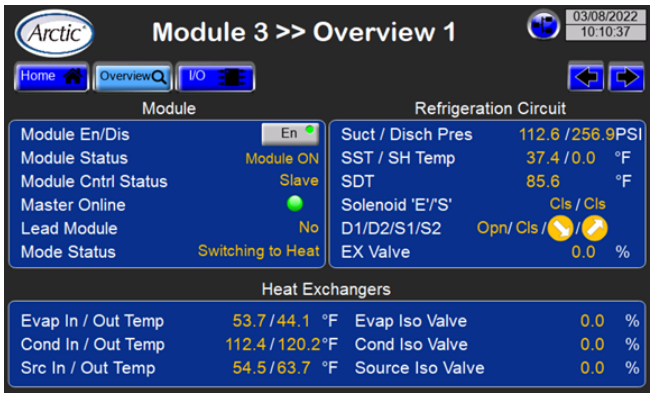
Overview menu is comprised of two screens: Overview 1 and Overview 2

These two screens are different for Primary and Secondary Module.

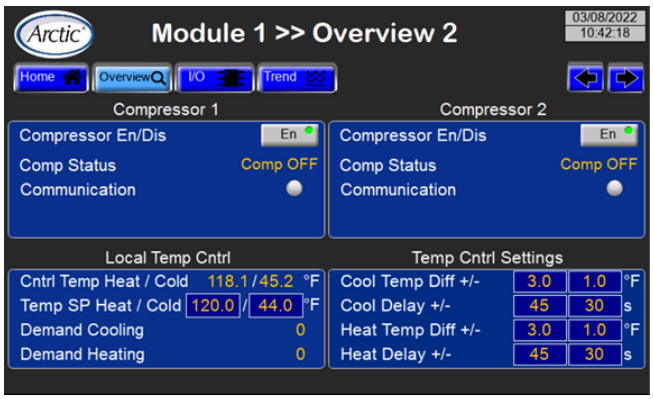
**Table 6. MWS overview screens**



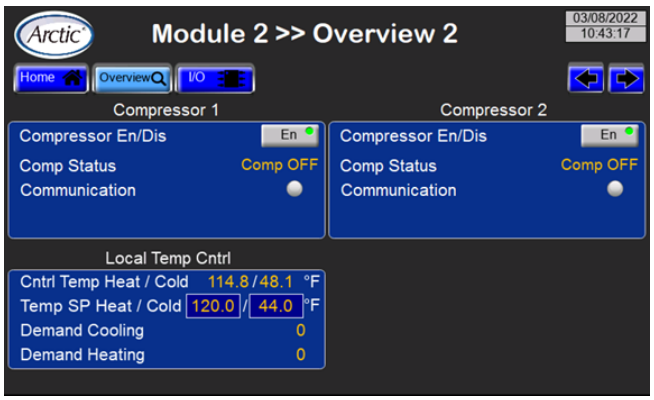

MWS Overview 1 – Primary Module




MWS Overview 1 – Secondary Module




MWS Overview 2 – Primary Module




MWS Overview 2 – Secondary Module

## Overview 1 – Module

### Module En/Dis

Pressing this button enables or disables a module. If module is disabled, it's excluded from primary control compressors sequence. Not accessible for 'user.'

### Module Status

Possible options:

- Module ON – Module is ready to run.
- OFF by Schedule – Module operates according to predefined schedule and is currently off as scheduled.
- OFF by DI – Module is off by opened state of PLC DI1.
- OFF by Switch – Module is off by Module En/Dis button.
- OFF by Alarm – Module is locked out by one of the major alarms.
- OFF by Primary – Module is switching between control states Primary/Secondary/Stand-alone.
- OFF by System – Module is off by one of the System Off conditions.
- Man Mode – Module is in manual mode.
- OFF by switching Mode – Module is going through a major parameter change. For example, number of refrigeration circuits.

### Module Cntrl Status

Possible options:

- Primary – Module acts as a primary module. Primary module performs temperature control for either heating or cooling loads. It also acts as a Primary when communicating with secondary modules and defines how many modules need to run its compressors in order to satisfy heating or cooling controlled temperatures.

  ***Note:*** *Primary Module is defined by its PLC IP address. So in the multipipe, Primary PLC IP address is always 192.168.1.11. All Secondary IP addresses go from 192.168.1.12 to 192.168.1.20 which amounts to nine Secondaries. Each IP address must be unique for all the devices to communicate properly, including HMI whose IP address is 192.168.1.10.*

- Secondary – Module acts as a secondary module. Conditions for the module to be a secondary module:
  - It's PLC has been assigned IP address from secondaries addresses range.
  - It is communicating with primary module.
  - Primary module exists on the network, in other words Primary PLC meets primary module conditions (see Primary Status below).
  - Stand-alone. Module doesn't meet either primary module or secondary module conditions.

  ***Note:*** *Stand-alone module operates as independent multipipe module and controls cooling / heating temperatures locally based on its Evaporator / Condenser EWT / LWT depending on cooling / heating / simultaneous mode and control temperature sensor selections. Stand-alone is rather fail-safe mode than intended mode. So, module runs temporarily in this mode until normal Primary / Secondary operation is restored. This applies except for systems that consist of one module only. In such a case it always operates in Stand-alone Mode, since Primary PLC won't have any subordinate Secondary Modules to communicate to.*

### Master Status

Applies to primary PLC only. Possible options:

- Primary ON – All primary modules conditions are satisfied by module.
- Waiting – All primary modules conditions are satisfied, and module is counting down a delay before acquiring primary ON status.
- OFF by Cool Sensor – System cooling temperature sensor failed.
- OFF by Heat Sensor – System heating temperature sensor failed.
- OFF by no secondaries – Primary PLC communicates with no secondary modules.
- OFF by Exp IO Fault – Failure occurred in Primary PLC IO expansion module #1 which renders all system temperature sensors failed.

***Note:*** *All Primary Status States 3 to 6 will cause all the modules to run in Stand-alone mode. These failing conditions are false at normal primary/secondary operation.*

### Master Online

Applies to secondary PLC only. Possible options:

- LED is green - secondary PLC is communicating with primary PLC.
- LED is gray - secondary PLC is not communicating with primary PLC.

### Lead Module

Indicates which module is currently a lead module in the bank.

***Note:*** *Lead Module is the module which always starts first. When there are no compressors running, Lead Module always keeps its Isolation Valves open. (depending on the mode) to allow for chilled/hot water circulation. By default, Primary Module is the Lead Module. Next time when last running compressor turns off because cooling/heating temperatures are satisfied, Lead Module 'marker' is passed on to the next module. As a result, next time, compressors sequence starts off from that module. The idea is to equalize compressors running hours.*

### Mode Status

1. Simultaneous – Module is in Simultaneous Mode.
2. Heating – Module is in Heating Mode.
3. Cooling – Module is in Cooling Mode.
4. Switching to Simult – Module is switching to Simultaneous Mode.
5. Switching to Heat – Module is switching to Heating Mode.
6. Switching to Cool – Module is switching to Cooling Mode.

### Heat Exchangers

Displays each heat exchanger Evaporator/Condenser/ Source inlet and outlet temperatures as well as opening status of its Isolation Valves.

### Refrigeration Circuit

Refrigerant temperatures/pressures are displayed: suction pressure, discharge pressure, saturated suction temperature, saturated discharge temperature, and suction super heat temperature.

- Solenoid E – solenoid valve installed at the evaporator heat exchanger inlet. It opens when compressors are running in Simultaneous or Cooling mode.
- Solenoid S – solenoid valve installed at the source heat exchanger inlet. It opens when compressors are running in Heating mode.
- D1/D2/S1/S2 – Discharge and Suction refrigerant valves. Depending on the Module Thermal Mode, valves are automatically positioned as follows:

| Valve | Mode | | |
|---|---|---|---|
| | **Simultaneous** | **Cooling Only** | **Heating Only** |
| Discharge 1 (D1) | Open | Closed | Open |
| Discharge 2 (D2) | Closed | Open | Closed |
| Suction 1 (S1) | Open | Open | Closed |
| Suction (S2) | Closed | Closed | Open |

If Module goes through Thermal Mode switchover, corresponding valves would be stroking to open/closed position displaying the following symbols:

-  – valve is opening
-  – valve is closing
- EX Valve – indicates the position of electronic expansion valve

Use  to navigate through the Overview screens.

## Overview 2– Compressor 1/Compressor 2

### Compressor En/Dis

Button to enable/disable compressor. It is used for testing or maintenance purposes.

### Comp Status

- Comp OFF — Compressor is off and cannot be turned on.
- Ready — Compressor is ready to run.
- OFF by Source Flow — Compressor is waiting for Source Flow confirmation.
- OFF by Cond Flow — Compressor is waiting for Condenser Flow confirmation.
- OFF by Evap Flow — Compressor is waiting for Evaporator Flow confirmation.
- OFF by Min Off — Compressor is cycling through safety Minimum Off Time.
- OFF by Switch — Compressor is off by En/Dis Switch.
- OFF by Alarm — Compressor is off by Alarm.
- Running — Compressor is running.
- ON by Min On — Compressor is commanded off but running cycling through a safety Minimum On Time.
- Start Delayed — Waiting for EXV positioning or going through second compressor start-up delay.
- Off by LP – Capacity limited to a single running compressor due to a low suction pressure.
- Off by HP – Capacity limited to a single running compressor due to a high discharge pressure.
- Commanded On – Compressor commanded on by PLC but not running as confirmed by external compressor control device.

### Communication

Comm LED indicates if PLC is communicating to compressor control device.

### Local Temp Cntrl

Applies only if module is running in stand-alone mode.

- Cntrl Temp Heat/Cold – Local module hot or chilled water temperature control sensor.
- Temp SP Heat/Cold – Local module heating or cooling temperature control setpoint. Can be adjusted by “tech” user only.
- Cool/Heat Comps Demand – Cooling or Heating Demand value in number of requested compressors.

### Temp Cntrl Settings

Viewable/adjustable for 'tech' user only.

- Cool Temp Diff +/- — Cooling temperature control differential above/below setpoint or positive/negative dead band (DB).
- Cool Delay +/- — Cooling compressor Stage-Up/Stage-Down Delays. (When next compressor has been staged up, Stage-Up Delay has to elapse before next compressor is allowed to stage up. When next compressor has been staged down, Stage-Down Delay has to elapse before next compressor is allowed to stage down.)
- Heat Temp Diff +/- — Heating temperature control differential above/below setpoint or positive/negative dead band (DB).

## Module I/O Screens

Data is collected by sensors as either analog or digital signals and displayed on the IO Status screens.

When the module screen is displayed, press 

to display the I/O menu.

The I/O menu is comprised of four screens for primary module and three screens for secondary module. Both primary and secondary modules have analog I/O (analog input and analog output), and digital I/O (digital input and digital output). Primary module, however, has two Expansion I/O screens – Exp IO #1 and Exp IO #2, while Secondary Module has only Exp IO #2 screen.

