motivair™

COOLING SOLUTIONS

MHR – 200 – 950 (SCREW COMPRESSORS)

- Heat Recovery Version
- R134A Refrigerant

Installation, Operation & Maintenance Manual

Updated May 8th, 2012

Contents:

Subject:

1. INTRODUCTION

1.1 GENERAL INFORMATION:

This manual contains the installation, use and maintenance instructions for the MHR chillers with scroll compressors, and highlights all warnings. It has been expressly prepared and written to allow authorized users to use the MHR chillers in complete safety and with the greatest of ease. Please read the whole of this manual with care, paying special attention to the sections marked with

as non-compliance may cause harm to people, deteriorate the environment and/or damage the unit. Motivair declines all responsibility for any improper use of the unit, unauthorized modifications or non-compliance with the instructions contained in this manual. Please keep this manual in a safe place and make it available to chiller operators and maintenance men.

1.2 WARNINGS:

The MHR units have been designed and built to ensure long-term operating reliability and maximum safety; for this reason and thanks to the company's design and construction policy, the company is able to guarantee that this product totally complies with most global safety standards. A further guarantee of this is provided by the factory tests carried out in the unit. The user, therefore, must only ensure the unit is properly used and that maintenance operations are carried out according to the indications contained in this manual.

The unit should not be touched until the whole of this manual has been carefully read.

This installation, use and maintenance manual must always be kept within easy reach of authorized staff who are obliged to read it before carrying out any operations of the unit.

For any further information or explanations please contact Motivair Corporation at the following address:

Motivair Corporation
85 Woodridge Drive
Amherst, NY 14228
Phone: (716) 691-9222
Fax: (716) 691-9229
www.motivaircorp.com

2. UNIT DESCRIPTION

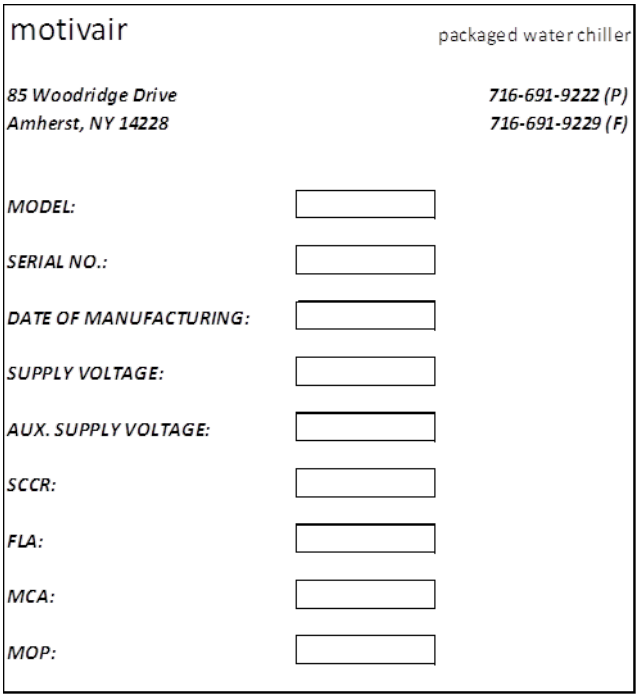
This chapter contains a general description of the main unit characteristics, together with those of its principle standard and optional components.

2.1 IDENTIFICATION:

2.1.1 Unit Identification:

The unit can be identified through the name plates attached on the chiller. This label contains the following information:

- Manufacturer's Name
- Manufacturer's Address
- Description of the series and type of unit
- Serial Number
- Year of Construction
- Type and Quantity of Refrigerant Liquid
- Max. Allowable Pressure
- Pressure Switch Set Point
- Electrical Data



2.2 INTENDED USE:

The MHR series of air cooled chilled have been designed to cool water (possibly containing inhibited ethylene glycol) circulating in a closed circuit. The heat pump units can cool or heat the water in the closed circuit depending on which operating cycle is chosen. The heat recovery units can also heat the water circulating in a second closed circuit. The heat or cold produced can be used for air-conditioning systems or industrial processes.

2.3 CONTRAINDICTIONS:

Do not use inflammable products near the unit.

Do not use substances that can form explosive mixtures near the unit.

Do not use the unit in conditions that can be harmful for the environment (see point 3.5).

2.4 GENERAL DESCRIPTION:

All the unit structures are made from galvanized sheet metal and are further protected with polyester powder paints. The structure is free standing and the panels are easy to remove in order to allow access to the inside of the unit for maintenance and repair operations.

3. SAFETY

3.1 DEFINITION:

This document uses the following definitions:

- **Dangerous Areas**: any area inside and/or near to the unit in which the presence of a person would give rise to a risk for that person's health.
- **Exposed Person**: anyone who is wholly or partly inside a dangerous area.
- **Operator/Maintenance Technician**: person or persons authorized to operate, adjust, service, repair or move the unit.

3.2 GENERAL SAFETY REGULATIONS:

It is forbidden for unauthorized persons to approach the unit.

Carefully observe the contents of Chaper 9 before carrying out any maintenance operation on the unit.

Do not enter the unit. Access is only permitted to qualified staff when the unit is disconnected.

Do not remove safety guards and by-pass safety and emergency devices.

Do not stand on the unit.

- Only use the unit to do what it was built for.
- The manufacturer declines all responsibility for damage deriving from improper use or technical modifications made to the unit.
- Check the safety devices are in perfect working order on a regular basis.
- Do not dismount, modify or disconnect unit parts.
- When working on the unit, only use suitable tools and equipment in good condition. Operators must wear normal personal protection equipment (gloves, helmet, goggles, etc.).
- Work on the electric system of the unit may only be carried out by a qualified electrician.
- Work on the refrigerant circuit may only be carried out by specialized staff.

3.3 SYMBOLS:

Check the state of the plates on a regular basis and repair them if necessary.

3.4 EMERGENCY AND SAFETY DEVICES:

An emergency external circuit breaker must be fitted by the unit installer to disconnect the unit from the power supply.

