INSTALLATION, OPERATION

AND MAINTENANCE MANUAL

FOR

MC & MH SERIES

FLUID CHILLER AND/OR FLUID HEATER MODULES

INDOOR MODELS

UNIT MODEL NO. _____
UNIT SERIAL NO. _____
SERVICED BY: _____
TEL. NO: _____

CANADIAN HEAD OFFICE AND FACTORY

1401 HASTINGS CRES. SE
CALGARY, ALBERTA
T2G 4C8
Ph: (403) 287-2590
Fx: 888-364-2727

USA HEAD OFFICE AND FACTORY

32050 W. 83rd STREET
DESOTO, KANSAS
66018
Ph: (913) 583-3181
Fx: (913) 583-1406

CANADIAN EASTERN FACTORY

1175 TWINNEY DRIVE
NEWMARKET, ONTARIO
L3Y 5V7
Ph: (905) 898-1114
Fx: (905) 898-7244

SALES OFFICES ACROSS CANADA AND USA

Retain instructions with unit and maintain in a legible condition.
Please give model number and serial number when contacting factory for information and/or parts.

www.engineeredair.com

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YOU HAVE RESPONSIBILITIES TOO

This installation, operation and maintenance manual cannot cover every possibility, situation or eventuality. Regular service, cleaning and maintaining the equipment is necessary. If you are not capable of performing these tasks, hire a qualified service specialist. **Failure to perform these duties can cause property damage and/or harm to the building occupants and will void the manufacturers' warranty.**

Warning: ⚠	**Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury or death. Read the installation, operating and maintenance instructions thoroughly before installing or servicing this equipment.**

INTRODUCTION

Engineered Air units are high quality products designed and manufactured to provide many years of trouble-free operation. We recommend that this manual be read thoroughly to ensure proper installation, efficient operation and proper maintenance of this equipment. The submittal record is considered to be part of the Installation, Operation and Maintenance Manual.

SAFETY PRECAUTIONS

Read, understand and follow the complete manual before beginning the installation, including all safety precautions and warnings.

Warning: ⚠ ⚠	**This unit is connected to high voltages. Electrical shock or death could occur if instructions are not followed. This equipment contains moving parts that can start unexpectedly. Injury or death could occur if instructions are not followed. All work should be performed by a qualified technician. Always disconnect and lock out power before servicing. DO NOT bypass any interlock or safety switches under any circumstances.**

WARRANTY

ENGINEERED AIR will furnish without charge, F.O.B. factory, freight collect, replacement parts for, or repairs to parts covered herein which prove defective in material or workmanship under normal and proper use within one year from the date of delivery, provided the customer gives ENGINEERED AIR written notice of such defects and provided that inspection by ENGINEERED AIR establishes the validity of the claim and all pertinent invoices have been paid in full.

The correction of such defects or replacement will be made only when the complete product or part(s) claimed defective are returned to ENGINEERED AIR, transportation charges prepaid, if such return is requested by ENGINEERED AIR.

Repairs or replacements as provided by the foregoing paragraph shall constitute fulfillment of all ENGINEERED AIR's obligations with respect to this warranty. The refrigerant charge is not included in any part of this warranty. ENGINEERED AIR shall not be liable for any damage to person, property, loss of revenue, or expense incurred, irrespective of cause. This warranty does not apply to any products or parts thereof that have been subject to accident, misuse or unauthorized alterations, or where ENGINEERED AIR's installation and service requirements have not been met. The foregoing warranty is in lieu of all other warranties, expressed or implied.

ENGINEERED AIR Warranty is void if:

1. The unit is not installed in accordance with this manual.
2. The start-up and operation of the unit is not performed in accordance with this manual.
3. The unit is operated in an atmosphere containing corrosive substances.
4. The unit is allowed to operate during building construction.

PARTS

Contact the nearest Engineered Air sales office or factory. Be sure to include Model Number, Serial Number, and date of installation and nature of failure along with the description of the parts required. Some parts may not be stocked items that must be made or ordered.

RECEIVING

Refer to the back of the packing slip for receiving unit instructions.

On receipt of the unit, check for damage. Inspect protective covers for punctures or other signs that there may be internal damage. Remove protective covers and check for internal damage. Replace covers if the unit is not being assembled or installed at this time.

All units are pre-tested at the factory immediately prior to shipping and are ensured to be in good operating condition at that time. If damage is found follow the instructions on the packing slip.

On receipt of the unit, check electrical characteristics (see rating plate) to make sure the unit voltage is compatible with that available for the unit. All parts for field installation are listed on the shipping order form.

TEMPORARY STORAGE

If a unit is to be stored prior to installation the following precautions are required:

- Store in a well-drained area that will not accumulate surface water.
- Store in an area where the unit will not get damaged.
- The entire perimeter and any full height cross members of the unit must be supported by a level surface and the supporting surface must be adequate for supporting the entire weight of the unit.
- All protective coverings that were provided for shipping must be in place.
- The equipment must be stored in a sheltered area.

INSTALLATION

Warning:

This unit is not explosion proof and cannot be installed in areas requiring any explosion proof rating.

Caution:

All wiring, piping electrical and other installations must be completed by qualified persons in accordance with all federal, state, provincial and/or local codes.

Note: Installation shall be in accordance with this manual and all other associated component and control Installation, Operation and Maintenance Manuals.