In the I/O menu, use 

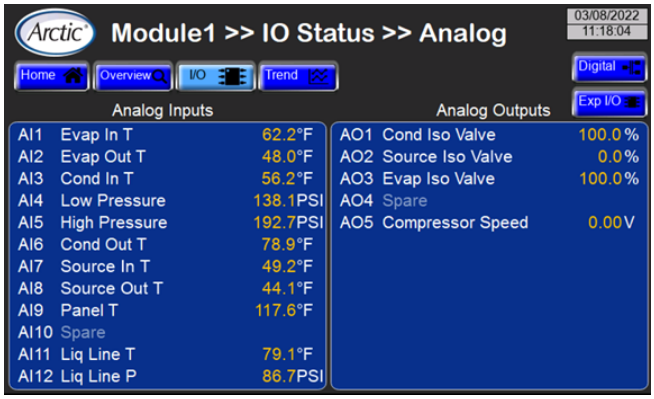
, 

, or 

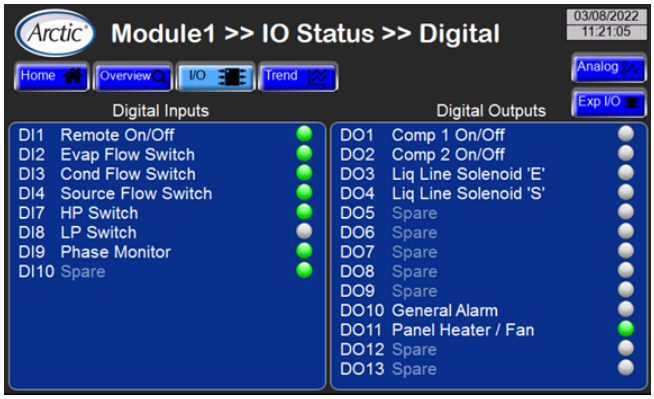
to switch between I/O screens.

Use  to switch between IO#1 and IO#2 screens in Expansion I/O screen.

**Table 7. Analog and digital input/output screens**



MWS Primary/Seconday I/O Analog Screen



MWS Primary/Seconday I/O Digital Screen

## Analog Inputs

Analog input (AI) data includes these parameters:

### AI1 –AI3, AI6 - AI8

These inputs indicate inlet/outlet temperatures for each of three heat exchangers: Evaporator, Condenser, and Source.

### AI4

This input indicates Suction Pressure

### AI5

This input indicates Discharge Pressure

### AI9

This input indicates Panel Temperature (optional). It is used when temperature control inside control panel is required for either heating (for cold environment) or cooling (for hot environment).

### AI11

This input indicates Liquid Line Temperature.

### AI12

This input indicates Liquid Line Pressure.

***Note:*** *All Analog Inputs are Universal Inputs (UI). Each UI can be re-configured to be either AI, DI or AO in terms of hardware functionality.*

## Analog Outputs

Analog output (AO) data includes these parameters:

### AO1 – AO3

These outputs indicate Condenser/Source/Evaporator Isolation Valves position.

## Digital Inputs

### Digital LEDs

There is an LED for each digital input (DI) that shows its state.

**Green LED** — DI is closed.

**Gray LED** — DI is open.

Digital input (DI) data includes these parameters:

### DI1

This input indicates Remote On/Off. This activates a module on or off via digital input. For Primary Module toggling DI1 will turn on/off the entire unit if respective option selected.

### DI2 – DI4

These inputs indicate the state of Evaporator/Condenser/Source flow switch. DI closed – flow present; DI opened – flow absent.

### DI7, DI8

These inputs indicate Discharge/Suction Pressure switches. DI closed – pressure is in the normal range; DI opened – pressure exceeds normal range threshold (faulty state).

### DI9

This input indicates Phase Monitor. This is feedback for the multipipe three-phase power supply protection feature. DI closed – no power supply issues; DI opened – power supply failure detected. If common power supply protection module is used for the multipipe, its failure will affect each module. In such a case, this DI is optional for Secondary Module.

## Digital Outputs

### Digital LEDs

There is an LED for each digital output (DO) that shows its state.

**Green LED** — DO is energized; connected device is powered up or running.

**Gray LED** — DO is de-energized; connected device is not powered up or not running.

### DO1, DO2

These outputs indicate Comp On/Off — turns a compressor on and off.

### DO3

This output indicates Liq Line Solenoid ’E’ – energizes and de-energizes the liquid line solenoid valve ‘E’.

### DO4

This output indicates Liq Line Solenoid ’S’ – energizes and de-energizes the liquid line solenoid valve ‘S’.

### DO10

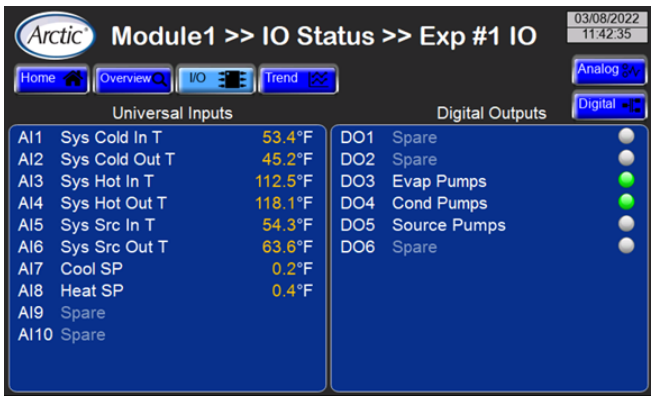
This output indicates General Alarm — energizes when any of the following alarms occur.

- An alarm that shuts down and locks out compressor 1 or 2.
- An alarm that shuts down and locks out the entire module.

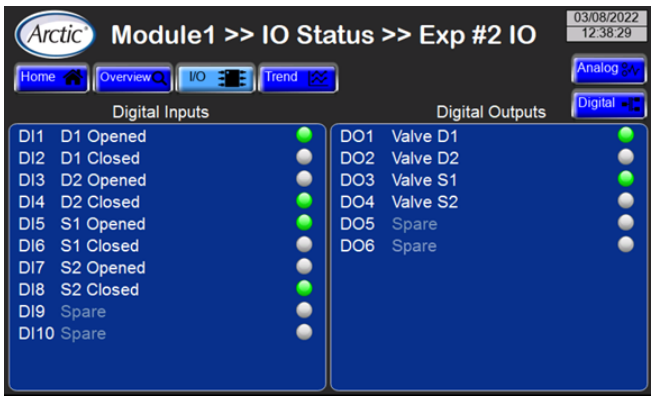
### DO11

This output indicate Panel Heater (optional) – used when temperature is required to be controlled inside control panel.

## Expansion IO Screen




MWS Primary Expansion I/O Screen#1




MWS Primary/Secondary Expansion I/O Screen#2

### Expansion IO Screen 1

This screen applies only to the primary module. This screen controls analog inputs and digital requests.

#### AI1 – AI6

These show inlet/outlet temperatures for each of three water loops: Chilled Water, Hot Water, and Source Water.

#### AI7, AI8

Cool SP/Heat SP (optional); External cooling/heating setpoints - used when cooling/heating setpoints come to multipipe control system from BMS as hard-wired AI signals.

***Note:*** *Another way to send cooling/heating setpoints is via BMS communication.*

***Note:*** *All c.pCOe #1 Analog Inputs are actually Universal Inputs (UI); same as PLC UI. So any c.pCOe UI can be re-configured to be either AI, DI, or AO.*

#### Digital LEDs

There is an LED for each digital output (DO) that shows its state.

**Green LED** — DO is energized; connected device is powered up or running.

**Gray LED** — DO is de-energized; connected device is not powered up or not running.

#### DO3 - DO5

Evap/Cond/Source Pumps – used to turn on/off pumps in each of three water loops: Chilled Water, Hot Water, and Source Water. These are hard-wired outputs that have to be wired into BMS for pumps control.

***Note:*** *Pumps on/off signals are also duplicated on BMS communication if it has been set up and is in use.*

### Expansion IO Screen 2

#### Digital LEDs

There is an LED for each digital input (DI) that shows its state.

**Green LED** — valve reached respective position.

**Gray LED** — specified valve position not reached.

#### DI1 – DI8

Shows status of the Discharge/Suction refrigerant valves: D1, D2, S1, S2.

#### DO1 – DO4

Shows status of the Discharge/Suction refrigerant valves: D1, D2, S1, S2 on/off control signals.

## Trend Screen


When in the primary module screen, pressing the trend button displays the trend screen. There are three trend screens: cooling, heating, and simultaneous. Use

to navigate through trend screens.

Since system variables are trended, trend screens apply to primary module only.

Both Cooling/Heating Screens display five trends: Chilled Water Inlet/Outlet Temperatures, Hot Water Inlet/Outlet Temperatures, Cooling Demand, Heating Demand, and Number of Requested Compressors.

Simultaneous Trend displays five trends as well: number of requested cooling/heating compressors and number of actually running simultaneous/cooling/heating compressors.

Trends can be viewed in real time as well as for the last four days. Each variable is trended every three seconds. Trending data is stored in HMI internal memory.

Cooling, Heating, and Simultaneous Trend Screens have similar but independently-managed controls and trends viewing such as scrolling, zooming, and deleting.

**Figure 21. Cooling trend screen**

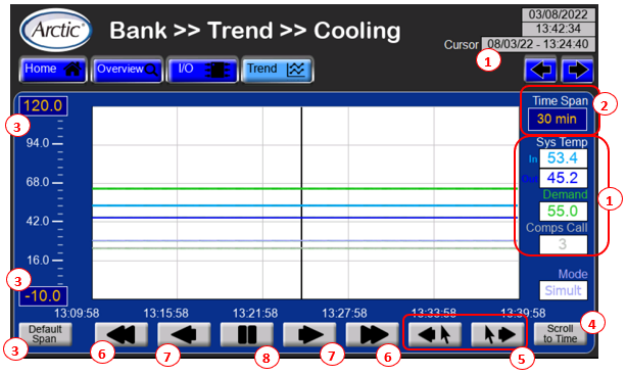



**Table 8. Trend screen labels**

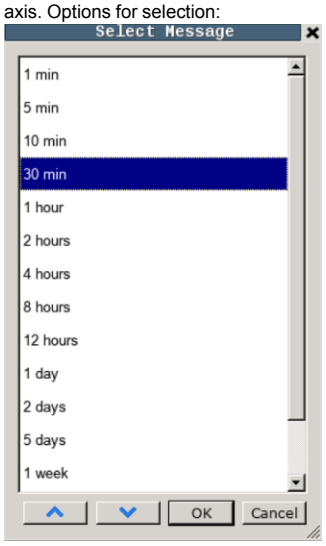
| Label | Description |
|---|---|
| 1 | According to where the cursor is placed, it is capturing real time values of in and out water temperatures. Current cursor timestamps are displayed as well. |
| 2 | Text box to select viewing time span. It is used for zooming in on trends time axis. Options for selection:<br>  |
| 3 | Maximum and Minimum thresholds for trends viewing. Used for zooming in on trends variables axis. Both Maximum and Minimum thresholds are adjustable via respective numeric boxes. Default Min/Max values: –10.0/160.0.. Default Span button is used to revert to defaults to reset longitudinal zooming. |
| 4 | Scroll to Time button is used to return to real time viewing. |
| 5 | Cursor positioning buttons. |
| 6 | Buttons used to scroll back and forth in time. They implement time axis trends pages scrolling. |
| 7 | Buttons used to scroll back and forth in time. High resolution time axis scrolling. |
| 8 | Button used to pause/resume real-time trending. |