3.5 DESCRIPTION OF RESIDUE RISKS:

The description of residue risks includes the following elements:

- The kind of danger the people working on the unit are subjected to;
- Description of the main dangers;
- Who is exposed to such dangers;
- The main safety methods used to reduce the risk of injury.

The following accident prevention instructions, with reference to the relative areas concerned by residue risks, must be integrated with all the general indications contained in the present chapter and with the accident prevention regulations in force in the country of installation.

3.5.1 **Residue risks near the unit:**

- Electrocution if the unit is not properly corrected to the mains power supply and earth circuit.
- Cuts or abrasions caused by sharp surfaces.
- Extraction and subsequent dispersion in the environment of substances present in the installation site.
- Ejection of objects falling on the fan blades.
- Leaking water (in case of malfunction).
- Formation of condensation and ice in front of the unit while the unit heat pumps are working.
- Alteration of the micro-climate (during operation).
- Noise (during operation). The sound pressure levels of each unit are carried in the technical manual.
- Leaking oil (in case of malfunction).
- Leaking refrigerant liquid (in case of malfunction).

  N.B. Refrigerant liquid is a substance which causes a greenhouse effect. Its vapors are heavier than air and can cause suffocation by reducing the amount of oxygen available for breathing. Rapid evaporation of the liquid can cause freezing to occur.

3.5.2 **Measures to take in case of leaking refrigerant gas:**

- Product Type:
  - R407C – R410A – R134a

- First Aid Measures:
  - General Information:
    - Do not give anything to people who have fainted.
  - Inhalation:
    - Take the person out into the open air. Use oxygen or artificial respiration if necessary. Do not give adrenaline or similar substances.
  - Contact with eyes:
    - Carefully rinse with abundant water for at least 15 minutes and see a doctor.
  - Contact with skin:
    - Wash with abundant water and remove all contaminated clothing immediately.

- Measures to Take in Case of Accidental Leaking:
  - Personal Precautions:
    - Evacuate all staff to safety areas. Make sure the area is suitably ventilated. Use personal protection equipment.
  - Environmental Precautions:
    - To intercept the emission.
  - Cleaning Methods:
    - To employ absorbent products.

3.5.3 **Operations with the panels removed:**

Some of the following operations and/or controls require the panels of the unit to be removed in order to access the inside of the unit.

Before removing an outer panel, except for the one protecting the electrical panel (easy to recognize due to its ventilations slits), the unit must be disconnected from the mains power supply.

Please note that some surfaces inside the unit may be hot (piping, compressor, etc.), cold (compressor, suction separator, etc.), sharp (coil fins), or moving (fans) even when the unit is not working.

These operations may only be carried out by qualified staff wearing safety clothing.

Operating checks may require the unit to work (totally or partially) while a panel is open. In this case the panel should be removed when the unit is not working.

These checks are particularly dangerous and may only be carried out by highly qualified staff.

Proceed as follows:

- Turn off mains power with the main power switch.
- Open the electrical panel and remove the relative fuses to disconnect the components that do not need to be working in order to carry out the relative check.
- Close the electrical panel.
- Remove the panel in question.
- Start the unit.
- Carry out the relative check with the greatest of care and using personal protection equipment.
- After completing the check, stop the unit and put the panel back in place.
- Turn off mains power and put back any fuses that were previously removed.
- Close the electrical panel.

4. INSPECTION AND TRANSPORT

4.1 INSPECTION:

CHECK THE CONDITION ON THE UNIT UPON RECEIPT. AS THE UNIT WAS CAREFULLY CHECKED BEFORE LEAVING THE FACTORY, ANY CLAIMS FOR DAMAGES SHOULD BE ADDRESSED TO THE FORWARDER. ANY DAMAGE SHOULD THEREFORE BE INDICATED ON THE DELIVERY NOTE BEFORE SIGNING IT. Please inform the company or the Agent of the nature of the damage to the unit immediately. The customer must always write a report describing any damage caused to the unit.

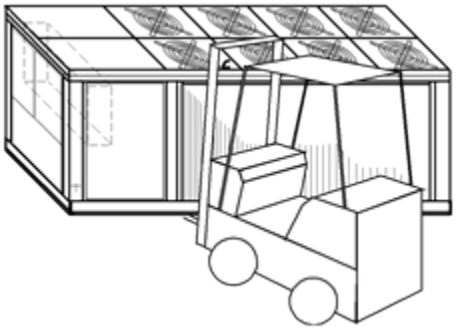
4.2 STORAGE:

The temperature in the area where the units are stored must range between -20 and +50°C.

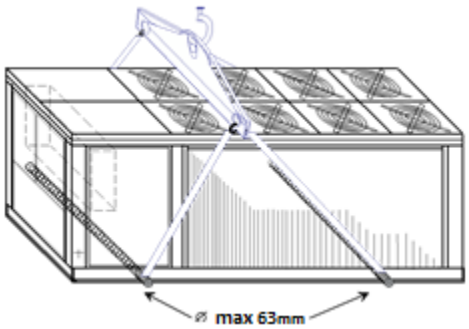
4.3 LIFTING AND TRANSPORT:

When unloading and positioning the unit, take great care not to make sudden and/or violent manoeuvers. Do not lift the unit by its piping or any other components. The unit should only be moved as shown in the plate attached to it. The lifting points are clearly indicated with the label.