CODES

In Canada:

1. The installation of this unit shall be in accordance with the latest edition of the Canadian Electrical Code, Part 1 – C.S.A. Standard C22.1, Provincial and Local Codes, and in accordance with the local authorities having jurisdiction.
2. This unit shall be electrically grounded in accordance with the latest edition of the Canadian Electrical Code, Part 1 – C.S.A. Standard C22.1, Provincial and Local Codes, and in accordance with the local authorities having jurisdiction.
3. The installation of this unit shall be in accordance with the latest edition of the National Plumbing Code of Canada, Provincial and Local Codes, and in accordance with the local authorities having jurisdiction.
4. The installation of this unit shall be in accordance with all other National, Provincial and Local Codes, and in accordance with the local authorities having jurisdiction.

In USA:

1. The installation of this unit shall be in accordance with the latest edition of the National Electrical Code (ANSI/NFPA 70), State and Local Codes and in accordance with the local authorities having jurisdiction.
2. This unit shall be electrically grounded in accordance with the latest edition of the National Electrical Code (ANSI/NFPA 70), State and Local Codes and in accordance with the local authorities having jurisdiction.
3. If the unit has not been provided with an electric disconnect switch, one of adequate ampacity shall be installed in accordance with Article 430 of the National Electrical Code (ANSI/NFPA 70).
4. The installation of this unit shall be in accordance with the latest edition of the National Standard Plumbing Code (NSPC), State and Local Codes and in accordance with the local authorities having jurisdiction.
5. The installation of this unit shall be in accordance with all other National, State and Local Codes, and in accordance with the local authorities having jurisdiction.

LIFTING

The frame of the fluid chiller and/or fluid heater modules have been designed specifically for two types of lifting. When lifting from below with a pallet lift, also known as a pallet jack, or lift truck, ensure the forks are positioned under the frame facing the electrical panel as shown in Figure A. Caution must be taken when positioning the pallet lift as not to hit the module and cause damage to the refrigeration system. When lifting from above use rigging spreaders and connect to the points shown in Figure B.

Stand alone or packaged outdoor installations will have the fluid chiller and/or fluid heater mounted inside a weather tight enclosure designed for base or curb mounting. The enclosure is constructed on a structural steel base frame. The module base frame is equipped with lifting lugs specifically located to facilitate proper lifting of the module. Spreader bars must be used to keep rigging away from the module cabinetry. All lifting lugs must be used. If using a lift truck, ONLY lift using the perimeter structural frame. DO NOT use forks to lift on cabinet or module floor.

If the module is equipped with acoustic panels it may be necessary to remove the panels to fit through some openings. When lifting from above or to access the lifting points.

Note: There may be bottom mounted components, such as drain piping, that can be easily damaged.

Figure A: Lifting from below

Figure B: Lifting from above

Warning: ⚠	**Injury or death can result from improper rigging and lifting. Rigging and lifting of equipment must be performed by qualified personnel with proper equipment using appropriate and approved safety precautions.**

Warning: ⚠	**Caution must be taken when moving the modules on pallet lifts. The modules have a high center of gravity and are subject to tipping. Injury or death can result from careless operation of pallet lift.**

POSITIONING THE MODULE FOR SERVICE

In general, the modules and their pipe-header assemblies are designed for indoor application and must be located in a space where the temperature is 40ºF (4.4ºC) or above. They must be installed on a concrete foundation or support structure, with enough strength to support the operating weight of the module (i.e. weight of the module including charged refrigerant piping, filled chilled-water piping, bracing materials, etc.).

When positioning the very first module, consideration must include, but not limited to:

- Any future modules,
- Refrigerant piping (for remote air-cooled models),
- Chilled fluid piping,
- Condenser fluid piping
- City water make-up,
- Sanitary drain,
- Electrical service runs and connections,
- Access for visual inspections,
- Access for frequent maintenance tasks.
- Safety and code consideration

Please consult Figure C for the required clearances and other positioning recommendations and limitations. Typically modules are installed as shown in Figure C below. It is important to note that if there are multiple modules in the system, they DO NOT have to be mounted side-by-side. Modules can be positioned at right-angles, 180° to each other or even in an adjacent room. As long as the header pipes are connected, and the temperature sensor for the Master Controller is installed at the end of combined headers, a multiple module system can be positioned as desired, thereby increasing design and layout flexibility. Most modules come in two (2) main parts: the module and the optional pipe-header assembly. Figure D identifies the header assembly of the module.