**Figure 22. Heating trend screen**

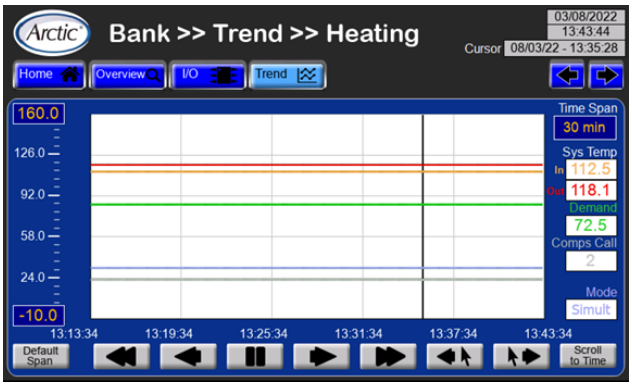
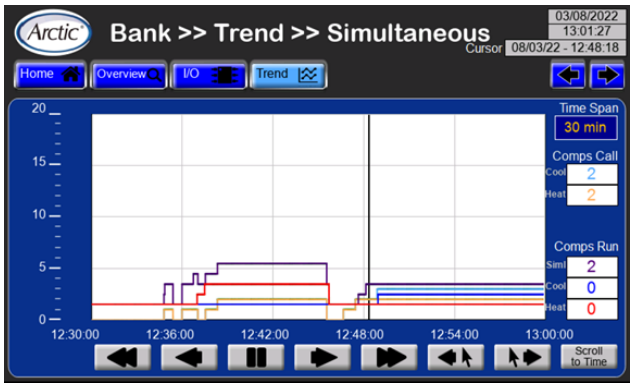



**Figure 23. Simultaneous trend screen**




# Operator Tasks

Before operating the unit, confirm that all compressor refrigeration service valves are fully back-seated counterclockwise.

## Normal Power Up

The following procedure is used for a start-up resulting from scheduled seasonal or programmed cold shut down of the unit.

**⚠ WARNING**

**Hazardous Voltage!**

**Failure to disconnect power before servicing could result in death or serious injury.**
**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.**

***Important:*** *This start-up procedure is not to be used for the first-time initial start-up for a newly installed system. See Preparation for Initial Start-Up in the Installation section of this manual for instructions regarding that situation.*

1. De-energize the multipipe using standard lockout/tagout procedures.
2. Using a known operational voltage meter, test and confirm the unit is de-energized before proceeding further.
3. Inspect power distribution fuses and overload settings to verify they are correct.
4. Verify that the oil level is correct in each compressor using the compressor sight glass.

***Note:*** *See recommended inspection interval in the maintenance section of this manual.*

**NOTICE**

**Compressor Failure!**

**Failure to follow instructions below could result in catastrophic compressor failure.**
**Do not operate with insufficient oil.**

5. Verify that pressure and temperature switches are closed.
6. Restore power to all modules.
7. Inspect refrigerant pressures for each module using the touchscreen interface panel.
8. Verify that pressure switches and thermostats have the correct cut-in and cut-out settings using the touchscreen interface panel.
9. Verify water flow to condenser and evaporator.
10. Monitor and record temperature and refrigerant pressures registering on the touchscreen interface panel.

# Emergency Power Shutdown

The multipipe does not include a disconnect to turn off the high voltage to the modules. As per NFPA 70, The National Electrical Code, a disconnect must be installed within the line of sight of the electrical and control panel. Should an emergency condition arise, the disconnect must be opened to shut down all voltage to the system.

There are several ways to interrupt power to all or part of the multipipe:

- Disconnect the primary power source from the building that feeds electricity to the system. This occurs in sudden emergencies (usually weather-related) or planned maintenance shut-downs.
- Press the panel disconnect switch on the exterior door of the multipipe's main power distribution panel, if so equipped.
- Move the circuit breaker switch to the OFF position (CB-1 and CB-2) on the power distribution panel. This cuts power to all of the modules.
- Move the circuit breaker switch to the OFF position (CB-1 and CB-2) on a module's electrical and control panel. This cuts power to the compressors in a single

module. It does not cut power to electrical and control panel or other modules.

- Press the SYSTEM ON button on the touchscreen interface panel that is built into the power distribution panel door.

***Note:*** *Pressing the SYSTEM ON button on the touchscreen interface panel, does not de-energize the system or the high voltage current into each module's electrical and control panel. This action sends a command to the controller in each module's compressors to discontinue electrical current to that component.*

# Water Quality Guidelines

The multipipe is equipped with high efficiency compact brazed plate heat exchangers (BPHX). Water quality must be maintained periodically by the end user to avoid scaling and corrosion inside the heat exchangers.

**Table 9. Water quality guidelines**

| Element /Compound/Property | Value/Unit |
|---|---|
| pH | 7.5 - 9.0 |
| Conductivity | < 500 µS/cm |
| Total Hardness | 4.5 - 8.5 dH° |
| Free Chlorine | < 1.0 ppm |
| Ammonia ($NH_3$) | < 0.5 ppm |
| Sulphate ($SO_4^{2-}$) | < 100 ppm |
| Hydrogen Carbonate ($HCO_{3-}$ | 60 – 200 ppm |
| ($HCO_{3-}$) / ($SO_4^{2-}$) | > 1.5 |
| (Ca + Mg) / ($HCO_{3-}$) | > 0.5 |

**Table 9. Water quality guidelines (continued)**

| Element /Compound/Property | Value/Unit |
|---|---|
| Chloride (Cl-) | < 200 ppm |

**Notes:**

1. Total Hardness/corrosion: Water with high hardness can cause corrosion problems due to its high ion content (Ca+2, Mg+2, Fe+2) which also means a high electrical conductivity and a high total dissolved solid (TDS). For this reason, too high hardness values should be avoided, not only due to higher risk of scaling, but also for corrosion risk. On the other hand, soft water, but not necessarily cation exchange softened water, may in contrast have a low buffering capacity and so be more corrosive. If the hardness values are outside the recommended range, other parameters such as oxygen content, conductivity, and pH values should be considered to evaluate the corrosion risk
2. Fe3+ and Mn4+ are strong oxidants and may increase the risk for localized corrosion on stainless steels in combination with brazing material copper.

# Monitor Water Quality

Maintaining water/glycol mixture quality and cleanliness is critical to multipipe maintainability. Strainers should be checked and cleaned on a regular basis. Water/glycol mixture samples should be taken and tested by a professional lab. The results will enable the accurate adjustment of quality thereby increasing the operational life of the system.

***Note:*** *Trane will not validate the multipipe warranty if proper water/glycol mixture composition and quality is not maintained.*

Protect the multipipe from freezing, particularly if the multipipe has a set point that is lower than the freezing point of the water/glycol mixture in the system. The equipment is designed to operate with a maximum propylene glycol concentration of 50%. See Table 10, p. 45, for the effects on the multipipe when operating with other glycol concentrations.

It shows the capacity reduction and the pressure drop that occurs when higher concentrations of glycol are used.

## Maintain Glycol Level

When the system has a water set point that is below the freezing point of the water/glycol in use, take precautions against freezing.

The glycol concentration should be based on the lowest fluid design temperature. See Table 11, p. 47for guidelines to add propylene glycol.

**Table 10. Glycol performance impact factors**

| Range Factor | Glycol Concentration Percentages and Performance Impact | | |
|---|---|---|---|
| Propylene Glycol Concentration | 30% | 40% | 50% |
| Lowest Ambient Temperature | 10 °F (-12 °C) | -4 °F (-10 °C) | -20 °F (-29 °C) |
| Recommended Minimum Leaving Fluid Temperature | 25 °F (-4 °C) | 10 °F (-12 °C) | -10 °F (-23 °C) |

**Table 10. Glycol performance impact factors (continued)**

| Range Factor | Glycol Concentration Percentages and Performance Impact | | | | | |
|---|---|---|---|---|---|---|
| Leaving Temperature | Capacity Reduction Factor | Pressure Drop Factor | Capacity Reduction Factor | Pressure Drop Factor | Capacity Reduction Factor | Pressure Drop Factor |
| 70 °F (21 °C) | 0.96 | 1.27 | 0.93 | 1.43 | 0.91 | 1.63 |
| 60 °F (15.6 °C) | 0.95 | 1.31 | 0.92 | 1.47 | 0.90 | 1.68 |
| 55 °F (13 °C) | 0.95 | 1.31 | 0.92 | 1.50 | 0.89 | 1.73 |
| 50 °F (10 °C) | 0.94 | 1.33 | 0.91 | 1.51 | 0.88 | 1.75 |

A 10% to 50% solution of glycol should be added to prevent pipe corrosion regardless of the fluid temperature. Propylene glycol has corrosion inhibitors that protect piping and components from corrosion and buildup of rust and other deposits. Trane recommends against using water/glycol solution in excess of 50% regardless of the ambient temperature conditions.

**NOTICE**

**Equipment Damage!**

**Failure to follow instructions below could result in permanent damage to pump and internal cooling surfaces.**

**Do not use automotive antifreeze.**

***Note:*** *If glycol-free solutions are mandated at the multipipe site, special inhibitors are available for rust prevention, mineral deposit inhibition, and biological suppression. Adding these inhibitors to the water solution is strongly recommended.*

Heaters, heat tracing cable, and closed cell insulation can be installed on any exposed “wet” multipipe components for protection against freezing in low ambient temperature and low refrigerant pressure conditions. However, the best freeze prevention is using the appropriate concentration of glycol. Trane does not warranty any component that fails due to freezing.

## Prevent Freezing

Many liquids expand in volume upon cooling. This expansion may cause pipes and other enclosed systems containing a liquid to rupture or burst when exposed to low temperature conditions. Burst protection is needed to protect piping and other enclosed systems when they are inactive as they could rupture due to expansion during cold weather or low refrigerant pressure.

Freeze points and burst points of glycol-water solutions are shown in Table 11, p. 47.

In order to maintain a high quality glycol solution, the water used in the glycol mixture must have very few impurities. Impurities in the water can increase metal corrosion, aggravate pitting of cast iron and steel, reduce the effectiveness of the corrosion inhibitors, and increase the depletion rate of the inhibitor package.

To assure inhibitor effectiveness, the levels of chlorides and sulfates in the water should not exceed 25 ppm each. The total hardness in terms of calcium carbonate should be less than 100 ppm. For best long-term results, de-ionized or distilled water is recommended. Trane can provide concentrated solutions of Dowfrost, propylene glycol, or premixed solutions for use with the system.

**NOTICE**

**Equipment Damage!**

**Failure to follow instructions below could result in permanent damage to pump and internal cooling surfaces.**

**Do not use automotive antifreeze.**

### Propylene Glycol

***Important:*** *The fluid volume increases as this slush forms and the temperature cools, flowing into available expansion volume in the multipipe. If the concentration of glycol is sufficient, no damage to the equipment from fluid expansion should occur within the temperature range indicated in . When liquids are cooled they eventually either crystallize like ice or become increasingly viscous until they fail to flow and set up like glass. The first type of behavior represents true freezing. The second is known as super-cooling. Glycols do not have sharp freezing points. Under normal conditions, propylene glycol sets to a glass-like solid, rather than freezing. The addition of glycol to water yields a solution with a freezing point below that of water. This has led to the extensive use of glycol-water solutions as cooling media at temperatures appreciably below the freezing point of water. Instead of having sharp freezing points, glycol-water solutions become slushy during freezing. As the temperature falls, the slush becomes more and more viscous and finally fails to flow.*

The calculations in this table are most accurate for Dowfrost (propylene glycol) and Dowtherm (ethylene glycol) branded products. Consult your local supplier or engineering contractor for more precise recommendations.