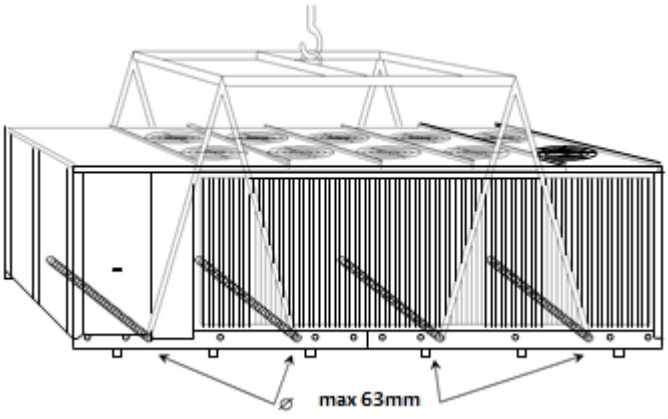
Attention!
Make sure the unit is securely anchored before lifting it in order to prevent it from accidentally overturning or falling.



per unità con lunghezza ≥ 6700 [mm]



for units longer than ≥6700 [mm]



4.4 UNPACKING:

Only unpack the unit when it has reached the installation site and no longer needs to be moved. Remove the packing material with care, making sure not to damage the unit. Given that various kinds of packing material are used (wood, polyethylene (PE, polystyrene, cardboard, etc.), they should be separated and delivered to specialized disposal and recycling companies for environmental reasons.

5. INSTALLATION

5.1 CHOOSING THE INSTALLATION SITE:

When choosing the installation site the following points should be considered:

- The weight of the unit:

The supporting surface under the unit must be perfectly horizontal and able to withstand its operating weight.

A supporting surface with an appropriate area should be built. This is particularly important if the unit is installed on unstable ground (gardens, embankments, etc.).

- The supporting surface must:
  - Lie on suitable foundations and be about 4-6 inches higher than the surrounding ground;
  - Be horizontal and able to withstand about 200% of the weight of the unit in operation. A suitable sealer layer of cork should be placed along the perimeter to avoid moisture collection.

- Spaces:

Make sure that sufficient free space, as indicated on the technical book, is left around the unit.

Less space will make it difficult or impossible to carry out maintenance operations and/or lead to faults in the unit due to the reduction in the air flow on the condenser coil or its recirculation.

Maintenance and clearance guidelines do not account for surrounding high walls or adjacent chillers.

Please note that obstacles such as canopies, shelters or coverings in general are not permitted.

Please note that the heat pump units cause ice and condensation to form and drain onto the floor in front of the unit. This water must therefore be collected and drained to prevent the floor from becoming slippery.

People may not enter the unit area unless they are authorized operators and maintenance personnel.

- Noise:
  - The unit generates noise while it'd working; do not install it in reverberating rooms. The unit must be positioned with the coil side facing the direction where noise is less critical.
- Prevailing winds:
  - Wind may alter operating conditions; to minimize its effects the unit should be positioned with the long side parallel to the direction of prevailing winds.
- Vibrations:
  - Although the units transmit a low level of vibrations to the ground, a sheet of rigid rubber should always be placed between the unit base and the supporting surface.
  - If greater insulation is required, vibration eliminating supports should be used (in rubber or with springs).

5.2 WATER CONNECTIONS:

5.2.1 General:

Please carefully carry out the following instructions and observe current law when installing the chilled water circuit.

Attention!
The water pipes must be suitably supported with brackets in order not to weigh on the chiller.

- Connect the pipes to the chiller with flexible joints in order to prevent the transmission of vibrations and to compensate thermal expansion.
- Install the following components on the pipes:
  - Shut-off valve (moisters) for shutting off the water mains;
  - Temperature and pressure gauges for routine maintenance and inspection purposes;
  - Check points on the inlet and outlet pipes for measuring temperatures if temperature indicators are not fitted;
  - Y-strainer with 500 micron mesh;
  - Relief valves, fitted in the uppermost parts of the water circuit, for expelling air;
  -  ***Expansion tank (if not already fitted) of a suitable size for the quantity of water contained in the system and the expected temperature range, and an automatic inlet valve for maintaining the pressure of the system and compensating the thermal expansion of the fluid.***
  - Drain valve or, where necessary, drain tank for emptying the circuit for maintenance operations or seasonal shut downs.

Drawings (#1) by Mike Pitirri will appear on this page on the PDF copy.

Drawings (#2) by Mike Pitirri will appear on this page on the PDF copy.

PIPING INSTALLATION:

This section is intended as a guide for the correct installation of the chilled water piping system, including this chiller. However, the chiller manufacturer accepts no responsibility whatsoever for the installation of the chiller or the associated piping.

All piping must be installed only by a licensed plumbing contractor, and in compliance with local codes. **DO NOT USE GALVANIZED PIPING IF GLYCOL IS TO BE USED IN THE CHILLED WATER SYSTEM**. Chemical reaction between the glycol and the galvanized piping (galvanic action) can be detrimental to the cooling system, the glycol and the chiller. Piping material may be copper, plastic, carbon or stainless steel, depending on the requirements of each installation.

It is the responsibility of the engineer and/or the piping contractor to insure that the piping is correctly sized in relation to the installation, and the available dynamic head of the pump installed inside the chiller. The chilled water connections on the chiller are not necessarily the appropriate size for the system piping. As a general guide, the chiller pipe connections should be considered as the ***minimum*** pipe size required for the installation. Drastic reductions in pipe sizing (small hoses, etc.) will reduce the chilled water flow and may cause a low flow alarm, or freezing damage in the evaporator. **NOTE**: installations with low water flow/high water temperature rise should always have a full-ported by-pass installed between the chiller inlet and outlet connections, with a manually adjustable gate valve in the by-pass line. Correctly adjusted, this blended return water will maintain an adequate flow through the chiller, at an acceptable return temperature.

Always install a pressure gauge in the return piping close to the chiller. This is essential for monitoring system pressure and pump performance.

It is good piping practice, especially on systems with short piping runs and/or low system pressure loss, to install a gate valve in the **DISCHARGE** line from the chiller for throttling purposes. This allows the operator to maintain optimum pump performance by adding resistance to the system. **NEVER** throttle the water flow on the return line to the chiller. This will cause cavitation and over-heating of the pump.