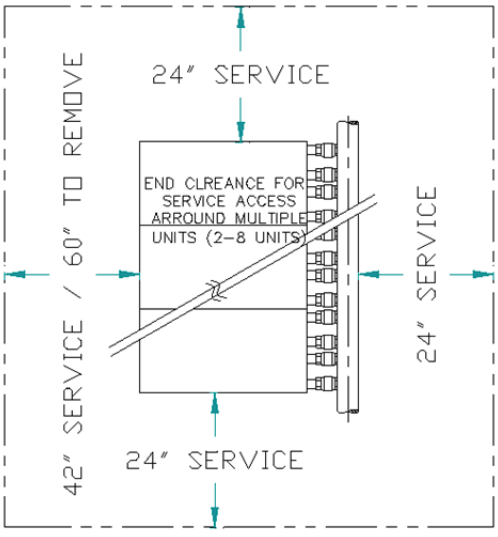


Figure C: Clearances for Service and Removal

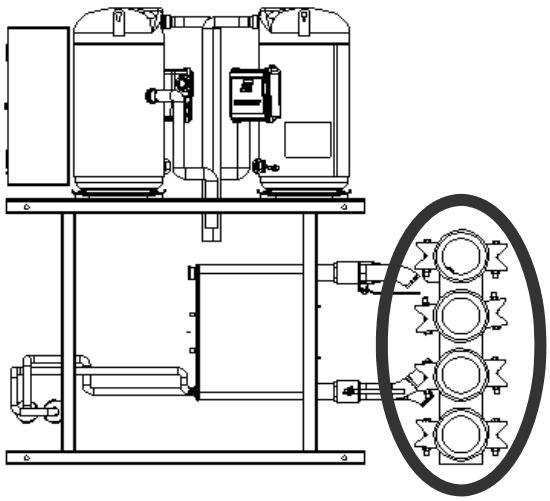


Figure D – The Module and Header Assembly

PIPE-HEADER ASSEMBLY (OPTIONAL)

Position the pipe-header assembly for all of the modules to be installed. Locate the headers so that any future headers can be connected. It is important that the header section be installed level with no more than ¼" difference in elevation from one end of each header to the other.

If the floor or supporting structure is not straight and level, additional measures must be taken such as shimming, grouting or structural support. All header sections are identical. If the first header assembly is not level, then connection to subsequent header assemblies and to the modules will be very difficult (Figure E). Furthermore, the first header assembly must be installed at the highest part of a curved floor otherwise it will be difficult to install subsequent modules in the future without significant floor re-construction (Figure F). Use shims or an adequate substructure to raise and support the header assemblies.

Once the first header assembly is positioned and leveled, firmly anchor both of the support legs on each header assembly to the foundation (or supporting structure). Grout if necessary.

Now position the next pipe-header assembly beside the first, making sure that the new assembly is level but at the same time in line with the first header. Connect second header assembly to the first with the grooved couplings (refer to coupling manufacturer's recommended lubrication when installing couplings). Secure the second pipe-header assembly to the floor in the same manner as the first. Repeat this step for all subsequent pipe-header assemblies.

For Safety and Service, consult local codes for minimum clearance distances for such things as electrical enclosures and fire protection equipment.

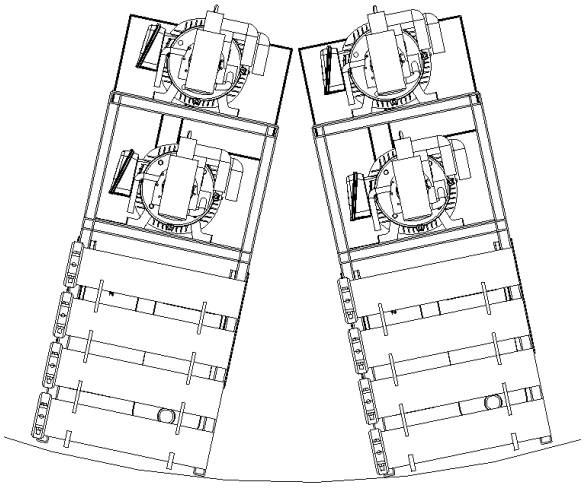


Figure E: Module mounted incorrectly on curved floor

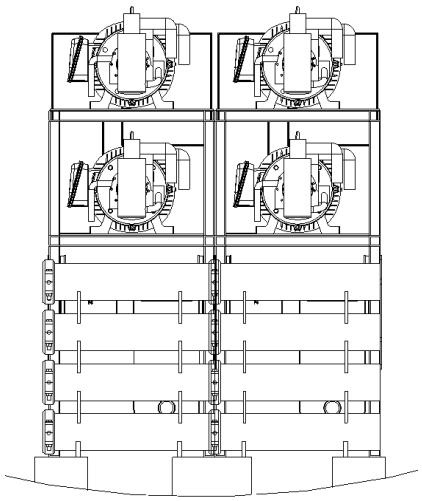


Figure F: Module mounted correctly on curved floor

CHILLER/HEATER MODULE

When moving the modules with the pipe-header assemblies disconnected, it is recommended that they be manipulated with a hand pump lift. Locate the pump lift as explained in the earlier section titled: “LIFTING.”

Position one at a time next to the header section so that the unions on the neoprene flex connectors mounted on the pipe-header assembly and the piping meet. If the connections are off by more than the allowances shown below, adjust the module with shims, supports or with a sub-structure so that the connection tolerance falls within that allowed.

	Axial Compression	Axial Extension	+/- Lateral Deflection	+/- Angular Deflection
inch/mm	0.87/22	0.23/6	0.87/22	13.30°

The modules should be supported along the running length of either of its side frames, but at a minimum it MUST be supported under EACH of the vertical frame members. The modules should be evenly supported so as not to warp or cause distortion in the frame.

Once the module is positioned and leveled, secure each of the four Victaulic connections to the pipe header assembly. Then properly secure each module to its neighboring module with the bolts provided (see inside of electrical panel). If bolts are used to fasten the modules to their foundation, ensure that they are properly anchored in order to prevent the module from displacing or tipping over. Any loose bolts should be removed and re-secured with new bolts and/or anchors. Grout if necessary.

NOTE: Shim each module only along the sides, leaving the underneath of each module clear such that a pump lift can be used in the future to remove individual modules for future servicing (see Figure A).

SHIPPING MATERIALS

Remove shipping materials. Shipping materials may include, but are not limited to:

- Protective covers over openings, piping etc.
- Tie-down bolts, straps and blocks on compressor vibration isolators.