The precise concentration of glycol for a particular unit is affected by several key factors such as ambient temperature extremes, entering and leaving water temperatures, and system size. A multipipe's optimum glycol concentration is modified by these considerations as reflected in Table 10, p. 45. These capacity correction factors are the "best informed estimates" for systems with copper evaporators. The percentages may vary depending on the materials and alloys of the heat exchangers, total surface area, the amount of present or future fouling, and the brand of glycol used.

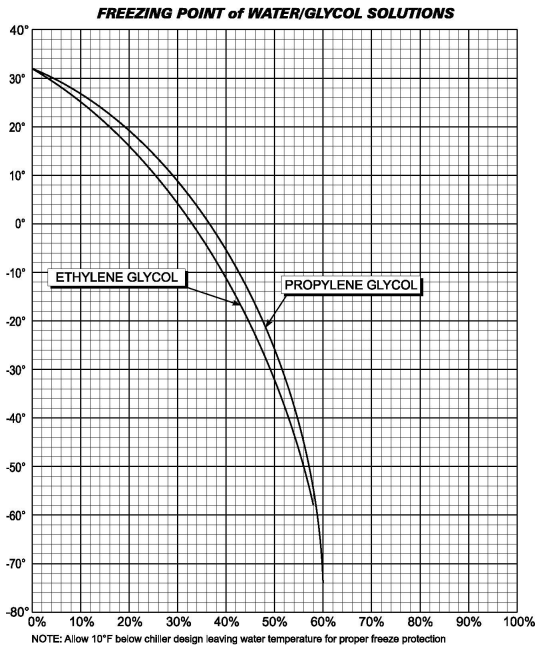
**Table 11. Freeze and burst protection chart**

| Water/Glycol Temperature | Freeze Protection | Burst Protection |
|---|---|---|
| 20 °F (-7 °C) | 18% glycol mixture | 12% glycol mixture |
| 10 °F (-12 °C) | 29% glycol mixture | 20% glycol mixture |
| 0 °F (-17.8 °C) | 36% glycol mixture | 24% glycol mixture |
| -10 °F (-23 °C) | 42% glycol mixture | 28% glycol mixture |
| -20 °F (-29 °C) | 46% glycol mixture | 30% glycol mixture |

## Storage Provisions

The units controls are designed for storage in ambient temperatures from -20 °F (-29 °C) to 145 °F (63 °C) with relative humidity from 0% to 100%. The glycol should be removed from the system if the unit is to be stored for extended periods. Although fluids can be drained via the plug in the bottom of the evaporator, the inhibitors in an approved glycol solution will best protect the surfaces of the evaporator against oxidation if the glycol remains inside the unit pump during storage.

**Figure 24. Water/Glycol concentration freezing points (in degrees fahrenheit)**



# Controls Interface

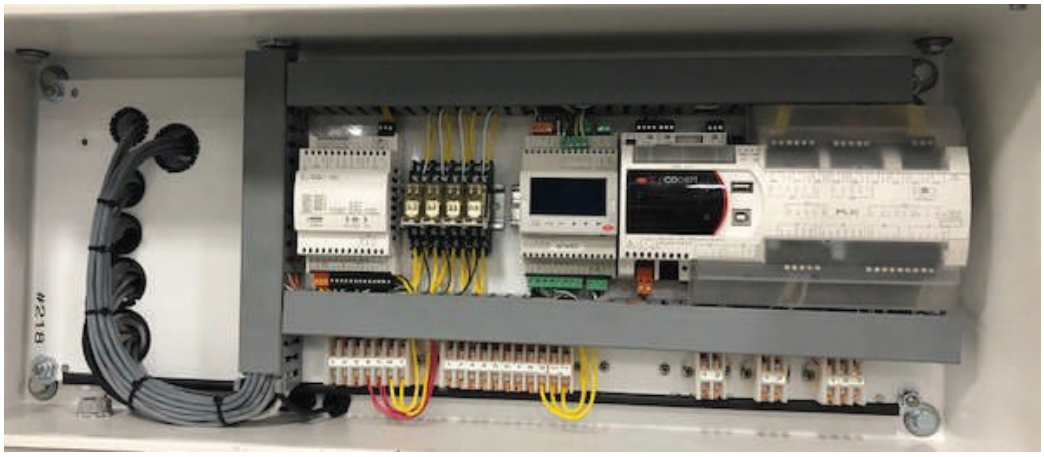
## Multipipe Controls

Each system is provided with a touchscreen interface panel that is used to turn the water-source multipipe system on and off, adjust set points, clear alarms, and perform detailed set-up of the microprocessor controllers.

The primary module contains the primary microprocessor controller. The primary microprocessor communicates with the secondary microprocessor in each module via a local communication network. The primary module also includes a phase monitor to protect against low voltage, phase imbalance, phase loss, and phase reversal conditions.

Each water-source multipipe control system includes operational switches for each compressor; high- and low-pressure transmitters to indicate refrigeration pressures in each circuit; high and low refrigeration pressure alarms (including shutting down the responsible compressors); anti-short cycling compressor timers; minimum compressor run timers; and connection to the BAS. See the following figure.

**Figure 25. MWS primary module control panel**



### Power Distribution

There are two different electrical panels used in the water-source multipipe system. The main power distribution panel receives power from the building source and distributes it to the individual modules. The module electrical and control panel receives power from the power distribution panel and provides power to individual electrical components.

**⚠ WARNING**

**Hazardous Voltage!**

**Failure to disconnect power before servicing could result in death or serious injury.**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.**

### Main Power Distribution

The power distribution panel distributes electricity from the external building power supply. It also houses breakers, phase monitor, and a touchscreen interface.

### Panel Disconnect

Some multipipe systems are optionally equipped with a panel-mounted disconnect switch installed on the outside of the power distribution panel (or on each module's electrical and control panel if the system has power supplied directly to each individual module). The disconnect switch must be turned to the off position before the panel can be opened for service.

### Module Electrical Panel

From the power distribution panel, power is fed to the individual modules in the multipipe system and connects to each module's electrical panel.

## Touchscreen Interface Panel

The touchscreen interface panel is the primary means for controlling and monitoring the system for operator and maintainer. An operator touch screen interface panel is installed on the primary module to allow operator adjustment of user set points and alarm monitoring. See the following figure.

**Figure 26. MWS touchscreen interface panel**


# Microprocessor Control System

Thermafit™ MWS water-source multipipe models employ a Carel c.pCO all-digital data control system to control and report key system settings and indicators.

## Primary Microprocessor Controller

A microprocessor controller is used to control tasks and automate functions. One microprocessor controller is designated the primary controller. All others are called secondary controllers. The primary microprocessor controller rotates the lead compressors every 168 system operating hours. The primary controller reads all analog and fault port values from the secondary controllers and passes these values to the Building Automation System (BAS). See “Electronic Control,” p. 27.

**Figure 27. c.pCO primary controller**


## Secondary Microprocessor Controller

In a normal configuration, a secondary controller controls the single module to which it is dedicated. The distributed design of the microprocessor controller system enables the multipipe to operate in the event the primary microprocessor controller fails. The system automatically fails-over to distributed primary control where each secondary controller operates its own module in the normal fashion, but lacks the ability to rotate the lead compressors every 168 system operating hours. See Figure 27, p. 49.

## Microprocessor Controller Functions

The microprocessor provides the following functions and alarms:

- Adjustable fluid temperature set point
- Multiple stage compressor control, including compressor rotation to provide balanced compressor usage and wear
- Reset temperature control set point based on decreased load
- High and low fluid temperature alarm set points
- Fluid inlet and outlet temperature
- Suction and discharge refrigeration pressures on each refrigeration circuit
- Compressor run status
- Current alarm status
- Demand load
- Compressor run hours
- Alarm logging with the time/date of the previous 2,000 alarms
- Remote start-stop input
- Dry contact for general alarm

# Thermal Capacity

The thermal capacity of the water-source multipipe modules is dependent on the leaving temperature of the chilled fluid mixture, maintaining a minimum flow of water

through the heat exchangers. In applications where it is desired to operate with a lower flow rate or higher temperature change, consult Trane technical support for recommendations.

## Low Pressure Bypass

This logic uses a time delay that temporarily bypasses the low-pressure switch for compressor start-up. Once the delay times out, normal controls are put back on line within the control circuit.

# Sequence of Operations

This manual describes a typical water-source multipipe system with few, if any, optional components or devices attached.

## Building Automation System (BAS) Controls System

Water-source multipipe machines are designed to operate in buildings with three separate fluid loops: Source Water, Chilled Water, and Hot Water loops. Pumps in each loop provide a variable flow, depending on the number of operational modules.

There are two options to maintain flow in each loop:

- Flow control based on differential pressure measurement.
- Flow control based on flow rate measurement.

In case of differential pressure, the constant differential pressure setpoint is maintained as per designed conditions/requirements.

In case of flow rate, flow setpoint varies and is dependent on number of running modules in respective fluid loop.

Pump operation and sequence is provided and maintained by BAS controls system. Multipipe controls system verifies flows for any fluid loop for each module before running those modules and compressors. BMS will not change Multipipe Bank Thermal Mode (Simultaneous/Cooling/Heating) too often. Recommended frequency – not more often than once an hour.

## Multipipe Controls System

A Multipipe Bank consists of a minimum of three and up to ten modules. The first module always acts as a Primary Module for the Multipipe Bank and the rest of the modules are Secondary Modules.

When the Primary Module fails, each Secondary Module will operate in stand-alone mode according to defined Thermal Mode and cooling/heating requirements.

A Multipipe Bank comes equipped with one operator interface (UI) that provides access to all Multipipe Modules.

A Multipipe Bank can operate in one of the following Thermal Modes: Simultaneous, Cooling, Heating.

- Simultaneous Mode. – Multipipe Modules are running to satisfy both cooling and heating loads. Simultaneous Mode is a preferable and recommended operational mode for Multipipe Modules, so the best efficiency can be achieved in this mode.
- Cooling Mode – All the heating energy produced by running compressors is rejected to a Source Water Loop.
- Heating Mode – All the cooling energy produced by running compressors is absorbed by a Source Water Loop.

Multipipe Bank Thermal Mode can be adjusted at Chiller Bank UI or communicated from BAS.

## Multipipe Bank Sequence

Multipipe Bank can be enabled from either BAS or Chiller Bank UI.

When operating, System Cooling and Heating Demands in Simultaneous Mode are constantly updated based on system temperature sensor measurements and temperature setpoints. Cooling/Heating temperature setpoints can be adjusted at either BAS or Chiller Bank UI. Alternatively, hardwired Cooling/Heating Setpoints can be used if selected via UI.