AUTOMATIC WATER MAKE-UP:

If the chilled water cooling system is expected to lose water during normal operation (mold-changing, etc.) an automatic water make-up system should be installed, or can be supplied as a factory option. The auto make-up system must include a water pressure regulator and pressure gauge. **CAUTION**: The tank inside the chiller has maximum pressure rating of 40 PSIG. Do not discharge city water (which can be as high as 60-80 PSIG) directly into the chiller. Instantaneous pressurization can cause the tank to rupture before the pressure relief valve opens. **NOTE**: Do not use an automatic water make-up system if glycol is installed for anti-freeze protection. The glycol will become diluted and the freeze protection will be lost. Some critical applications require the installation of emergency city water and drain solenoid valves, in the event of a chiller failure. In this case, the chiller **MUST** be isolated from the city water pressure to avoid damage. After operation of the emergency city water system, the glycol concentration must be carefully checked using a spectrometer. Add glycol to maintain the correct anti-freeze concentration if required.

CHILLER FLOW CONTROL INSTALLATION:

When installing chiller automatic flow control or stop valves to isolate the flow from the main piping loop, installation of valves should be on the inlet piping to the chiller. Special precautions must be observed when installing control valves on both the inlets and outlets of the chiller for complete isolation from the piping loop. Care must be taken not to trap liquid between the pump discharge check valves and the control valve, and in some instances will require the installation of an expansion tank. Please contact Motivair for more information if the installation requires complete isolation.

EXPANSION TANK:

There is a small air space provided inside the top of the insulated reservoir of the chiller. This is designed to act as a compression chamber, in order to absorb moderate hydraulic expansion of the water, during operation. For systems with extensive piping, or large system chilled water volumes it is recommended to install a closed diaphragm expansion tank in the return chilled water line, close to the chiller. The tank should be sized using the appropriate calculations for the volume of water in the system and the maximum expected temperature fluctuation of the water in the piping system, under any conditions. The purpose of the expansion tank is to absorb hydraulic expansion of the water in the system, which can cause damage to the chiller, piping and/or equipment to be cooled. The expansion tank should be connected to the side of a vertical pipe or to the bottom of the horizontal return piping so that trapped air circulating in the chilled water does not become trapped in the expansion tank. Expansion tanks are typically factory pre-charged with compressed air to approximately 12-20 PSIG. After installation, filling and venting of the entire system, the pressure of the expansion tank should be set to provide a pressure of 5-10 PSIG on the return side of the chiller, ***with the chiller in operation.*** Air pressure can be added or removed from the diaphragm tank via the Schraeder valve.

NOTE: Vertical piping immediately connected to and from the chiller will impose a static (or standing) head pressure, which can be read on the pump discharge gauge of the chiller, and the gauge installed on the return line to the chiller, when the system is not operating. For example, if the supply and/or return piping approximately 6-7 PSIG on the gauges (feet x .424 = PSIG). This is simply the weight of the water in the vertical piping at that location, and does not indicate an overall ***system*** pressure.

SYSTEM VENTING:

The single most common problem in chiller installations is the lack of chilled water flow caused by poor piping practices and/or inadequate venting of the system. The symptom is a repeated flow alarm, when the flow switch installed in the return line inside the chiller opens the control circuit, stops the chiller and set the alarm.

This chiller is a CLOSED CIRCUIT system and is not open to atmosphere. This means that air will remain in ***all*** local high points of the system when it is initially filled with water.

NOTE: A ***local*** high point is ***any*** point in the piping, which can be described as an inverted "U" section. More clearly defined, if the piping rises vertically **ANYWHERE, AND AT ANY ELEVATION IN THE SYSTEM**, travels horizontally, then drops again vertically, this inverted "U" section of piping ***is a permanent air lock*** **AND MUST BE VENTED**. Venting is required **AT ALL LOCAL HIGH POINTS**, and is required on both the supply and return pipes. Vents can be either manual, or automatic. Automatic vents should always be installed with an isolation valve for future service access, repair or replacement. Automatic vents are particularly susceptible to drawing air into the return chilled water piping if this line is allowed to fall into a vacuum.

POSITIVE PRESSURIZATION OF THE SYSTEM:

There are two (2) reasons for positive pressure in a closed loop, pumped piping system:

1. Prevention of air being drawn into the system at vent locations close to the chiller, caused by the pump drawing a vacuum in the return line.
2. Optimizing pump performance by providing a net positive suction head (N.P.S.H.) to the pump.

Positive system pressure can be imposed by ***carefully and slowly*** introducing city water pressure, via a hose connection anywhere in the system. After the system has been completely filled and vented, note the gauge pressure at the supply and return of the chiller. If there is no significant vertical piping connected directly to the chiller, the gauges should be at zero. If a pre-pressurized expansion tank is installed in the system, the initial system pressure should be approximately that of the expansion tank. Start the chiller and observe the operating pressure on both the return and discharge water pressure gauges. The return line to the chiller (while operating) should be approximately 5-10 PSIG, confirmed by the return line pressure gauge. The discharge gauge on the chiller should be approximately 30-40 PSIG, depending on the piping and system pressure losses of each installation.

The return (or suction) pressure can be raised or lowered by ***carefully*** using city water pressure via a hose connection, or by adjusting the diaphragm pressure of the expansion tank, or a combination of both.

NOTE: The expansion tank should not normally be pressurized to more than 20 PSIG, measured when the system is not operating. The final discharge pump pressure should **NEVER** be allowed to exceed the maximum pump rating pressure (normally around 35-50 PSIG).

CAUTION: Supercharging the pump with city water pressure higher than the normal rating of the pump, can damage the mechanical pump seals, or cause damage to the chiller, piping system or customer equipment. This damage is not covered by the chiller warranty.

WATER/GLYCOL FILLING:

If glycol is required for anti-freeze protection, **ALWAYS** use an industrial inhibited ethylene glycol, or propylene (food-grade) glycol. **DO NOT** use automobile anti-freeze. Suitable glycols are manufactured by the Dow Chemical Company for this purpose, and available nationwide. There are other glycol suppliers available, but always exercise great caution in the selection of a glycol supplier, and always confirm the freeze protection after installation, using a spectrometer. Damage caused by freezing is not covered under warranty.