REFRIGERATION PIPING

To complete the installation, a refrigeration technician experienced and qualified in system piping is required. The technician is responsible for the design, selection and installation of the refrigerant piping for this equipment. The following information is intended to provide general information and guidelines for the successful installation of this equipment.

For detailed information about installation practices consult ASHRAE handbooks, ANSI/ASME Codes, ANSI/ASHRAE Safety Code for Mechanical Refrigeration, CAN/CSA B52 Mechanical Refrigeration Code and any local authorities having jurisdiction.

NOTE:	**Piping design and installation of the remote air condenser system are the responsibility of the installing contractor. This manual is intended to provide general guidelines and recommendations only. It is not a complete design manual.**

NOTE:	**DO NOT select tubing sizes based on the size of the connection stubs. The correct tubing size for your installation must be designed and selected for each and every job.**

Caution: ⚠	**Underground Piping is not recommended. Improper installation of a condensing unit with underground piping will result in equipment failure. Consult Factory on all systems with underground refrigerant piping. Underground piping will void compressor warranty unless specifically authorized by the factory.**

Liquid Line

1. Liquid lines should have a maximum refrigerant velocity of 300 feet per minute (1.52 m/s) to avoid liquid hammer.
2. Select pressure drop for a temperature penalty of less than 2°F. (1.1°C)
3. If a liquid line travels through a warm area, such as a boiler room, insulate the line to prevent heat gain.
4. Ensure the temperature penalty does not exceed the subcooling provided by the remote condenser.

Discharge Line

1. Select pressure drop for a temperature penalty of less than 2°F (1.1°C).
2. A trap shall be installed at the compressor.
3. An inverted trap shall be installed at the condenser to prevent liquid from draining back to the compressor.
4. A check valve is required at the condenser inlet.

NOTE: Pipe sizes must be selected with sufficient velocity to ensure proper oil return to compressor regardless of the pressure drop temperature penalty.

ELECTRICAL INSTALLATION

DO NOT install anything that will interfere with equipment access or the rating plate.
The unit must be electrically grounded and all wiring must be installed in accordance with the National Electrical Code, ANSI/NFPA 70, and/or the Canadian Electric Code CSA 22-1 and to the approval of the authorities having jurisdiction. Field wiring diagrams, internal wiring diagrams and operating functions are included in the control cabinet. The power requirements are indicated on the rating plate. Where field wiring of control circuits is required, take care to size the field wiring for a maximum 10% voltage drop. The control circuit ampacity is noted on the field wiring diagram. See the field wiring diagram for requirements for shielded or twisted pair wire for solid state devices.

Warning:

No unspecified external load shall be added to the control transformer circuit(s) or to the main power circuit(s).

Recommended 24V Field Wiring Size (copper conductors only)

Circuit Load (Amps) (1)	Maximum Total Length of Run									
	< 50 Ft (~ 15 m)	< 100 Ft (~ 30 m)	< 150 Ft (~ 45 m)	< 200 Ft (~ 60 m)	< 250 Ft (~ 75 m)	< 300 Ft (~ 90 m)	< 350 Ft (~ 105 m)	< 400 Ft (~ 120 m)	< 450 Ft (~ 135 m)	< 500 Ft (~ 150 m)
1	16 AWG	16 AWG	16 AWG	16 AWG	16 AWG	16 AWG	14 AWG	14 AWG	14 AWG	12 AWG
2	16 AWG	16 AWG	16 AWG	14 AWG	12 AWG	12 AWG	12 AWG	10 AWG	10 AWG	10 AWG
3	16 AWG	16 AWG	14 AWG	12 AWG	12 AWG	10 AWG	10 AWG	10 AWG		
4	16 AWG	14 AWG	12 AWG	10 AWG	10 AWG	10 AWG				
5	16 AWG	12 AWG	12 AWG	10 AWG						
6	16 AWG	12 AWG	10 AWG	10 AWG						
7	14 AWG	12 AWG	10 AWG							
8	14 AWG	10 AWG	10 AWG							
9	14 AWG	10 AWG								
10	12 AWG	10 AWG								
11	12 AWG	10 AWG								
12	12 AWG	10 AWG								
13	12 AWG									
14	12 AWG									
15	12 AWG									

Notes:

1) The field wiring load depends on the actual load on a particular control circuit the field wiring is connected to. Refer to the internal wiring diagram of the unit.
2) The table above is based on a maximum 10% voltage drop on a 24V control circuit. Wire size was calculated using the following formula:

   CM = (25 x I x L) / V

   Where **CM** is circular mils of conductor for a constant load of **I** amps, wire length **L** in feet from the unit to the field device and back, and voltage drop **V**.

When connecting to a three phase power supply, check for the correct rotation of all motors and fans. All electrical conduit outlets in the control panel must be sealed to prevent moist building air from migrating to the control panel.

FIELD INSTALLED CONTROLS AND SENSORS

The modules are factory wired to be as complete as possible, but some control sensors need to be field installed and wired. Identify any auxiliary control devices such as temperature sensors, alarm devices, etc. and connect them to proper circuits. The wiring diagram that accompanies the equipment shows the wiring to be completed in the field. At a minimum, the following devices must be connected in addition to the dedicated power disconnect to the module:

1. The request for evaporator flow and condenser flow contacts – A digital output (dry contact) to enable the evaporator and condenser pumps to start.
2. Evaporator and condenser flow switches (by others) – A digital input to the controller to verify fluid flow on the evaporator and condenser before the unit will operate.
3. Remote alarm contact (Optional) - A dry output contact that closes whenever an alarm condition is active.
4. Chilled water temperature sensor and flow switch.
5. Condenser water temperature sensor and flow switch.