Cooling/Heating Demands are converted into called cooling/heating compressors respectively, which are distributed across the Multipipe Bank, so that modules run in the following modes:

- Simultaneous Mode – if number of called heating and cooling compressors are equal.
- Simultaneous and Heating Mode or Heating dominant – if number of called heating compressors is higher than number of called cooling compressors.
- Simultaneous and Cooling Mode or Cooling dominant – if number of called cooling compressors is higher than number of called heating compressors.

When Multipipe Bank is in Cooling Mode, Heating Demand is disabled. When Multipipe Bank is in Heating Mode, Cooling Demand disabled.

### Simultaneous Mode – Heating Dominant

Heating prevalence occurs when Heating Demand gets ahead of Cooling Demand. This happens when either Heating Demand increases or Cooling Demand decreases.

At this point BAS brings Source Water pump into operation, which runs at required speed to match number of operational modules for source loop.

If Heating Demand increases, all subsequent Multipipe Modules will run in Heating Mode until heating load is satisfied. If Cooling Demand decreases, Simultaneous Multipipe Modules start switching over to Heating Mode until remaining number of Multipipe Modules running in Simultaneous Mode, will satisfy cooling load.

### Heating Mode

If Cooling Demand keeps decreasing further, at some point cooling may no longer be required. However, as long as Multipipe Bank remains in Simultaneous Mode, Chilled Water pumps maintains Minimum Speed standing by for increase in Cooling Demand any time.

The same operational state can be achieved by switching Multipipe Bank in Heating Mode. The only difference is that Chilled Water pumps will be disabled since Heating Mode implies that no cooling will be needed.

## Simultaneous Mode – Cooling Dominant

Cooling prevalence occurs when Cooling Demand gets ahead of Heating Demand. This happens when either Cooling Demand increases or Heating Demand decreases.

If Cooling Demand increases, all subsequent Multipipe Modules will run in Cooling Mode until cooling load is satisfied.

If Heating Demand decreases, Simultaneous Multipipe Modules start switching over to Cooling Mode until the remaining number of Multipipe Modules running in Simultaneous mode, will satisfy heating load.

## Cooling Mode

If heating is no longer required, all modules switch over to Cooling Mode. Hot Water pumps, however, stay running, maintaining minimum flow and ready for Heating Demand increase any time.

Alternatively, Multipipe Bank switches over to Cooling Mode where Hot Water pumps no longer runs due to heating load being disabled.

# Start-Up

## Preparation for Initial Start-Up

After the system is completely installed with all wires connected and all piping securely coupled, the multipipe system can be prepared for initial start-up.

Confirm there is sufficient cooling/heating load available for proper testing of the multipipe system.

### Initial Start-Up Checklist

1. Close all drain valves and header purge valves.
2. Fill the unit with clean fluid.
3. Inspect all connections for leaks during the filling process.
4. De-energize using industry-standard lockout/tagout procedures. Verify main power is turned off at the power distribution panel. Validate de-energization using voltage meter.
5. Inspect all electrical connections to confirm terminals are secure.
6. Inspect all fuses and overload settings to ensure they conform to specifications.
7. Inspect all refrigerant pressures for each module to confirm no refrigerant has been lost.
8. Confirm the oil level is correct in each compressor.

***NOTICE***

**Compressor Failure!**

**Failure to follow instructions below could result in catastrophic compressor failure.**
**Do not operate with insufficient oil.**

9. Connect phase monitor wiring, if required.
10. Confirm refrigerant valves are open at the compressors.
11. Confirm that pressure and temperature switches are in the closed position.
12. Apply power to all modules in the multipipe system.
13. Turn on the condenser, evaporator, and source fluid pumps and confirm there is proper flow and the pressure drop across the system is as expected.

### Table 12. Initial start-up readiness checklist

| ☐ | Start-Up Readiness Dimension |
|---|---|
| ☐ | Describe voltage service:<br>☐ Fused disconnect<br>☐ Non-fused disconnect<br>☐ 50 Hz<br>☐ 60 Hz |
| ☐ | Record rated power supply: _____volts_____ phase<br>• Circuit breaker rating: _____ |
| ☐ | Record supply voltage on multipipe nameplate: _____ |
| ☐ | Record power supply voltage to ground: L-1= _____, L-2 = _____, L-3 = _____ |
| ☐ | Record voltage between each phase: L-1 to L-2 = _____, L-2 to L-3 = _____, L-1 to L-3 = _____<br>☐ Agrees with nameplate values?<br>☐ Voltages must be within 2%. |
| ☐ | Check the box if all electrical connections inside the power distribution panel are tight. |
| ☐ | Check the box if all electrical connections inside each module electrical and control panel are tight. Confirm all components inside each module are securely mounted and have not shifted during shipment. |
| ☐ | Record the control voltage between TB-1-1 and TB-2-1: _____ |
| ☐ | Check the box if multipipe system includes any remote panels (city water switchover, remote control panel, or customer supplied control devices). If so, voltage drops are likely to occur. Measure and record all control voltages:<br>List devices: Voltage 1=_____ Voltage 2=_____ Voltage 3=_____ |
| ☐ | Check the box if there are any field-supplied wiring junction boxes located between the multipipe unit and any remote panels. |
| ☐ | Check the box if there are any splices made in the field-supplied wiring junction boxes. |
| ☐ | Check the box if there are any customer-supplied devices connected to the multipipe wiring.<br>List devices: _____ |
| ☐ | Check the box if there are any Trane remote devices connected to the multipipe wiring. |
| ☐ | Check the box if voltage drops are detected. |
| ☐ | Check the box if the appropriate fluid mixture has been added to the multipipe. |
| ☐ | Check the box if all multipipe modules are installed with minimum clearances available from all sides. |
| ☐ | Check the box if refrigeration gauges (or on the touchscreen interface) are indicating equal refrigerant pressures. |
| ☐ | Check the box if chilled water lines are permanently connected from the unit to customer's equipment |
| ☐ | Check the box if chilled water lines have been flushed clean of mud, slag, and other construction debris. |
| ☐ | Check the box if all chilled water line filters and strainers are clean. |
| ☐ | Check the box if chilled water lines have been leak tested according to pre-start-up instructions. |
| ☐ | Check the box if source/sink reservoir (if included) is at operating level with correct fluid mixture. |

**Table 12. Initial start-up readiness checklist (continued)**

| ☐ | **Start-Up Readiness Dimension** |
|---|---|
| ☐ | Check the box if high voltage wiring is installed, tested, and functional. |
| ☐ | Check the box if all control wiring between modular units is installed, tested, and functional. |
| ☐ | Check the box if control wiring is complete, including any remote interface panel or special-purpose module wiring. |
| ☐ | Check the box if all responsible installing contractors and sub-contractors have been notified to have representatives available on site to provide technical support for the initial start-up procedure. |
| ☐ | Check the box if full load will be available for system on the initial start-up date. |
| ☐ | Touchscreen Interface Panel: Record version and date of the software loaded into the touchscreen interface panel:<br>Version: _____ Date: _____<br>***Note:*** *To view the software version, from the home screen, press the software button on the System Control screen.* |

# Maintenance Procedures

## Maintenance Strategy

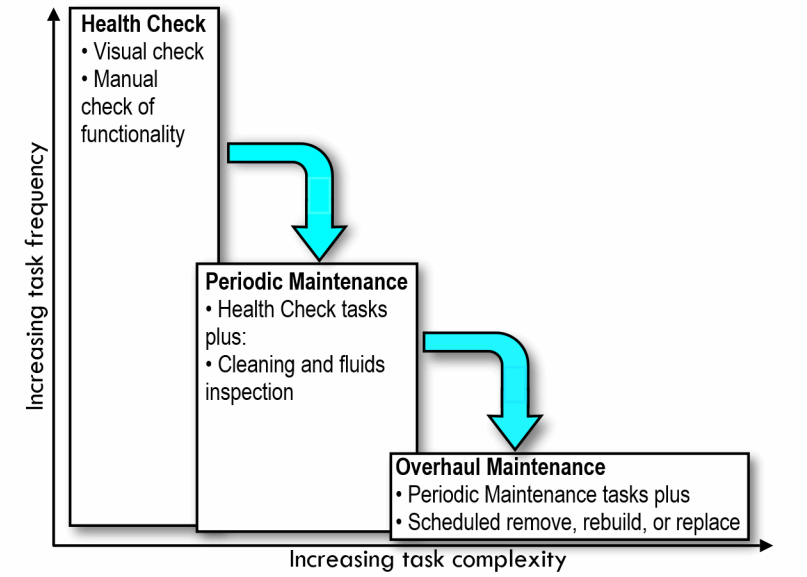
The primary goal of preventive maintenance is to avoid the consequences of failure of equipment. Trane equipment is designed to be easily accessed for servicing.

One approach to equipment maintenance envisions three levels of maintenance effort reflecting frequent, periodic, and scheduled maintenance tasks, with each level building on the previous level. Finally, since all components will eventually wear out, a prudent maintenance strategy will anticipate and schedule replacement or rebuilding of critical components before they fail and require emergency response to keep equipment operational. See below figure.

- A daily or weekly “health check” involves habitual visual and manual inspections of the components of the equipment so that anomalies become evident when they occur.
- Weekly or monthly periodic maintenance involves cleaning specific components and inspecting glycol and lubrication fluids.
- Prudent maintenance strategy will anticipate and schedule replacing or rebuilding of critical components before they fail and require emergency response to keep equipment pumps operational. See below figure.

Maintenance for HVAC equipment and facilities can include a “preventive maintenance checklist” which includes small checks which can significantly extend service life.

**Figure 28. An approach to water-source multipipe maintenance**




## Power Disconnect Switch

Some units are optionally equipped with a panel-mounted disconnect switch installed on the outside of the power distribution panel (or on each module’s electrical and control panel if the unit has power supplied to each individual module). The disconnect switch must be turned to the off position before the panel can be opened for service. When the panel door is open, power can be reconnected by turning the handle located on the inside of the panel to the ON position.

**⚠ WARNING**

**PPE for Arc/Flash Required!**

**Failure to wear appropriate PPE could result in death or serious injury.**

**On this unit, if the handle shield is cracked the circuit breaker could arc/flash when reset. To avoid being injured, technicians MUST put on all necessary Personal Protective Equipment (PPE), in accordance with NFPA70E for arc/flash protection, PRIOR to entering the starter panel cabinet.**

**NOTICE**

**Component Damage!**

**Failure to follow instructions could damage sensitive electronic components beyond repair.**

**To prevent arcing or surges of electrical current, do not use wires or cables to jump components or bypass the manufacturer's safety systems.**

# Federal Clean Air Act

Responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be properly certified. The Federal Clean Air Act prescribes procedures for handling, reclaiming, recovering, and recycling of refrigerants and the equipment that must be used in maintenance procedures involving potential leakage of HVAC refrigerants. State and local governments may have additional requirements that must be followed to responsibly handle HVAC refrigerants.

# Inspection and Maintenance Schedule

Proactive measures should be taken to prevent potential problems with the equipment. These include maintaining a operational log and conducting weekly, quarterly, and annual inspections of the multipipe system. See the following table.

## Daily

A daily visual inspection can reveal obvious problems. Keep notes of the systems performance:

- Log pressures and temperatures.
- Visual inspect of the unit.