Glycol can be pre-mixed with water to the correct concentration, then pumped into the system, or pumped in separately from the water, provided the system capacity is calculated accurately. The most common method for filling the system is to pump the water/glycol into the fill or drain connection of the chiller, ***with all system vents open.*** There is a manual vent located at the back of the chiller for initial filling/venting purposes, in addition to the high point piping vents. **NOTE**: The system should be filled slowly and carefully, allowing all the air to escape. The system can only be filled as fast as the air can escape. Be patient, and do not over-pressurize the system. After initial operation, check all air is vented from the system.

Attention!
A safety flow switch has to be installed (if the flow switch/differential water pressure switch are not already fitted) along a straight section of piping at a distance from the exchanger outlet of not less than 8-10 times the diameter of the piping. The warranty will immediately become null and void if the above is not complied with.

5.2.2 **Evaporator**:

It is vitally important that the water enters the unit from the connection point marked with the "WATER INLET" plate.

Threaded or flanged male unions, depending on the models, are used to make water connections (please refer to the scale drawings which also show the position of the unions).

It is vitally important to connect the water circuit so that the flow of water to the exchanger is always constant under all operating conditions. A variable flow of water is only accepted for units with the desuperheaters.

As the demand for cooling by the heat load does not generally coincide with what is delivered by the compressors, they often work intermittently. In units with a low water content, where the effect of thermal inertia is not felt so much, the system should be checked to make sure it satisfies the following relation:

- Systems with low volumes may cause compressor short cycling. System volume should be equal to or greater than the chiller nominal design flow (10° delta temperature across evaporator) times 3 to 5 depending on system heat load profile. Adequate system volume is the responsibility of the owner and or consulting engineer.
    - Example: Chiller flow = 100 GPM
      Estimated system volume = between 300-500 gallons.

If the above volumes are not obtained, a storage tank should be installed so as to satisfy the above relation when added to the capacity of the system. This tank requires no special features; it just needs to be isolated, just like the chilled water pipes, so as not to affect the performance of the system and to prevent the formation of condensation.

A safety valve should be installed on the water circuit (if not already fitted). In case of serious system faults (e.g. fire) this will allow the system to be drained in order to prevent the risk of explosions. Always connect the drain to a pipe with a diameter not less than that of the valve opening and install the outlet in an area where the jet cannot cause harm to people.

Attention!
While connecting the water circuit, never work with open flames near to or inside the unit.

5.3 ELECTRICAL CONNECTIONS:

5.3.1 General:

These operations may only be carried out by specialized staff.

Before carrying out any operations on electrical components, make sure the unit is disconnected from the mains power supply.

Make sure that the main power supply corresponds to the rated valves of the unit shown on the name plate (voltage, number of phases, frequency). The unit must be connected with a three-pole cable plus earth. Electrical connections must be made carefully following the instructions shown on the wiring diagram attached to the unit. The earth connection is obligatory by law. The earth cable must be connected to the earth bar located in the electrical panel and marked with PE. Auxiliary circuit power is supplied by the power line by means of a transformer located in the electrical panel.

The cross-section of the cable and the line protections must comply with the Indications shown on the wiring diagram and in the relative sheet attached to the unit. All local safety codes must be followed.

Observe the phase sequence; otherwise the unit will not work. Input voltage must not exceed variations of over 10% and phase unbalance must always be less than 2%.

Unit operation must always take place within the above values as otherwise the warranty will immediately become null and void.

5.3.2 Electrical connections to the flow switch/water differential pressure switch:

The chiller (if not already fitted) must only work while water is flowing. The flow switch/differential water pressure switch must therefore be connected as shown on the wiring diagram supplied with the unit.

5.3.3 Electrical connections to the optional circulations pump:

The circulation pump must always be connected to the unit control system as shown on the wiring diagram.

The pump must be started up before starting up the chiller while it must be stopped after the chiller has stopped (minimum recommended delay: 60 seconds).

5.3.4 External Signals:

If a remote ON-OFF command is required, connect the external enable to the contacts shown on the wiring diagram. For the electrical connection to the remote ON-OFF contact and remote Chiller heat pump operation, do not install drive cables inside the ducts used for power cables; if it is not possible, a shielded cable must be used.

When making the connections described in paragraph's 5.3.2 – 5.3.3 – 5.3.4, carefully follow the indications shown in the wiring diagram. The connecting cables must be designed to handle electrical load.

6. START UP

6.1 PRELIMINARY CONTROLS:

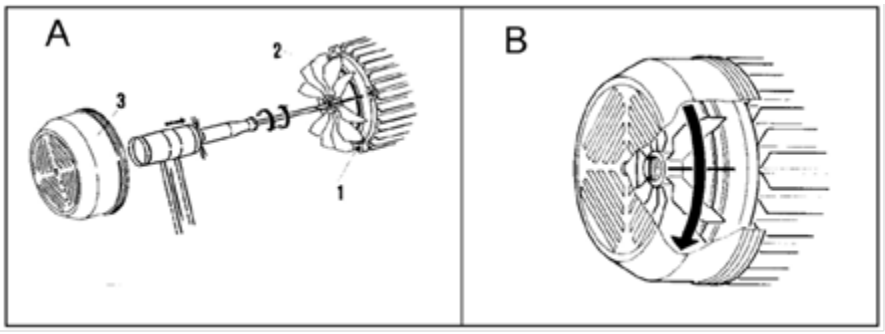
- Make sure that the electrical connections have been made correctly and that all the terminals have been well tightened.
- Verify the deep closing of the fuses-holder cover.
- Use a tester to make sure that the voltage on terminals L1, L2, L3, is equal to that shown on the rating plate (permitted tolerance 10%). If voltage is subject to frequent variations, please contact the factory in order to decide on suitable protection devices.
- Make sure that the pressure gauges (when fitted) show the correct pressure. The pressure gauges can be fitted with shut-off valves. These must only be opened when necessary and closed again after inspection.
- Use a leak tester, if necessary to make sure there are no leaks of refrigerant liquid.
- Check the heating elements of the sump (if fitted) are correctly powered.