FLUID PIPING CONNECTIONS

When connecting the fluid system to the pipe-header assembly it is recommended that the following components are used and follow the layout in Figure G. One end of the line of pipe/headers will be connected to the fluid piping; the other end will need to be capped. If additional modules are planned for the future, it is suggested that valves be installed in the pipe/header assembly before it is capped. This will allow for the addition of future modules without draining or shutting down the system.

The piping as shown in Figure G enters and leaves on opposing sides. Other options are:

1. Piping enters and leaves from the right with the capped ends on the left.
2. Piping enters and leaves from the left with the capped ends on the right.
3. Piping enters on the right and leaves on the left.

NOTE: All piping and connections are to be performed by a qualified personnel. All piping is to be installed in accordance with all relevant codes and standards. When installing and piping the system, you must not allow dirt, scale, welding slag or any other foreign matter to enter the system. Sizing and layout of the fluid system is beyond the scope of this manual.

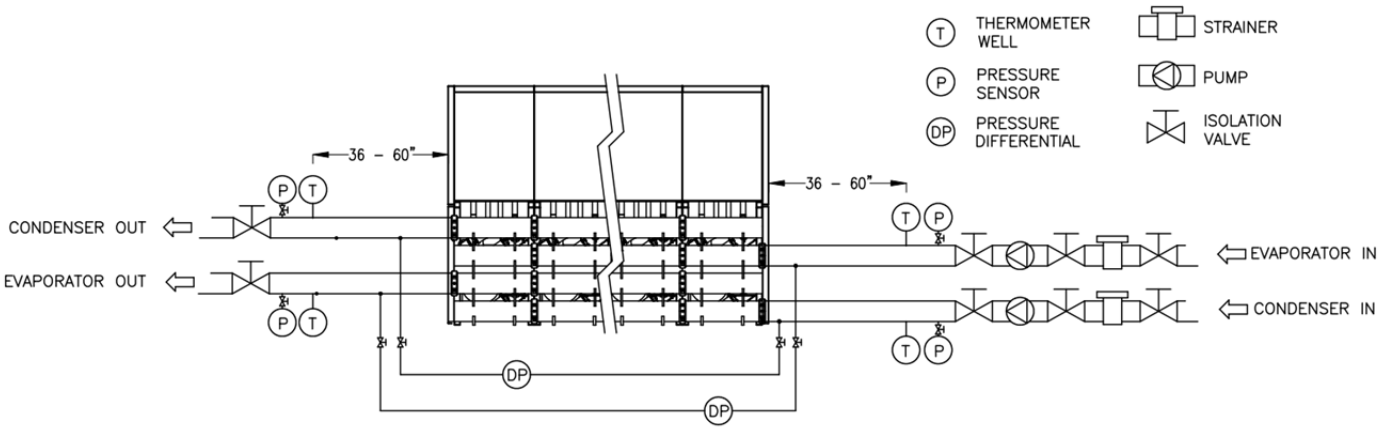


Figure G – Chiller piping

FLUSHING AND CLEANING OF THE SYSTEMS

After the piping systems are complete, it must be cleaned of any debris. All newly installed piping should be thoroughly flushed to remove any particles of dirt or debris that may have accumulated inside the piping during assembly. Evaporators, condensers, valves, heat exchangers and pumps may trap debris that may damage the equipment. Such damage is not covered under warranty. When flushing a newly installed system the modules must be isolated from the initial flush so no foreign debris gets introduced into the heat exchangers.

The heat exchangers and piping may contain material or residue from manufacturing, transportation or storage. To prevent possible damage to other components in the system, these systems must be flushed and degreased. Consult a qualified water treatment specialist.

WATER OR HEAT TRANSFER FLUID QUALITY

Particles larger than 1 mm in the heat transfer fluid can damage the heat exchangers. Strainers shall be installed before the exchangers with a size of 16-20 mesh (number of openings per inch). The particles could otherwise block the channels, causing bad performance, increased pressure drop and risk of freezing.

Using untreated fluids in the heat exchangers may result in fouling or scaling and a decrease in the operating efficiency. Heat exchanger damage may also result. It is recommended that a qualified chemical treatment professional be consulted before operating the system. As a minimum, the fluid shall remain within the limits outlined in Figure I.

Fluid Contaminants	Value or Concentration
pH	7 to 9
Calcium Carbonate	30-500 mg/liter
Sulphate	< 200 mg/liter
Chlorides	< 200 mg/liter
Nitrates	< 100 mg/liter
Iron	< 4.5 mg/liter
Ammonia	< 2.0 mg/liter
Manganese	< 0.1 mg/liter
Particulates (dissolved)	< 1000 mg/liter

Figure I: Fluid limits

HEAT TRANSFER FLUIDS

The heat exchangers provided have been selected for use with a specific heat transfer fluid as shown on the Submittal Record. Use of other fluids will result in different performance and can damage the heat exchangers.