**Table 13. Recommended equipment service intervals**

| Task | Frequency |
|---|---|
| Visually inspect the equipment | Daily |
| Log pressure and temperatures | Daily |
| Inspect touchscreen interface panel for alarm history | Weekly |
| Clean strainers on the inlet water pipe | Monthly |
| Check the compressor oil level sight glass | Monthly |
| Confirm the glycol concentration | Monthly |
| Confirm the refrigeration pressures | Monthly |
| Check the refrigeration liquid line sight glass | Monthly |
| Inspect refrigerant pressures and temperature set points | Quarterly |
| Inspect superheat (10 °F to 12 °F [5°C to 6°C]) and sub-cooling temperatures (10°F to 15°F [5°C to 8°C]) | Quarterly |
| Inspect the evaporator entering and leaving evaporator temperature | Quarterly |
| Collect fluid mixture sample for analysis | Quarterly |
| Inspect crankcase heaters | Quarterly |
| Inspect piping for signs of leaks | Quarterly |
| Inspect refrigerant piping for oil or refrigerant leaks | Quarterly |
| Observe refrigeration operating pressures | Quarterly |
| Confirm motor amperage draw and voltage | Quarterly |
| Confirm equipment superheat and sub-cooling | Quarterly |
| Check for worn or burned contactors | Quarterly |
| Inspect all electrical connections and fuses | Annually |
| Inspect each compressor for refrigerant pressures, overheating, oil leaks | Annually |
| Inspect compressor terminals for pitting, corrosion, and loose connections | Annually |
| Inspect compressor oil level | Annually |

**Table 13. Recommended equipment service intervals (continued)**

| Task | Frequency |
|---|---|
| Confirm and record compressor amperage draw and voltage | Annually |
| Compare fluid flow against design specifications | Annually |

## Weekly

Weekly inspection is a continuation and elaboration of daily best practice:

- Inspect touchscreen interface panel for alarm status and additions to the alarm history. (Do not clear alarms as this is a very important performance record if troubleshooting problems occur.)
- Notate and record any excessive vibrations or motor noise.
- Measure all refrigerant static pressure on any idle circuits. Record any significant changes or reductions in pressure.
- Initially, clean strainers weekly after start-up. Thereafter, inspect and clean strainers as needed.

## Monthly

The monthly maintenance inspection examines many items that generally require frequent attention. This routine event identifies small problems early before they can become big problems requiring serious repair and refurbishment:

1. Verify that the strainer(s) are clean.
2. Check the compressor oil level sight glass. The oil should always be clear and free-flowing. Any milky appearance indicates that liquid refrigerant is making its way back into the compressor and will cause premature compressor failure.

**NOTICE**

**Equipment Damage!**

**Failure to remove moisture from system could cause corrosion within the chiller/heater components, and degrade performance.**
**Perform vacuum evacuation of system to remove moisture.**

3. When the compressor is not operating, the oil level should be at least at the bottom of the sight glass, up to two-thirds full. When the compressor is operating, the oil level will normally be at the bottom of the sight glass, or even below, but it must be visible.
4. Low oil sight glass conditions could signify a short cycling, an oil leak, or an undercharged unit that lacks proper refrigerant velocity to return oil to the compressor sump. Eventually, dry compressor starts could occur causing premature compressor failure. This may indicate that some oil has been lost from a previous refrigerant leak repair. The compressor data label indicates the correct oil type and quantity with which it should be filled.

***Note:*** *A flashlight may be required to see the oil churning in the sump of the compressor. Adjusting the line of sight may be necessary to visually inspect the oil in the compressor sump during operation. At a minimum, the oil must be seen churning in the compressor sump. It should be clear.*

**NOTICE**

**Compressor Failure!**

**Failure to follow instructions below could result in catastrophic compressor failure.**
**Do not operate with insufficient oil.**

5. Check the glycol concentration using a refractometer.

**NOTICE**

**Compressor Damage!**

**Failure to follow instructions below could result in extensive compressor damage.**
**Verify that suction pressure is sufficient. Secure the circuit or module offline until status can be examined in detail.**

6. Check the refrigeration pressures.

***Important:*** *Extended operation with suction pressures below 80 psi is a clear sign of insufficient refrigerant charge, refrigeration obstruction, or valve closed. This can cause extensive damage to a compressor.*

7. Check the refrigeration liquid line sight glass for persistent bubbles (“flashing”).

**NOTICE**

**Equipment Damage!**

**Failure to remove moisture from system could cause corrosion within the chiller/heater components, and degrade performance.**
**Perform vacuum evacuation of system to remove moisture.**

***Note:*** *Bubbles in the sight glass do not necessarily indicate loss or lack of refrigerant charge. If the refrigeration pressures are in the normal range, the unit is most likely adequately charged.*

## Quarterly

The quarterly maintenance inspection is a comprehensive event that examines all aspects of the equipment to identify early problems before they can damage the equipment and require major repair or refurbishment:

1. Inspect alarm log, refrigerant operating/static pressures, and temperature set points of each module independently.
2. Inspect system superheat and sub-cooling. System superheat should be 10 °F to 12 °F (5 °C to 6 °C). System sub-cooling should be 10+ °F (5 °C) depending on the ambient conditions.
3. Inspect the approach delta T - entering evaporator fluid mixture temperature and leaving refrigerant temperature.
4. Inspect strainers.
5. Collect chilled fluid mixture sample for professional analysis. Check for cleanliness. Drain and refill with clean solution if excessive sludge or dirt is present. Flush the equipment prior to refilling.
6. Inspect fluid mixture levels. Add glycol as required.
7. If equipped, inspect crankcase heaters for proper operation.
8. Inspect the fluid piping for signs of leaks at joints and fittings.
9. Inspect refrigerant piping circuit for signs of oil or refrigerant leakage. Conduct “sniffer test” to find refrigerant leaks. Inspect all pressure switch bellows.
10. Tighten all refrigeration piping connections such as Rotalocks, Schrader valves, caps, and ball valves.
11. Install a manifold and gauge set to observe equipment refrigeration operating pressures.
    a. Verify that the pressure controls (low pressure and high pressure switches) are “cutting in” and “cutting out” at the appropriate pressures.
    b. Verify refrigerant charge by recording the superheat and sub-cooling temperatures.
    c. Observe head pressure for signs of improper condensing from clogged strainers or for a modulating valve issue.
12. Check compressor motor amperage draws and voltage supplies and maintain a record of those values. Verify that they are within the name plate rating. Also, check for voltage imbalance. The equipment’s phase monitor will open if the voltage imbalance exceeds 4%.
13. Check for chattering, excessive wear, or burned contacts. Replace contacts, if in doubt.

## Annually

The annual equipment maintenance inspection is critical to the long-term performance of the unit. Whether the equipment has a service life of 15 years or 30 years is almost entirely dependent upon how consistently and how diligently the annual maintenance inspection and tasks are performed. The annual event is a comprehensive inspection that examines all aspect of the equipment to identify and repair small problems before they can become major issues that damage equipment and require significant repair or refurbishment.

1. Inspect all electrical connections for damage and ensure terminals are tight. Inspect all contactors for pitting and corrosion and replace as necessary.

**⚠ WARNING**

**Hazardous Voltage!**

**Failure to disconnect power before servicing could result in death or serious injury.**

**Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.**

2. Inspect fuses to ensure they are secure, of correct amperage rating, undamaged and functioning.
3. Energize each compressor and check refrigerant pressures, signs of overheating, and oil leaks. Check for noises and for leaks with an electronic or bubble leak detector. Inspect flared fittings, refrigeration gauges, compressor connections, braze joints, pressure switches, and access ports on Schrader valves.

**⚠ WARNING**

**Refrigerant under High Pressure!**

**Failure to follow instructions below could result in an explosion which could result in death or serious injury or equipment damage.**

**System contains refrigerant under high pressure. Recover refrigerant to relieve pressure before opening the system. See unit nameplate for refrigerant type. Do not use non-approved refrigerants, refrigerant substitutes, or refrigerant additives.**

4. Follow proper “LOTO” procedures to de-energize. each compressor and inspect terminals for pitting, corrosion, and loose connections.
5. Inspect that the oil level is visible in each compressor and not discolored. Annual oil samples should be taken to be analyzed for destructive acids, corrosive materials, or metal deposits.
6. Inspect and record the compressor amperage draws and voltage.
7. Record fluid mixture flow to ensure it meets design specifications.
8. If equiped, tighten rotalock fittings. The recommended torque is 80 lbf for 2 inch and larger and 60 lbf for rotalock fittings smaller than 2 inch.
9. Inspect all copper lines and control capillary tubing to ensure that the lines are separated and not vibrating against one another or the frame or housing.
10. Ensure all refrigeration lines are properly supported to prevent vibration from causing premature failure of copper piping.

11. Inspect all insulation on piping and control sensors. Repair and replace as necessary.
12. Inspect entire plumbing system for leaks.
13. Review logged alarms and look for repetitive trends.
14. If equipped, inspect crankcase heaters to verify proper operation.
15. Sample refrigerant to analyze for moisture or acid.
16. Inspect operating pressures and temperatures and ensure the equipment has a full refrigerant charge.

# Multipipe Troubleshooting

## General Approach to Fault Isolation

Trane manufactures equipment with embedded fault detection and diagnostics in each module's controller that offers continuous dedicated monitoring to record and report faults as they occur in real time allowing repairs to be performed in a timely manner.

Various faults occurring in a building's HVAC system can lead to unnecessary energy consumption and poor thermal comfort for a building's occupants. Fault detection and isolation plays a significant role in monitoring, maintaining, and repairing equipment to improve operator safety and minimize operating costs.

Fault detection is recognizing that a problem has occurred, even if the root cause is not yet known. Fault isolation is the process of reducing potential causes to determine the most likely source of equipment failure.

## Controller Diagnostic Codes

The following table assists in explaining the alarm codes that appear in the remote interface panel in the event of an alarm. The alarm history is accessed by pressing the alarm log key.