The heating elements (crank case heaters) must be turned on at least 12 hours before start-up; this take place automatically when the main power switch is closed (position I).

To check if the heating elements work correctly, make sure that the lower part of the compressor is 20°F-30°F higher than room temperature.

- Check the water circuit is correctly connected (the indications on the unit rating plate must be observed).
- Make sure that the water circuit has been cleaned beforehand: the water circuit should be washer, bypassing the unit, and then the system filter checked for dirt.
- The units are dispatched with the relief valves and drains open. Special plates show where they are located. They must be closed during installation before the water circuit is filled.

- In the models with a built-in hydraulic kit, the pump water drain plug has been removed for discharge of the water therein to prevent freezing during winter season. The plug is included in the envelope containing the documentation of the unit.
- Make sure the water circuit has been well vented to eliminate any air residue's; this operation is carried out by gradually loading and opening the relief valves fitted to the uppermost part of the unit by the installer (please consult section 5.2 for further information).
- In case water with glycol is used, the anti-freezing set point in the PLC can be moved, the value must be equal to the value of the freezing temperature of the fluid plus 10°F.
- **Damage caused by freezing is not covered under warranty.**
- Before starting the pump, make sure that the moving parts turn freely. To do so, remove the fan cover (3) from the rear motor cover (1), insert a screwdriver into the notch on the ventilation side of the motor shaft and rotate it. If it blocks, rotate the screwdriver by gently hitting it with a hammer (fig. A). Then put the fan cover back.
- Power the unit and check, for the three-phase version; the motor rotates clockwise, looking at it from the fan side (fig. B). If this is not the case, invert any two phase wires.
- After starting the pump, make sure that the correct quantity of water is circulating. The pressure gauges (if fitted) installed up line and down line from the pump may be used to carry out this check: the difference between the two pressures must be equal to the pressure drop of the system, including the evaporator. To adjust the flow of water, turn the valve located down line from the pump. For units fitted with two pumps, both of them must be adjusted. Mark the position of each valve so that if they are closed for maintenance operations, they can be moved to the same place before starting up the unit again.
- To set adequately the water flow, check the water temperature rise between inlet and outlet when the unit is full load working (all the compressors on): the temperature rise should range from 8°F-12°F. If it is less than 8°F, the water flow is too high: shut slightly the pump supply valve. If it exceeds 12°F, check the water system pressure drops.



Attention!
Before starting up the unit, make sure that all the external panels are in place and fixed with screws.

6.2 START UP:

ATTENTION:
UNIT MUST BE STARTED BY A FACTORY CERTIFIED TECHNICIAN.
FACTORY START-UP REPORTS MUST BE COMPLETED AND RETURNED TO MOTIVAIR FOR WARRANTY VERIFICATION.

Select the operating cycle (heating or cooling). For microprocessor controlled units, use the arrow keys to move to the: "Mode Select" menu and select "summer" (cooling) or "winter" (heating).
N.B.: this operation is only required for the versions with heat pump.

Attention!
The operating cycle should be changed on a seasonal basis. Frequent changes between summer and winter modes should be avoided as they can cause the compressors to work badly and consequently damage them.

- Start the unit by pressing the "ON" switch located on the microprocessor cover and make sure the following happens (indications between brackets refer to units with heat pumps working in the heating cycle mode).
- First start the pump and, if the temperature from the water returning from the unit is high (low) enough, the compressors and fans will start up automatically after about a minute.
- When the temperature from the water returning from the unit decreases (increases), the compressors will step down capacity or stop in sequence.
- The fans will stop together with the last compressor while the water circulation pump will remain operating.
- When the temperature of the water returning from the unit increases (decreases) the compressors will start up in sequence as well as all the fans.
  N.B.: Not all the fans may start up in the units fitted with condensation control devices that started when the external air temperature was lower than 60°F.
- If the unit doesn't start, please consult chapter 9, part one.

The power supply must not be switched off while the unit is stopped. Power should only be switched off for prolonged pauses (e.g. seasonal shut downs). To shut down the unit for short periods, please carefully follow the instructions shown in paragraph 7.

6.3 CHECKS DURING UNIT OPERATION:

6.3.1 GENERAL:

- Check the unit for strange sounds or excessive vibrations.
- Check that the above sequence is repeated regularly, leaving each compressor working for at least 10 minutes (if this is not the case, system volume must be increased).

- After a few operating hours, check that the crown of the liquid and moisture indicator shows a dry circuit.
- Make sure there are no bubbles inside the liquid indicator. Bubbles indicate there is not enough refrigerant liquid in the circuit (though a few bubbles are accepted).
- A few minutes after the compressors start during the summer operating cycle, make sure the condensation temperature is 33°F +/- 8°F higher than the temperate of the air entering the condenser (depending on the size of the chiller, the kind of refrigerant gas used and the room temperature) and that the evaporation temperature is about 10°F less than the temperature of the water leaving the evaporator.
- Make sure that the overheating temperature of the refrigerant lies between 10°F and 13°F. Do this by measuring the temperature with a contact thermometer placed on the suction pipe of the compressor and that indicated on a pressure gauge connected to the suction line as well: the difference between the two gives the values of overheating.
- Make sure that the sub cooling temperature of the refrigerant fluid lies between 8°F and 15°F. Do this by measuring the temperature with a contact thermometer placed on the suction pipe of the compressor and that indicated on a pressure gauge connected to the suction line as well: the difference between the two gives the values of sub cooling.

The above checks can be made by using the supplied pressure gauges (if fitted). in this case, remember to close the shut-off valves (if fitted) after making the measurements.