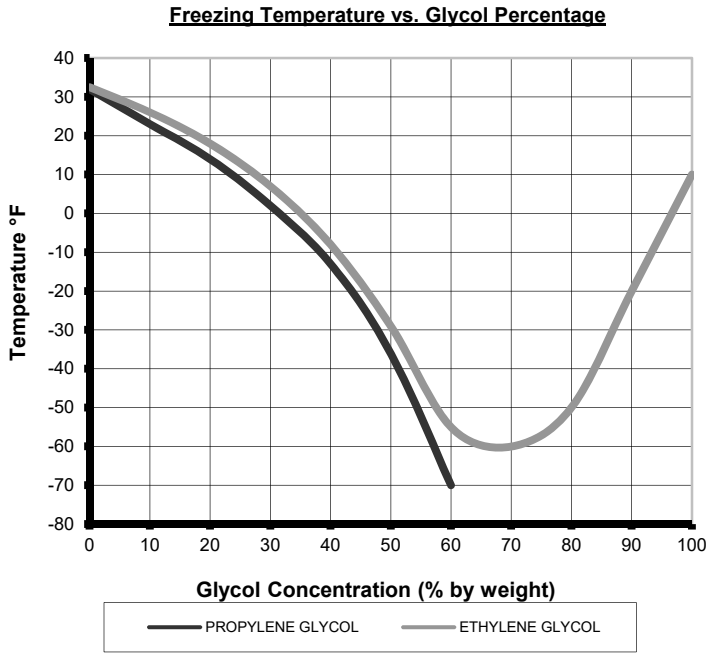
It is imperative to properly select and apply heat transfer fluids used in heating and cooling systems. Untreated, improperly treated or improper use of fluids or use of fluids not approved for use in commercial heating and cooling systems can damage heat exchangers and system components. For selection and application of heat transfer fluids, always follow the manufacturers' recommendations including treatment, mixing and filling. Warranty will be void if coil damage results from misapplication or improper treatment of the heat transfer fluids.

GLYCOL

Typically, a module is designed to operate with water or a water/glycol solution. Before introducing glycol into the system, check the following conditions are met:

The solution selected should be non-corrosive and have suitable corrosion inhibiters. This will prevent or reduce corrosion of the system and gaskets. The glycol solution should be mixed to protect for a temperature of at least 15°F (8.3°C) below the system operating temperature or the lowest ambient temperature (whichever is lower) it may be subject to, and should be checked regularly to maintain the proper concentration.

NOTE:	**Do not use 100% ethylene glycol as the freezing point actually rises to a freezing point of approx. 10°F (-12.2°C). The chart below is only a rough guide and should not be used to select glycol solutions. Refer to the glycol's manufacturer's published information.**



CONTROLS

The individual modules each have their own local controller. When a master controller is present, the local controller looks after all the local safety operations. It receives signals from the master controller to stage on/off compressors.

For further controller information refer to the Controls Manual for MC & MH series.

BEFORE START-UP

Remove tie-down bolts, straps and blocks on compressor vibration isolators.

START-UP CHECK LIST

Warning:	**This unit is connected to high voltages. Electrical shock or death could occur if instructions are not followed. This equipment contains moving parts that can start unexpectedly. Injury or death could occur if instructions are not followed. All work should be performed by a qualified technician. Always disconnect and lock out power before servicing. DO NOT bypass any interlock or safety switches under any circumstances.**

Caution:	**Screw and Scroll compressors MUST be checked for proper rotation at startup. Permanent damage can occur if rotation is not correct.**

The start-up and operation must be in accordance with safe practices. Start-up must be performed by qualified personnel.

Piping

1. Ensure that every module is level within tolerance and that it is securely anchored to its supporting foundation. Do the same for each pipe-header assembly.
2. Ensure that every module is properly secured to its respective pipe-header assembly via the rubber flex connectors.
3. Visually check all fluid and refrigerant connections to confirm there is no cross connection of circuits, reversed piping or damage.
4. Check that all fluid connections and drains are closed after flushing the system. Connection points (such as drain valves) should be plugged or capped.
5. Ensure that the system has been properly purged of trapped air.

Electrical

It is important that proper lock-out, tag-out procedures be followed when servicing or inspecting the electrical components of the modules. Perform inspections only after the electrical power is proven off.

1. The electrical installation must be inspected by authority having jurisdiction to ensure that all work was performed in accordance with local and national codes.
2. Check every terminal screws in the control panel to make sure that they are tight.
3. All field electrical connections should be checked for proper connection.
4. Verify that all installed fuses are of the proper specified size and type.

Refrigeration

The following work should be performed by a qualified refrigeration technician.

1. All refrigeration piping and components should be inspected for damage.
2. Place refrigerant gauges on the suction and discharge ports of each refrigeration circuit and verify that a refrigerant charge is present. Refer to the serial plate for the correct refrigerant charge and type.

The Fluid System

1. Confirm that the fluid circulating pumps are operational with proper rotation and that fluid flow through both the chilled-fluid and condenser heat exchangers are correct.
2. Ensure fluid flow rates through the condenser and evaporator by measuring the pressure differential across both heat exchangers and comparing them to the fluid pressure drop on the submittal.

General

1. Re-install all access panels.
2. Remove any packing material or debris and dispose appropriately.

CHARGING INSTRUCTIONS

For systems being charged in the field the following shall be considered:

1. Charging a system should be done at design head pressure (typically at 5-8°F (3-5°C) saturated discharge temperature above the design leaving fluid temperature). For water cooled systems condenser fluid flow can be temporarily restricted to simulate this condition.
2. The system must be at design fluid flow and evaporator load.
3. Charge refrigerant into the system slowly until the system sight glass is clear.
4. MC/MH systems are designed to operate with superheat set at 8°F (4.4°C) and subcooling set at 10°F (5.5°C).

OPERATION

Warning:	**This unit is connected to high voltages. Electrical shock or death could occur if instructions are not followed. This equipment contains moving parts that can start unexpectedly. Injury or death could occur if instructions are not followed. All work should be performed by a qualified technician. Always disconnect and lock out power before servicing. DO NOT bypass any interlock or safety switches under any circumstances.**

Warning:	**Proper commissioning and start-up of the modular fluid chiller/heater is the responsibility of the installing contractor. It is recommended that a fluid balance be completed by a certified fluid balancing contractor to insure the fluid flow being delivered matches the unit rating plate. Failure to perform a proper fluid balance can cause injury or death, damage to the equipment, property damage, or system operational problems. Decreased capacities can result from improper fluid flow.**

REFRIGERATION CONTROLS

Refer to the wiring diagram and unit function for specific information. Standard pressure control settings are found in the following notes. Application specific control settings are noted on the wiring diagram and in the unit function.

1. Hermetic Compressors:
   a) Low Pressure Controls:
      All compressors have an auto-reset low pressure control with contacts that open at low pressure and close when the pressure increases.

   b) High pressure controls:
      i. Hermetic compressors, 6 tons and smaller.
         High pressure controls are optional. These compressors are equipped with an internal pressure relief valve. On a high pressure condition, the internal pressure relief valve opens and relieves high pressure to the low side of the system. The internal valve will stay open until the pressures equalize.

      ii. Compressors larger than 6 tons.
         High pressure controls are standard. The manual-reset contacts open when the system discharge pressure exceeds set point. The compressor is locked out until the control is manually reset.

      iii. Overheat and Overload Protection:
         Hermetic compressors are typically supplied with either a winding thermostat or current sensing overload device. These are capable of sensing motor overheating caused by a shortage of gas, refrigerant system restrictions, single phasing or locked rotor conditions.

Note: Winding thermostats can stay open for up to twenty four hours under some conditions.

2. Semi-Hermetic Compressor:

    a) High and Low Pressure Control:
    The manual-reset high pressure control contacts open when the discharge pressure exceeds setpoint de-energizing the control circuit. The low pressure control is auto reset.

    b) Overheat and Overload Protection:
    Semi-hermetic compressors are equipped with solid state motor protection with three motor winding temperature sensors. Compressor Protection Modules (CPM) typically have a two minute anti-short cycle timer, for addition compressor protection.

    c) Oil Pressure Safety Control:
    Semi-hermetic compressors are lubricated by a positive displacement oil pump. The compressor is protected against a loss of lubrication by the manual reset oil pressure safety control. This control senses the differential pressure between the oil pump discharge and the crankcase.

    d) Low Ambient Compressor Lock-Out (Air cooled systems):
    These controls will prevent the cooling system from starting when the ambient temperature is too low. The low ambient control may be part of the system controller or a separate device.

3. Head Pressure Control:
    Head pressure controls are designed to maintain an adequate operating head pressure, to allow the TX valve and other components to work correctly. Low head pressures can cause flashing in the sight glass, TX valve underfeeding and reduced system capacity.

    Engineered Air systems are custom built and may employ any of several different methods of controlling head pressure.

4. Cylinder Unloading (Optional):
    This is a form of capacity control on some compressors that reduces the pumping capacity of the compressor during low load conditions. Unloading may be activated by the control system or by a pressure actuated Cylinder Unloading Control (CUC). Refer to the unit function for application specific pressure settings.

5. Fluid Cooled Systems (Standard):
    If the system is equipped with a fluid cooled condenser, set the fluid flow rate to maintain a saturated discharge temperature of 5-8°F (3-5°C) above the fluid leaving temperature. Be sure to check the unit submittal for application specific settings

6. Remote Air Cooled Systems (Optional):

   a) Above 50°F (10°C) ambient (Standard):
   Condenser Fan Cycling (CFC) head pressure controls will cycle fans to maintain proper head pressure on cooler days.

   b) Above 20°F (-7°C) ambient (Optional):
   Engineered Air Flash Intercooler is used with nested CFC controls to allow a floating head pressure. The intercooler eliminates flash gas at the TX valve. Refer to unit function for operating data on these systems.

   c) Above 0°F (-18°C) ambient (Optional):
   Variable speed condenser fan motors or inlet dampers on condenser fans will vary air flow to control head pressure. Refer to unit function for a description of operation.

   d) Above -40°F (-40°C) ambient (Optional):
   Condenser flooding head pressure controls are used to control the effective surface area of the condensers during low ambient operation. These systems DO NOT USE pressure actuated fan cycling controls. Condenser fans are either constant run or cycled by ambient temperature. Refer to the valve manufacturers' literature for information regarding operation of these valves. Refer to unit function for a description of system operation.

   e) Pumpdown System (Optional):
   Depending on options, the cooling system may include a liquid line solenoid for refrigerant control and management. The control circuit may be wired for:

   a) solenoid drop, or

   b) single pumpdown, or

   c) recycling pumpdown, depending on the specific application.

   d) Hot Gas Bypass (Optional):
   Hot gas bypass is provided on systems to prevent frost formation on the evaporator coil during low load conditions.

   The hot gas valve will start to open at a pressure that corresponds to approximately 34°F (1°C) coil temperature. All compressors equipped with unloading should be fully unloaded before hot gas starts to open.

Caution: ⚠	**When recovering refrigerant from a system equipped with a fluid cooled condenser, the fluid valve must be manually opened so fluid flows continuously through the condenser while the refrigerant is being recovered. Failure to do so can cause the condenser to freeze, which will permanently damage the condenser.**

REFRIGERANT HANDLING

Recovery, reuse, recycling, reclamation, and safe disposal of refrigerant is the only acceptable practice today. Venting of refrigerant into the atmosphere during installation or servicing is unacceptable. To avoid damage, use an accepted refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government safety and environmental laws.

Caution: ⚠	**Environmental laws govern the safe handling of refrigerants. Only personnel qualified to safely handle refrigerant may service this equipment. All refrigerant must be handled safely and responsibly. Records must be kept as required by the authorities having jurisdiction.**

When servicing the refrigeration system, the refrigerant must be properly recovered to prevent release to atmosphere. Always use the same refrigerant as indicated on the unit rating plate.
Do not change the type of refrigerant in the system. Warranty is void if refrigerant type is changed.

Zeotropic refrigerants (e.g. R407C, R404A), must be charged into the system as a liquid. Care must be taken to introduce the refrigerant safely.

COMPRESSOR OIL

Several types of oil are used by compressor manufacturers. The different types of oil cannot be mixed or interchanged. Consult the compressor manufacturer for the correct type, viscosity and quantity of oil used in the compressor.

On larger compressors, it is a good practice to do an acid test yearly. If the oil is acidic, discolored or has a bad smell, change the oil and take corrective action to stop acid formation.

Oil Level
Small Hermetic compressors have no visual means of determining oil level. In the case of a leak, if the amount of oil lost is small and can be reasonably calculated, this amount should be added to the compressor. If there is a major loss of oil, the service personnel must remove the compressor, drain the oil completely and add the compressor manufacturers measured oil charge for replacement compressors before placing the compressor into operation. Contact the compressor manufacturer for the type and quantity of oil required.

Larger hermetic, semi-hermetic and screw compressors are equipped with an oil level sight glass. Consult compressor manufacturer for correct oil level. The oil level sight glass is typically between 1/4 and 3/4 full. Excessive oil in the system can damage the compressor.

WATER FLOW

Variable water flow systems must ensure minimum design water flow to the chiller systems is maintained (Refer to Submittal Record). Water flow cannot be infinitely variable and pump (VFD controlled) must be able to supply the required flow of each operating chiller. Typically water flow is controlled by the differential pressure of the system at the chiller inlet and outlet.

SHUTDOWN PROCEDURE

Warning: 	**Electrical shock or death can occur if instructions are not followed. This equipment contains moving parts that can start unexpectedly. Injury or death could occur if instructions are not followed. All work should be performed by a qualified technician. Always disconnect power before servicing. DO NOT bypass any interlock or safety switches under any circumstances.**

Note: Consult all manuals for the components in the system for their specific shut-down procedures.

1. Temporary Shutdown:
   To shut the unit down for a short time (such as for inspection or service). Turn off the unit using the display keypad, and turn off the main disconnect.

2. Re-Startup after Temporary Shutdown

   a) Turn on main disconnect for the unit.
   b) After a time delay, to allow the crankcase oil to warm up, the unit will be ready to start. Turn on the unit using the display keypad.

3. Extended Shutdown
   Note: Leaving the main power on will keep the crankcase heaters energized and will not harm the system.

4. Re-Start After Extended Shutdown

   a) If the main power was off, re-connect main power and allow 24 hours for crankcase heaters to work prior to start-up of compressors.
   b) If main power was left on, check to ensure the crankcase heaters are still operating. If not, replace them and allow at least 24 hours before starting the compressor.
   c) Follow the steps in the initial start-up procedure.

MAINTENANCE

Warning: **This unit is connected to high voltages. Electrical shock or death could occur if instructions are not followed. This equipment contains moving parts that can start unexpectedly. Injury or death could occur if instructions are not followed. All work should be performed by a qualified technician. Always disconnect and lock out power before servicing. DO NOT bypass any interlock or safety switches under any circumstances.**

In order to provide a maintenance history, we recommend that the owner have a maintenance file for each unit. The following maintenance instructions are to be carried out each spring and fall or as otherwise indicated by qualified service personnel**.**

ELECTRICAL

1. Check all wiring for loose connections.
2. Check voltage at unit (while in operation).
3. Check amperage draw against unit rating plate.
4. Where possible, all contactors should be inspected to ensure that contacts are clean and are making good contact. If contacts are abnormally pitted or burned badly, replace contactor. Single phasing and motor burnouts can result from bad contacts.

REFRIGERATION

Seasonal Maintenance

1. On semi-hermetic and screw compressors, check compressor oil level and add refrigerant oil if necessary.
2. Check operating temperature and pressures.
3. On units with sight glasses, check for leaks. There should be no foaming under steady state operation.
4. Condensing Section:
    a) Fluid Cooled - With time, condensers can foul with mineral deposits from the fluid, resulting in a reduced heat transfer capacity and increased refrigerant head pressure. Should this condition occur, the condenser coil should be chemically cleaned or replaced.
    b) Air Cooled – The external surface of finned coils can be cleaned using a low pressure water spray and a brush. Coil fins are easily damaged. Do not use high pressure steam or water to clean coils; it will permanently damage the coil. When using cleaning additives or solutions they must be compatible with the coil materials or coatings. Use a fin comb to straighten any damaged or bent fins.
5. Inspect refrigerant lines for evidence of oil leaks.
6. Ensure flow sensors are clean and sensing properly.