**Table 14. MWS module alarm summary**

| Alarm | Primary / Secondary | Type | Action |
|---|---|---|---|
| BMS offline | Primary | Auto Reset | Warning |
| Condenser Flow Alarm | Primary / Secondary | User Reset | Locks out module |
| Condenser LWT too low | Primary / Secondary | Auto Reset | Warning |
| CoreSense 1 communication lost | Primary / Secondary | Auto Reset | Shuts down compressor 1 |
| CoreSense 1 Failure | Primary / Secondary | Auto Reset | Shuts down compressor 1 |
| CoreSense 1 Fault | Primary / Secondary | Auto Reset | Shuts down compressor 1 |
| CoreSense 1 Lockout | Primary / Secondary | Auto Reset | Shuts down compressor 1[a] |
| CoreSense 1 Warning | Primary / Secondary | Auto Reset | Warning |
| CoreSense 2 communication lost | Primary / Secondary | Auto Reset | Shuts down compressor 2 |
| CoreSense 2 Failure | Primary / Secondary | Auto Reset | Shuts down compressor 2 |
| CoreSense 2 Fault | Primary / Secondary | Auto Reset | Shuts down compressor 2 |
| CoreSense 2 Lockout | Primary / Secondary | Auto Reset | Shuts down compressor 2 [a] |
| CoreSense 2 Warning | Primary / Secondary | Auto Reset | Warning |
| cpCOe #1 Offline Alarm | Primary | Auto Reset | Switches Primary Module and Secondary Modules in Stand-alone Mode |
| cpCOe #1 UI1 sensor failure | Primary | Auto Reset | Switches Primary Module and Secondary Modules in Stand-alone Mode [b] |
| cpCOe #1 UI2 sensor failure | Primary | Auto Reset | Switches Primary Module and Secondary Modules in Stand-alone Mode [c] |
| cpCOe #1 UI3 sensor failure | Primary | Auto Reset | Switches Primary Module and Secondary Modules in Stand-alone Mode [b] |
| cpCOe #1 UI4 sensor failure | Primary | Auto Reset | Switches Primary Module and Secondary Modules in Stand-alone Mode [c] |
| cpCOe #1 UI5 sensor failure | Primary | Auto Reset | Warning |
| cpCOe #1 UI6 sensor failure | Primary | Auto Reset | Warning |
| cpCOe #1 UI7 sensor failure | Primary | Auto Reset | Switches to Internal Cooling Setpoint if External is selected |
| cpCOe #1 UI8 sensor failure | Primary | Auto Reset | Switches to Internal Heating Setpoint if External is selected |
| cpCOe #1 wrong config Alarm | Primary | Auto Reset | Warning |

**Table 14. MWS module alarm summary (continued)**

| Alarm | Primary / Secondary | Type | Action |
|---|---|---|---|
| cpCOe #2 Offline Alarm | Primary / Secondary | Auto Reset | Locks out module |
| cpCOe #2 wrong config Alarm | Primary / Secondary | Auto Reset | Warning |
| Differential Pressure low | Primary / Secondary | User Reset | Locks out module |
| Error in retain memory writings | Primary / Secondary | User Reset | Warning |
| Error in the number of retain memory writings | Primary / Secondary | User Reset | Warning |
| Evaporator Flow Alarm | Primary / Secondary | User Reset | Locks out module |
| Evaporator Freezing Alarm | Primary / Secondary | User Reset | Locks out module |
| Evaporator LWT too high | Primary / Secondary | Auto Reset | Warning |
| EVD #1 Driver A Alarm | Primary / Secondary | Auto Reset | Warning |
| EVD #1 Driver B Alarm | Primary / Secondary | Auto Reset | Warning |
| EVD #1 offline | Primary / Secondary | Auto Reset | Warning |
| EVD #1 System Alarm | Primary / Secondary | Auto Reset | Warning |
| HP Alarm | Primary / Secondary | User Reset | Locks out module |
| HP Switch Alarm | Primary / Secondary | Auto Reset | Locks out module |
| LP Alarm | Primary / Secondary | Auto Reset | Shuts down module |
| LP Lockout Alarm | Primary / Secondary | User Reset | Locks out module |
| Phase Monitor Alarm | Primary / Secondary | Auto Reset | Locks out module |
| Primary communication lost | Secondary | Auto Reset | Switches Secondary Modules in Stand-alone Mode |
| Secondary 1 communication lost | Primary | Auto Reset | Warning |
| Secondary 2 communication lost | Primary | Auto Reset | Warning |
| Secondary 3 communication lost | Primary | Auto Reset | Warning |
| Secondary 4 communication lost | Primary | Auto Reset | Warning |
| Secondary 5 communication lost | Primary | Auto Reset | Warning |
| Secondary 6 communication lost | Primary | Auto Reset | Warning |
| Secondary 7 communication lost | Primary | Auto Reset | Warning |
| Secondary 8 communication lost | Primary | Auto Reset | Warning |
| Secondary 9 communication lost | Primary | Auto Reset | Warning |
| Source Flow Alarm | Primary / Secondary | User Reset | Locks out module |
| Source Freezing Alarm | Primary / Secondary | User Reset | Locks out module |
| System Chilled LWT too high | Primary | Auto Reset | Warning |
| System Hot LWT too low | Primary | Auto Reset | Warning |
| UI1 sensor failure | Primary / Secondary | Auto Reset | Shuts down local cooling control (d) |
| UI2 sensor failure | Primary / Secondary | Auto Reset | Shuts down local cooling control (e) |
| UI3 sensor failure | Primary / Secondary | Auto Reset | Shuts down local heating control (d) |
| UI4 sensor failure | Primary / Secondary | Auto Reset | Shuts down module if LP Alarm Mode = Sensor (detailed under Setup) |
| UI5 sensor failure | Primary / Secondary | Auto Reset | Shuts down module |

**Table 14. MWS module alarm summary (continued)**

| Alarm | Primary / Secondary | Type | Action |
|---|---|---|---|
| UI6 sensor failure | Primary / Secondary | Auto Reset | Shuts down local heating control [e] |
| UI7 sensor failure | Primary / Secondary | Auto Reset | Warning |
| UI8 sensor failure | Primary / Secondary | Auto Reset | Locks out module if it is running in Heating Mode |
| UI9 sensor failure | Primary / Secondary | Auto Reset | Warning |
| UI10 sensor failure | Primary / Secondary | Auto Reset | Warning |
| UI11 sensor failure | Primary / Secondary | Auto Reset | Warning |
| UI12 sensor failure | Primary / Secondary | Auto Reset | Warning |
| Valve D1 Closing Failure | Primary / Secondary | User Reset | Locks out module |
| Valve D1 Opening Failure | Primary / Secondary | User Reset | Locks out module |
| Valve D2 Closing Failure | Primary / Secondary | User Reset | Locks out module |
| Valve D2 Opening Failure | Primary / Secondary | User Reset | Locks out module |
| Valve S1 Closing Failure | Primary / Secondary | User Reset | Locks out module |
| Valve S1 Opening Failure | Primary / Secondary | User Reset | Locks out module |
| Valve S2 Closing Failure | Primary / Secondary | User Reset | Locks out module |
| Valve S2 Opening Failure | Primary / Secondary | User Reset | Locks out module |
| Wrong Primary rotation control parameters | Primary | Auto Reset | Warning |
| Wrong temperature control parameters | Primary / Secondary | Auto Reset | Warning |

[a] If both compressors are in lockout, that will in turn lock out the module.
[b] If EWT is selected as the cooling / heating temperature control sensor
[c] If LWT is selected as the cooling / heating temperature control sensor
[d] If EWT is selected as the cooling / heating temperature control sensor and module is running in stand-alone mode
[e] If LWT is selected as the cooling / heating temperature control sensor and module is running in stand-alone mode

# Compressor Diagnostic Codes

Copeland compressors used in Trane equipment are highly automated with digital capability to record and report a range of operating parameters and critical events. This technology can be employed to assist in troubleshooting compressor faults and potential corrective action.

## CoreSense™ Flash Codes

If equipped, the CoreSense technology in the Copeland compressor will communicate an abnormal system condition through a unique flash code:

- The flash code number corresponds to the number of LED flashes, followed by a pause, and then the flash code is repeated.
- A lockout condition produces a red flash, followed by a pause, a solid red, a second pause, and then repeated.

**Table 15. CoreSense™ communications LED flash code information**

| Status | Fault Condition | Code Fault Description | Code Reset Description | Trouble Shooting Information |
|---|---|---|---|---|
| Solid Green | Normal Operation | Module is powered and operation is normal | N/A | N/A |
| Solid Red | Module Malfunction | Module has internal fault | N/A | 1. Reset module by removing power from T2-T1<br>2. Replace module |
| Warning LED Flash | | | | |

**Table 15. CoreSense™ communications LED flash code information (continued)**

| Status | Fault Condition | Code Fault Description | Code Reset Description | Trouble Shooting Information |
|---|---|---|---|---|
| Green Flash Code 1 | Loss of Communication | Module and master controller have lost communications with each other for more than 5 minutes | When communications are confirmed | 1. Check the control wiring<br>2. Verify dipswitch 8 is “on” |
| Green Flash Code 2 | Future Use | N/A | N/A | N/A |
| Green Flash Code 3 | Short Cycling | Run time of less than 3 minutes; number of short cycles exceeds 48 in 24 hours | < 48 short cycles in 24 hours | 1. Check system charge and pressure control setting.<br>2. Adjust set-point of temperature controller.<br>3. Install anti-short cycling control. |
| Green Flash Code 4 | Open/Shorted Scroll Thermistor | Ω > 370K or Ω < 1K | 5.1K < Ω < 370K | 1. Check for poor connections at module and thermistor fusite.<br>2. Check continuity of thermistor wiring harness. |
| Green Flash Code 5 | Future Use | N/A | N/A | N/A |
| Alert/Lockout LED Flash | | | | |
| Red Flash Code 1 | Motor High Temperature | Ω > 4.5K ± 25%; lockout after 5 alerts | Ω < 2.75K and 30 minutes | 1. Check supply voltage.<br>2. Check system charge and superheat.<br>3. Check contactor |
| Red Flash Code 2 | Open/Shorted Motor Thermistor | Ω > 220K or Ω < 40; lockout after 6 hours | 40 < Ω < 2.75K and 30 minutes | 1. Check for poor connections at module and thermistor fusite.<br>2. Check continuity of thermistor wiring harness. |
| Red Flash Code 3 | Short Cycling | Run time of less than 3 minutes; lockout if the number of alerts exceeds the number configured by the user in 24 hours | Interrupt power to T2-T1 or perform Modbus reset command | 1. Check system charge and pressure control setting.<br>2. Adjust set-point of temperature controller.<br>3. Install anti-short cycling control. |
| Red Flash Code 4 | Scroll High Temperature | Ω < 2.4K; lockout if the number of alerts exceeds the number configured by the user in 24 hours | Interrupt power to T2-T1 or perform Modbus reset command | 1. Check system charge and superheat.<br>2. Check system operating conditions<br>3. Check for abnormally low suction pressure |
| Red Flash Code 5 | Future Use | N/A | N/A | N/A |
| Red Flash Code 6 | Missing Phase | Missing phase | After 5 minutes, missing phase condition is not present | 1. Check incoming power.<br>2. Check fuses/breakers.<br>3. Check contactor. |
| Red Flash Code 7 | Reverse Phase | Reverse phase; Lockout after 1 Alert | Interrupt power to T2-T1 or perform Modbus reset command | 1. Check incoming phase sequence.<br>2. Check contactor.<br>3. Check module phasing wires A-B-C. |
| Red Flash Code 8 | Future Use | N/A | N/A | N/A |
| Red Flash Code 9 | Module Low Voltage | Low voltage on T2-T1 terminals1 | After 5 minutes, the voltage is back in the normal range | 1. Verify correct module p/n.<br>2. Check VA rating of transformer.<br>3. Check for blown fuse in transformer secondary. |

## Phase Monitor Protection

If the system fails to power up, eliminate electrical phase issues by inspecting the phase monitor device located in the power distribution panel.

When all voltages are acceptable and the phase sequence is correct the output relay is energized and the LED glows green. Under-voltages and unbalanced voltages must be sensed for a continuous trip delay period before the relay de-energizes. Reset is automatic upon correction of the fault condition. The output relay will not energize if a fault condition is sensed as power is applied. The LED flashes red during the trip delay, then glows red when the output de-energizes. The LED flashes green/red if phase reversal is sensed.

**Table 16. LED phase monitor diagnostic codes**

| LED Display | Indication |
|---|---|
|  | Glowing green: All voltages are acceptable and phase sequence is correct. |
|  | Flashing red: Trip delay prior to de-energizing. Glowing red: Output has been de-energized upon fault detection. |
| | Flashing red and green: Phase reversal is detected. |
|  | No power to phase monitor. |

If the phase monitor fails to energize (the LED glows red) check wiring of all three phases, voltage, and phase sequence. If phase sequence is incorrect, the LED flashes green/red. To correct this, swap any two line voltage connections at the mounting socket. No further adjustment should be required.

## Symptoms and Solutions

This section lists the most common troubleshooting symptoms and the closest potential solutions for each. This is not an exhaustive listing of all potential causes or resolutions, but represents the best direction in which to initiate a solution.

***Note:*** *An anti-short cycle timer is included in the primary microprocessor controller to prevent the compressors from starting until the delay has elapsed. The microprocessor also provides minimum compressor run timers. Take these fixed timer parameters into consideration when conducting a fault isolation process.*

| **1. Symptom: Compressor will not start** | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Temperature control not in demand | Check setpoint. |
| Flow switch open due to low water flow | Check flow switch functionality; check flow rate. |
| Low pressure, high pressure sensor open | Low/high pressure event has occurred; obstructed BPHE; check sensor functionality. |
| High pressure switch open | High pressure event has occurred; check obstructed BPHE; check pressure switch functionality. |
| Compressor overload opened | Allow motor to cool and reset; high amp load/floodback; compressor operating outside of operating envelope. |
| No power to module | Check breakers and fuses; energize from module electrical and control panel. |
| Phase monitor open or tripped | Check phase sequence, unbalanced voltage, overvoltage, undervoltage; loss of phase. |
| Breaker tripped | Reset breaker; check amp draw, high refrigeration pressure, low voltage, and lose connection. |
| Overcurrent | Check overload (circuit breaker, compressor grounded). |
| A ball valve is not at proper position | Check Ball valve and its actuator; check relay and wires in control panel. |

| 2. Symptom: Compressor will not run | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Breakers and switches are off | Confirm all breakers and switches are on. |
| Main switch open or circuit breakers open | Check circuits and motor winding for shorts or grounds. |
| Fuse is blown | Replace fuse or reset breakers. |
| Investigate for possible overloading | Overloads are auto-reset. Monitor to assure the overload does not re-occur. |
| Defective contactor or coil | Determine type and cause. Correct fault before resetting safety. |

| 3. Symptom: Compressor has excessive noise or vibration | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Flooding of refrigerant back to compressor | Check setting of expansion valve; check crankcase heater. |
| Improper phase sequence | Check phase sequence. |
| Improper or worn compressor supports (vibration-isolating mounting) | Replace support. |
| Faulty crankcase heater | Replace crankcase heater. |

| 4. Symptom: Compressor Loading/Unloading Cycles Too Short | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Temperature differential set too low | Ramp/set temperature differential setpoint; check stage up/down settings. |
| Incorrect liquid temperature settings | Select proper control settings. |
| Insufficient evaporator, condenser, or source water flow | Check flow rate. |
| Low system liquid/water volume | Water system volume needs to be increased. |

| 5. Symptom: Compressor loses oil | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Low refrigerant charge | Check for leaks and repair. Add refrigerant to proper charge. |
| Oil trapped in the system | Check operating condition to confirm compressor runs inside envelop. |
| Defective crankcase heater | Replace crankcase heater. |
| Compressor short cycling | Adjust proper control settings for Min. ON/OFF runtime. |
| Liquid refrigerant | Check compressor superheat. Superheat at the compressor suction should be approximately 12° F. |

| 6. Symptom: Low refrigeration suction pressure | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Lack of refrigerant | Check for leaks; repair and add charge. |
| Evaporator or source BPHE is dirty | Clean with chemical. |
| Suction line blockage | Check suction line for any obstacle. |
| Condensing temperature too low | Check condensing temperature; check control valves on source BPHE. |
| Low water temperature | Raise set point; check design specification. |
| Low discharge pressure | Refrigerant charge; replace compressor; check source head pressure in heating mode. |
| Improper expansion valve settings | Check EXV functionality and settings. |
| Internal leakage refrigeration through ball valves which are in close position | Check to confirm the ball valve is closed completely (no whistling sound when compressors are running). |

| 6. Symptom: Low refrigeration suction pressure | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Clogged liquid line filter-drier | Replace filter drier or cartridges. |
| Excessive glycol concentration | Charge to proper glycol concentration. |
| Liquid line solenoid restricted or faulty | Replace solenoid valve, coil, or internals as necessary. |
| Insufficient water in evaporator (cooling) and source (heating) | Adjust flow rate through heat exchanger. |
| Restricted water/glycol line | Clean strainers; check manual and electronic valves. |
| Water/glycol mixture contaminated | Identify source of contamination (intensive cleanup effort needed); external filter may be required. |
| Evaporator clogged or fouled | Reverse flush with appropriate chemical solutions. |

| 7. Symptom: High refrigeration suction pressure | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Expansion valve opens too far | Check EXV settings and functionality. |
| Excessive refrigerant charge | Reclaim excess refrigerant and verify proper subcooling and superheat. |
| High water temperature | Low refrigerant charge; check faulty compressor, excessive load, design specification. |

| 8. Symptom: Low refrigerant discharge pressure | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Improper charge | Check for leaks, repair, and add refrigerant as needed. |
| Faulty compressor | Check compressor. |
| Low source temperature in heating mode | Check design condition. |
| Low suction pressure | See ‘Low refrigeration suction pressure’. |
| Condenser pressure control valve not adjusted or does not function properly | Check control valve settings; check valve actuator. |

| 9. Symptom: High refrigerant discharge pressure | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| System overcharged with refrigerant | Remove excess refrigerant. |
| Condenser or source tubes clogged or fouled | Reverse flush with appropriate chemical solution. |
| Non-condensables in system | Purge non-condensables. |
| Insufficient condenser or source water flow | Check and adjust flow rate. |
| Restricted water in condenser or source BPHE | Clean strainers; check control valve settings and functionality. |
| EXV does not function properly | Check EXV functions; check SSH settings. |
| Overshooting LWT temperature in heating mode | Water system volume needs to increase; check stage band control settings. |

| 10. Symptom: Low chilled water temperature | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Temperature controllers set too low | Reset temperature setpoint. |
| Low water flow | Clean strainer; check pump, VFD, and differential pressure settings; check to ensure electric and manual water valves are fully open. |
| Faulty system temperature sensor | Replace temperature sensor. |

| 11. Symptom: High chilled water temperature | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Load higher than capacity of unit | Refer to design specifications. |
| Loss of refrigeration charge | Check refrigerant charge. |
| Fouled evaporator (cooling) or source (heating) BPHEs | Reverse flush evaporator; check strainer for debris. |
| High water flow rate | Check pump, VFD and differential pressure settings. |
| Faulty system temperature sensor | Replace temperature sensor. |

| 12. Symptom: Compressor thermal protector switch open | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Operating beyond design conditions or compressor envelop | Check chiller settings; refer to design specification |
| Faulty compressor overload | Replace overload. |

| 13. Symptom: No low voltage (24 Vac) | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Transformer primary side fuse open | Check fuse prong contact points; replace fuse. |
| Transformer defective | Replace transformer. |
| No primary voltage on transformer | Check breakers, fuses, and power supply specifications. |

| 14. Symptom: Expansion valve superheat too high | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Water/glycol temperature too warm | Check setpoints and charge. |
| Obstructed filter dryer | Replace dryer core. |
| Low refrigerant charge | Recharge refrigerant as per nameplate. |
| Sensing bulb not properly located | Check if secured to pipe or insulated; check sensor position on pipe. |
| Defective or improper settings of EXV | Check EXV functions; check EXV settings. |

| 15. Symptom: Thermal expansion valve superheat too low | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Sensing bulb not properly located | Check if secured to pipe or insulated; check sensor position on pipe. |
| EXV valve superheat setting is too low or not functioning properly | Check EXV settings and functionality. |

| 16. Symptom: Contactor/relay inoperative | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Coil shorted or open | Replace coil. |
| Mechanical parts broken or jammed | Replace assembly. |
| Contacts pitted or burned | Replace contactors. |
| No 24 Vac to coil | Replace secondary fuse to transformer; check transformer. |

| 17. Symptom: Freeze protection safety activated | |
|---|---|
| **Possible Causes** | **Potential Solutions** |
| Unit setpoint is too low | Use a proper setpoint. |
| Low water flow | Clean strainer; check pump, VFD and differential pressure settings. |
| Low suction pressure | See “low suction pressure”. |

# Appendix A. Request for Initial Start-Up

# Thermafit™ MWS Multipipe

As part of a continuous commitment to quality, initial start-up of this system by a factory-certified technician may be purchased from Trane. No initial start-up will be scheduled without a Request for Initial Start-Up form completed and on file with the Trane customer service department. Submitting this form indicates that all critical work described on the form has been completed. To prevent additional charges for aborted start-ups, the following items must be completely functional and operating and this form signed and returned to Trane at least 10 working days prior to the scheduled initial start-up date.

**MWS Initial Start-Up Data**

| | |
|---|---|
| Model Number: | Primary Module Serial Number: |
| Primary Contact Name: | Primary Contact Phone: |
| Primary Contact FAX: | Primary Contact Mobile: |
| Name of multipipe Site: | |
| Physical Location of multipipe: | |
| **Requested Date for Initial Start-Up:**<br>**Requested Time for Initial Start-Up:** | |

**Mandatory Initial Start-Up Requirements**

| Mandatory Tasks | Date Completed | Completed By (Initials) |
|---|---|---|
| All modules are installed with minimum clearances available from all sides. | | |
| Refrigeration gauges are indicating equal pressures. | | |
| Chilled water lines from multipipe to customer's equipment are permanently connected. | | |
| Chilled water lines have been flushed clean of mud, slag, and other construction debris. | | |
| All chilled water line filters and strainers are clean. | | |
| Chilled water lines have been leak tested according to prestart instructions. | | |
| Multipipe reservoir (if included) is at operating level with correct water/glycol mixture. | | |
| High voltage wiring is installed, tested, and functional. | | |
| All water, refrigeration, electrical, and control connections between multipipe modules are completed. | | |
| All control wiring between modular multipipes is installed, tested, and functional. | | |
| Control wiring is complete, including any remote interface panel or special-purpose module wiring. | | |
| Automatic City Water Switchover (if included) is installed, flushed, and leak-tested. | | |
| Condenser, if applicable, is installed, piped, wired, and leak-tested. | | |
| All responsible installing contractors and sub-contractors are notified to have representatives available on site to provide technical support for the initial start-up procedure. | | |
| Full load will be available for multipipe on the initial start-up date. | | |

# Initial Start-Up Agreement

By signing this form, you agree the multipipe is ready for initial start-up. It is understood that, if the multipipe is not ready for initial start-up due to site problems, the initial start-up will be aborted at the discretion of the designated start-up technician. Payment for an aborted start-up will be forfeited. Rescheduled initial start-ups are subject to any additional costs that may have been incurred by the technician. An approved purchase order or payment in advance will be required to reschedule an aborted initial start-up.

Name (Printed): _____ Date: _____

Signature: _____ Company: _____

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ARTC-SVX011A-EN 24 Jun 2024
Supersedes (New)