- Verify, during the operation, the electrical absorption of the water pump (if installed): it must correspond to the data indicated on the wiring diagram. In contrary case it means that the pump is not working in curve. Act on the shut off valve placed after the pump in order to go back to acceptable values.

6.3.2 Defrosting (only heat pump units):

During operation in the winter cycle (heat pump), the coil works as an evaporator, cooling and dehumidifying the external air. Depending on the temperature and moisture of the external air, condensation or frost will form. The frost accumulated on the coil obstructs the air inlet thereby reducing air flow and the heat transfer rate. The heat pump units are fitted with control devices that automatically defrost the coil whenever necessary. This controls device features a temperature probe placed on the coil which, when the temperature is equal to or lower than the set-point, activates the defrost cycle function which will take place only if a certain time (default setting: 30 minutes) has elapsed since the last defrosting process.

Defrosting takes place as follows:

- The fans stop;
- The operating cycle is inverted with the 4-way valve, thereby making the finned coil work like a condenser. The condensation heat causes the frost to melt and drain to the ground.
- When the end-of-cycle pressure is reached, the 4-way valve is inverted once more and the winter operating cycle continues.
- Defrosting lasts from about 1 to a maximum of 5 minutes when is it interrupted even if the end-of-cycle pressure set-point has not been reached.

6.4 STOPPING THE UNIT:

Stop the unit by pressing the “OFF” key on the front panel.

Attention!
Do not stop the unit by turning off the main power switch, as this would also disconnect both the heating elements of the sump and the possible antifreeze kits which would affect compressor operation after start up.

7. OPERATION

7.1 GENERAL:

- Start and stop the unit with the ON/OFF button located on the microprocessor cover.
- The compressors and fans will automatically start and stop depending on the temperature of the water returning from the unit while the circulation pump will remain working continuously.
- If a fault should occur, the unit will totally or partially block and will give an alarm signal; the microprocessor display will indicate which safety device was activated.
- Before resetting the unit, the reasons for the block must be identified and eliminated.
- Some safety devices must be reset both physically and from the keyboard.

These operations must be carried out by a certified technician. IT IS FORBIDDEN TO TAMPER WITH THE SAFETY DEVICES. IN SUCH A CASE WARRANTY EXPIRES IMMEDIATELY.

7.2 SEASONAL SHUT DOWN:

If the unit is planned to be shut down for a long time and the unit is required to be disconnected from the mains supply, the minimum temperature to which the unit may be subjected must be identified. If this is lower than the freezing point of the fluid contained in the exchangers, these must be drained.

8. TROUBLE SHOOTING

PROBLEM	*POSSIBLE REASONS*	*RECOMMENDED ACTION*
I. THE UNIT DOESN'T START	1. No flow-switch or differential pressure switch agreement 2. The connections are faulty or the contacts are open 3. The compressor's faulty 4. The external enables have not been given 5. The working probe enable has not been given 6. The antifreeze enable has not been given (+) 7. A safety device enable has not been given (+) 8. The anti-recirculation timer is active 9. The fan thermal cut-outs trip (+)	1. Check idraulic circuit, verify the right running of pumps and if valves are open 2. Check the phase sequence, check the voltage and close the contacts 3. See point II. 4. Check the water circulation pump and the water differential pressure switch, and vent the circuit. Check further external enables 5. System on temperature, no cooling demand. Check adjustment and operation 6. Check adjustment and operation. 7. See points IV or V. 8. Wait for about 5 minutes. 9. See point VI.
II. A COMPRESSOR DOESN'T START	1. The compressor has failed 2. The power circuit is open 3. The motor protection is open (+) 4. The compressor contactor is disabled	1. Replace. 2. Close the compressor circuit breaker after identifying the reason why it cut in 3. The compressor was working in critical conditions or there isn't enough refrigerant. Check the work conditions and see point VII 4. Check the voltage at the ends of the contactor coil and the continuity of he coil. Replace if faulty
III. THE COMPRESSOR STARTS AND STOPS REPEATEDLY	1. The compressor's faulty 2. The low pressure switch has cut in (+) 3. The differential oil pressure switch has cut in (+) (only for semihermetic compressors) 4. The compressor contactor is faulty 5. The set-point values are incorrectly set 6. There's not enough refrigerant liquid	1. Check and replace if necessary 2. See point V. 3. Make sure the difference in pressure between the oil pump delivery and low pressure is greater than at least one bar, otherwise check the oil level and top up if necessary. Check the filter and the oil pump (replace if faulty). Have the compressor overhauled if necessary 4. Check and replace if necessary 5. Modify them by referring to the information shown on the microprocessor programme 6. See point VII.
IV. A COMPRESSOR DOESN'T START BECAUSE THE HIGH PRESSURE SWITCH HAS CUT IN (+)	1. The pressure switch doesn't work 2. The end-of-defrosting pressure switch doesn't work ** 3. There's too much refrigerant liquid 4. There's non condensable gas in the refrigerant circuit 5. The refrigerant filter is clogged 6. The metal filters of the condenser are clogged. The air flow is too low * 7. The fans do not work * 8. There's air in the water circuit ** 9. The circulation pump is faulty **	1. Check and replace. 2. Check and replace. 3. Remove the excess refrigerant liquid from the system. 4. Drain the circuit, pressurize and recharge the unit 5. Check and replace. 6. Clean the filters with compressed air or water. 7. See point VI. 8. Vent the water circuit. 9. Check the pump and replace if necessary.
V. A COMPRESSOR DOESN'T START BECAUSE THE LOW PRESSURE SWITCH HAS CUT IN (+)	1. The pressure switch doesn't work 2. The unit is completely empty 3. The liquid shut-off valve is not completely open 4. The thermostatic expansion valve doesn't work properly 5. The refrigerant filter is clogged 6. The metal filters of the evaporator are clogged. The air flow is too low ** 7. The fans do not work ** 8. The coil is covered with frost ** 9. The water circulation pump is faulty *	1. Check and replace. 2. See point VII. 3. Check and open it completely if necessary. 4. Check, clean and replace if necessary. 5. Check and replace. 6. Clean the filters with compressed air or water. 7. See point VI. 8. See point XIII. 9. Check the pump and replace if necessary.

(+) The microprocessor indicates when the safety devices cut in (see attached manual).

* Operation only during cooling cycle.

** Operation only during heating cycle.

8. TROUBLE SHOOTING

PROBLEM	*POSSIBLE REASONS*	*RECOMMENDED ACTIONS*
VI. THE FANS DON'T START	1. Fan contactor is not energized 2. The fan thermal cut-outs trip (+) 3. The connections are faulty 4. The fan motor is faulty	1. Check the voltage at the ends of the contactor coil and the continuity of the coil. Replace if faulty 2. Inspect the insulation between the windings and between the windings and the earth 3. Check and tighten 4. Check and replace if necessary
VII. LACK OF REFRIGERANT LIQUID	1. There's a leak in the refrigerant circuit	1. After pressurizing the circuit at about 10 bar, check with a leak tester. Repair, depressurize and fill with refrigerant liquid
VIII. THE FLUID PIPE IS HOT	1. There's not enough refrigerant liquid in the circuit	1. See previous point (VII)
IX. THE FLUID PIPE IS COVERED WITH FROST	1. The liquid shut-off valve is partially closed 2. The fluid filter is clogged	1. Open the valve completely. 2. Replace the filter cartridge or the filter (depending on the model)
X. THE UNIT CONTINUES TO WORK WITHOUT STOPPING	1. Lack of refrigerant gas 2. Compressor not performing as expected 3. The heat load is excessive 4. The thermostat is badly adjusted or broken 5. The liquid filter is clogged	1. See point VII. 2. Inspect and replace or overhaul 3. Reduce the heat load 4. Check the thermostat set-point and replace the thermostat if necessary 5. Replace
XI. THE UNIT WORKS REGULARLY BUT HAS AN INSUFFICIENT OUTPUT	1. There isn't enough refrigerant liquid 2. Moisture in the refrigerant circuit	1. See point VII. 2. Empty the cooling circuit, dry it, replace the filter - do the charge again
XII. THE COMPRESSOR SUCTION LINE IS COVERED WITH FROST	1. The thermostatic expansion valve doesn't work properly 2. There isn't enough refrigerant liquid 3. The liquid shut-off valve line is partially closed 4. The filter on the liquid line is clogged 5. The water circulation pump is faulty *	1. Check, clean and replace if necessary 2. See point VII. 3. Check and open it completely if necessary 4. Clean or replace 5. Inspect the pump and replace it if necessary
XIII. THE DEFROSTING CYCLE IS NEVER ACTUATED	1. The 4-way inversion valve is not energized** 2. The defrosting thermostat set-point is incorrect or the probe is faulty **	1. Check valve coils. Replace the inversion valve if necessary 2. Change the set-point or replace the probe if necessary
XIV. ABNORMAL NOISE IN THE SYSTEM	1. The compressor is noisy 2. The thermostatic valve is noisy 3. There are vibrations in the piping 4. The panels vibrate	1. Check and replace if necessary 2. Check and add refrigerant liquid 3. Fix the pipes with brackets 4. Install correctly

(+) The microprocessor indicates when the safety devices cut in (see attached manual).

* Operation only during cooling cycle.

** Operation only during heating cycle.

9. ROUTINE MAINTENANCE AND CONTROLS

WARNINGS

Before carrying out any work on the unit or accessing internal parts, make sure the unit is disconnected from the mains power supply.

Given the compressor delivery pipe has a high temperature, special attention should be paid when working near it.

When working near the finned coils, pay special attention to the aluminum fins as these are particularly sharp.

After maintenance operations have been completed, the unit should always be closed with relative panels which should be fixed with the relative screws.

Please remember that all the operations described in this chapter MUST ONLY BE CARRIED OUT BY QUALIFIED STADD WEARING PERSONAL SAFETY EQUIPMENT.

9.1 GENERAL:

The unit should be serviced periodically to make sure it works correctly. The controls that should be made on a monthly and quarterly basis are described below. Furthermore, if the unit is not expected to be used for a long period, and if the room temperatures are lower than the fluid freezing point, the fluid should be drained from the piping and the heat exchangers.

9.1.1 Monthly Maintenance:

- Make sure the terminals in the electrical panel and in the compressor terminal board are well tightened. Check the fixed and mobile contacts of the contractors and replace them if they are worn.
- Verify the deep closing of the fuses-holder cover.
- Inspect the liquid and moisture indicator to make sure the right quantity of refrigerant is contained in the circuit.
- Make sure no oil is leaking from the compressor.
- Make sure that no water is leaking from the water circuit.
- Drain the water circuit (optional).

- Make sure the flow switch/water differential pressure switch works correctly.
- Check the heating elements in the compressor sump.
- Clean the strainers in the water pipes.
- Clean the finned coil (and the condenser filters, if present), by directing a jet of compressed air in the opposite direction from that of the air flow. If the filters are clogged, use a jet of water instead.
- Check that the unit doesn't make any unusual noises.
- Make sure the possible antifreeze kit works correctly.

9.1.2 Quarterly Maintenance:

- Make sure the fans are fixed, balanced and in good condition.
- Check the color of the liquid and moisture indicator; if the color indicates a moist circuit, change the filter.
- Check the state of the paint work: touch up any scratches in order to prevent rusting.

9.2 REPAIRING THE REFRIGERANT CIRCUIT:

These repairs may only be made by factory certified technicians using the normal techniques for chillers that make use of halogen fluids as refrigerants.

9.3 TOPPING UP THE REFRIGERANT:

This operation should only be carried out after identifying and repairing the leak.

For units using R407C, R410A and R134a no more than two top ups are allowed. If another top up is required the refrigerant circuit must be completely emptied and then filled with new refrigerant.

NOTES: