

INSTALLATION and OPERATION MANUAL



MACxxxHE-xx-32



Table of Contents

	Page
<u>Safety Precautions and Warnings</u>	<u>3</u>
<u>Introduction</u>	<u>4</u>
<u>System Description</u>	<u>6</u>
<u>Piping Layout, Design and Installation</u>	<u>7</u>
<u>Installation Notes</u>	<u>7</u>
<u>Chillers liquid Solution Data</u>	<u>8</u>
<u>Single Chiller Installation Example</u>	<u>9</u>
<u>Banked Chillers Example</u>	<u>10</u>
<u>Chiller System Flow Data</u>	<u>11</u>
<u>Expansion Tank and Air/Gas Purge</u>	<u>12</u>
<u>System Filling Instructions</u>	<u>13</u>
<u>Air Elimination</u>	<u>13</u>
<u>Description of Piping Components</u>	<u>14</u>
<u>Electrical Data</u>	<u>15</u>
<u>Description of Electrical Controls</u>	<u>17</u>
<u>Electrical and Ladder Wiring Diagrams</u>	<u>19</u>
<u>Description of Refrigerant Components</u>	<u>31</u>
<u>Refrigeration System Operation</u>	<u>32</u>
<u>Sequence of Operation</u>	<u>32</u>
<u>System Faults</u>	<u>33</u>
<u>Maintenance and Servicing</u>	<u>33</u>
<u>Decommissioning</u>	<u>37</u>

Safety Precautions and Warnings



The Multiaqua chiller contains an A2L (R32) refrigerant.

Please read the entire IOM before the installation of the chiller.



RECOGNIZE THIS SYMBOL AS AN INDICATION OF IMPORTANT SAFETY OR INSTRUCTION RELATED INFORMATION.



Upon receiving the chiller and components, inspect for any shipping damage. Claims for damage, either apparent or concealed, should be filed immediately with the shipping company.

FOR OUTDOOR USE ONLY

NOT DESIGNED FOR USE WITH POTABLE WATER

FOR INSTALLATION ONLY IN LOCATIONS NOT ACCESSIBLE TO THE GENERAL PUBLIC

Upon receiving the chiller and components, inspect for any shipping damage. Claims for damage, either apparent or concealed, should be filed immediately with the shipping company.

The installation of the Multiaqua chiller must follow the prevailing Building and Mechanical Codes.

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

Only technicians with training carried out by national training organizations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation may work on this equipment. The achieved competence must be documented by a certificate.

When servicing the refrigeration circuit of the chiller, 15% or greater silver brazing rods must be used. Low temperature solder alloys such as lead /tin alloys, are not acceptable for pipe connections.



When handling A2L refrigerants, precautions must be taken to ensure the equipment used to recover and transport the refrigerant are manufactured and certified to be used with A2L refrigerants.

Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.

The chiller shall be stored in a room without continuously operating ignition source (for example: Open flames, an operating gas appliance or an operating electric heater.)

Pipe-work including piping material, pipe routing, and installation shall include protection from physical damage in operation and service, and be in compliance with national and local

codes and standards, such as ASHRAE 15, ASHRAE 15.2, IAPMO Uniform Mechanical Code, ICC International Mechanical Code, or CSA B52. All field joints shall be accessible for inspection prior to being covered or enclosed.

Multiaqua Chiller Introduction

This manual covers the following Multiaqua model numbers.

MAC120HE-01-32, MAC120HE-01-32-L, MAC120HE-02-32, MAC120HE-02-32-L
MAC120HE-03-32, MAC120HE-03-32-L, MAC060HE-01-32, MAC060HE-01-32-L
MAC060HE-02-32, MAC060HE-02-32-L, MAC060HE-03-32, MAC060HE-03-32-L
MAC048HE-01-32, MAC048HE-01-32-L, MAC048HE-02-32, MAC048HE-02-32-L
MAC036HE-01-32, MAC036HE-01-32-L, MAC036HE-02-32, MAC036HE-02-32-L

Unit shall be capable of starting and running at outdoor temperatures from 55°F to 120°F.

Optional Low Ambient Kit shall allow starting and running at outdoor temperatures from 54 °F to 0°F. A field supplied and field installed crank case heater must be used when operating at these temperatures.

Throughout this manual the term “liquid solution” is used in place of a water and glycol mixture.

Unit shall be capable of initial starting up with a maximum 70°F entering liquid solution temperature and an ambient not above 95° F. The unit shall be capable of running at a minimum liquid solution temperature of 35°F.

The maximum pressure on the liquid solution’s piping loop is 125 PSI for the MAC120HE and 60 PSI for the MAC060,048,036HE chillers and the maximum use altitude of the Multiaqua chillers is 6000 feet. The maximum temperature of the liquid solution is 70-degree F.

The minimum pressure of the liquid solution’s piping loop is 15 PSI.

The Multiaqua Chiller System is of the only air conditioning/refrigeration system of its kind in the world today offering the degree of application flexibility described in the following manual.

The Multiaqua Chiller System is not only unique in its application flexibility; it is unique in superior quality, rated capacities, and rugged durability. When installed in accordance with these instructions, the system will deliver years of trouble-free service.

Proper equipment sizing, piping design, and installation are critical to the performance of the chiller. This manual is meant to be a “how to” introduction to piping and installing the Multiaqua Chiller System.

MAC-xxxHE-01-32 Chiller Features

- High Efficiency Compressors
 - Loss of Flow Protection
- Control Power Transformer
 - Low Ambient Option
- Integrated Chilled Solution Pump Control
 - Flow Switch
- Strainer Connection Kit
- Painted Metal Condenser Protector Grille
- Dual or Single Refrigeration Circuits and Single Liquid Solution Circuit

Website information addresses are supplied throughout this manual for piping and accessory information. The plumbing industry also has pressure drop information on ferrous and copper piping systems.

The following sections will describe each component and how it functions within the system. Installation information is supplied where appropriate. The piping design section will explain the design and layout the piping system from a “how to” perspective. Following the examples provided will enable the installer to determine the correct pipe and accessory sizing, as well as equipment location. It is important to know before installation if the proposed system will operate correctly. That determination can be made by doing a formal layout of a new application or a review of an existing piping system.



It is essential to operate the system with a minimum of 10% glycol solution, or more, as required by the coldest ambient temperatures in your climate zone. DO NOT OPERATE THIS SYSTEM USING WATER ALONE.

For proper liquid solutions mix ratios, refer to page 8 or the glycol manufacturer’s recommended mix ratios.



No liquid, other than the liquid solution mixture of water and Propylene Glycol, shall be used in the piping system and must be mixed in accordance with table 6 on page 8.



Corrosive environments may subject metal parts of the chiller to rust and deterioration. The oxidation could shorten the chiller’s useful life. Corrosive elements include salt spray, fog or mist in sea coastal areas, sulfur or chlorine from lawn watering systems, and various chemical contaminants from industries such as paper mills and petroleum refineries.

If the unit is to be installed in an area where contaminants are likely to be a problem, special attention should be given to the equipment location and exposure.

- **Avoid having lawn sprinklers spray directly on the chiller cabinet.**
- **In coastal areas, locate the chiller on the side of the building away from the waterfront.**
- **Elevate the chiller adequately to ensure that it does not sit in standing water or where water can in contact with the cabinet base.**
- **Regular maintenance will reduce the build-up of contaminants and help protect the cabinet finish.**
- **In severe locations, having the chiller coated with an “epoxy” or other coating formulated for air conditioning systems located in coastal areas may be necessary.**



Consult local building codes or ordinances for special installation requirements. When selecting a site to locate the chiller, consider the following:

- **A minimum clearance of 36” on the service access ends of the cabinet, 36” on the coil air inlet sides and nothing can be installed above the fan discharge. It must be free from any obstruction.**
- **The chiller must be located outdoors. No ductwork can be connected to the chiller’s condenser or condenser fans.**

- If a concrete slab is used, do not connect the slab directly to any building's foundation or structure to prevent sound transmission.
- Locate the slab on a level surface that is above grade to prevent ground water from entering the chiller cabinet.

System Description



The Multiaqua Chiller is a self-contained, air-cooled condenser, coupled with an insulated, brazed plate heat exchanger (evaporator). The system utilizes scroll compressors to circulate refrigerant between the condenser and heat exchanger. The refrigerant is metered into the heat exchanger with a thermostatic expansion valve. Protecting the system are high- and low-pressure switches as well as a liquid solution flow switch.

Liquid solution (water and Propylene Glycol) is circulated through the heat exchanger by either a field supplied pump or the optional internal circulating pumps that comes preinstalled on the 3,4- and 5-ton models. The liquid solution flows through the heat exchanger to the system's supply piping and on into the air handlers. The system is designed to have a continuous flow of liquid solution at all times through the chiller.

A solenoid-operated, motorized valve (or circulator) controls the flow of the chilled liquid solution through the air handlers. The valves, or circulators, can be actuated by a variety of different control schemes.

Liquid solution temperature is controlled by a chiller-mounted digital electronic control. A system sequence of operation, individual control description, troubleshooting information, and a schematic are included in the controls section.



It must be recognized that ferrous pipe may cause accelerated deterioration of the brazed plate heat exchanger and could void the heat exchanger warranty.

Cooling Load Diversity

Equipment sizing for a chilled liquid solution system can utilize Cooling Load Diversity. Diversity is described as the actual amount of cooling needed (heat load) by various sections of a structure at a given time. Conventional air conditioning systems are designed for the highest structure heat load. The conventional system determines and selects equipment based on the peak heat load demanded by the structure. A system sized to take advantage of diversity would determine the heat load by the time of day, building exposure, and usage. As

an example, the sections of a structure facing west demand more cooling in the afternoon than sections facing east. The opposite of this is true in the morning where the east section is exposed to a higher heat load requiring more cooling. Utilizing diversity, the chiller system would adapt to the needs of each side of the structure during peak demand by delivering more cooling to that area and less to the areas that do not need it. A structure utilizing a conventional DX system that requires 8 tons of cooling at peak load could utilize a much smaller capacity system (potentially 4 or 5 tons) if the system installed could take advantage of load diversity. Load diversity would supply the necessary amount of cooling to the space when or as needed instead of keeping a larger capacity available at all times.

Cooling load diversity can best be determined by referring to the ACCA (Air Conditioning Contractors of America) Manual “J”. Refer to the appendix A-2: Multi-Zone Systems. ACCA’s Internet address is <http://www.acca.org/>

Due to load diversity, a Multiaqua Chiller can serve more total air handler tonnage than chiller capacity. A 10-ton chiller may be delivering chilled liquid solution to 15 tons or more of air handler capacity. Thus, with cooling load diversity in use, the building does not need equal amounts of cooling in each area at the same time.

Piping Layout Design and Installation

Multiaqua chillers are designed to operate exclusively with R32 (A2L) refrigerant in a self-contained, pre-charged refrigerant system. Do not access the closed refrigerant circuit for any reason other than after-sale, after installation, component replacement. Routine maintenance and service is to be performed by qualified personnel only.

The installation of the Multiaqua chiller must follow the prevailing Building and Mechanical Codes.

The chiller must be installed outside of the building and installed on a level concrete pad. Understanding the function and friction loss of each part of the piping system is important to the layout and successful installation of a chilled liquid solution system.

For More information on design and how a hydronic system works, please visit <https://multiaqua.com/how-it-works/>

Installation Notes:



Piping such as PEX, steel, copper, or PVC can be used with the Multiaqua system. Check local building codes for material conformation. Care must be taken when using PVC as the presence of propylene glycol may destroy plastics. Pressure drop data for the selected piping material is readily available and should be used. Should the Multiaqua chiller be installed using an existing steel (ferrous metal) piping system, dielectric fittings must be used at the chiller and air handler? The factory supplied wye strainer will capture particles of rust and sediment inherent with steel piping and should be checked and cleaned after initial start-up. The strainer should be inspected and cleaned as part of regular maintenance during the life of the system.

Any piping used to conduct liquid solution must be insulated in accordance with local and national mechanical codes. Information on insulation installation and application can be obtained from Armaflex web site at www.armacore.com and Owens-Corning site at www.owenscorning.com/mechanical/pipe/. For future servicing of the chiller and air handlers, it is suggested that shut-off valves be installed at the chiller and air handler(s). If ball valves are used, they can double as balancing valve (s) in the supply piping at each chiller and air handler. Chiller shut-off valves should be attached at the chiller connections with unions.

The air handlers are to be controlled with electrically operated, slow-opening valves, circulators, or motorized zone valves. A thermostat can operate the valves.

Bypass valves, as shown in Drawing 1, should be installed between the supply and the return chilled liquid solution supply pipes at a convenient location to the installation. The bypass valve operates to bypass liquid solution between the supplies and return chilled liquid solution lines. In the event air handler valves shut down, the bypass valve is set to open and bypass liquid solution between the supplies and return lines relieving pressure thereby eliminating the possibility of pump cavitations. To adjust the valve, run the system with one air handler solenoid actuated. De-energize the solenoid valve (at this point no liquid solution will be flowing through the air handlers), and adjust the bypass valve to relieve pressure between the supply and return piping.

Bleed ports will be factory installed on all Multiaqua air handlers. Bleed ports are opened to eliminate air trapped in the air handlers after filling the system with the liquid solution and before chiller operation.

The minimum liquid solution content in the 10-ton chiller system (piping, chiller, and air handlers), is 50 U.S. gallons. Estimate the system liquid solution content. Should the system have less than 50 gallons of liquid solution content, a chilled liquid solution storage tank must be installed. The tank stores enough chilled liquid solution to prevent frequent chiller compressor cycling at light load and prevents chilled liquid temperature swings at higher load conditions when the chiller compressor is waiting to cycle on the time delay control.

Propylene Glycol must be added to the water used in the system. Propylene helps prevent freeze-ups due to low ambient temperature conditions and low chilled liquid solution temperatures. In comparison to water, Propylene Glycol slightly lessens the temperature exchange in the chiller's heat exchanger. However, that is offset by the increased flow of liquid solution through the piping system enabled by the Propylene Glycol. To determine the Propylene Glycol content for various ambient temperatures, refer to Table 6.

In no instance should a Multiaqua chiller be installed with less than 10% Propylene Glycol content in the piping system. Using less than the recommended Propylene Glycol percentage content voids equipment warranty.

Cold ambient mitigation is mandatory. Failure to do so will result in the damage to components, property damage, and void warranty.

Table 6				
Percent of Propylene Glycol to Water Content				
Propylene Glycol %	Water Flow	Capacity	Min. ambient Temperature	GPM Adjustment = 100 % Capacity
10%	x 1.020	x .99	26°F	x 1.01
20%	x 1.028	x .98	18°F	x 1.03
30%	x 1.036	x .98	8°F	x 1.07
40%	x 1.048	x .97	-7°F	x 1.11
50%	x 1.057	x .96	-29°F	x 1.16



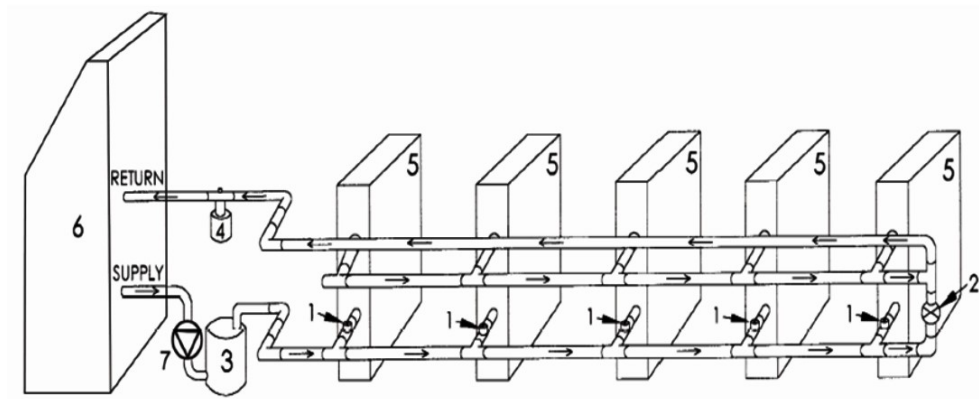
Ethylene Glycol is environmentally hazardous and not recommended. Inhibited Propylene Glycol (typical automotive coolant) is not to be used in a Multiaqua Chiller under any circumstances. Dow Chemical's "Ambitrol" Glycol-based

coolant of food grade Propylene Glycol is suggested. Information on Ambitrol is available from Dow at www.dow.com, search word "Ambitrol"

Installation Examples

Below is an example of one chiller, associated piping, accessory valves and five fan coils.

Not all the accessories are shown in these illustrations. Please refer to prevailing codes and mechanical drawings to ensure the correct accessories are being installed.



- 1– 2 Way Liquid Solution Control Valve
- 2– Bypass Valve
- 3– Storage Tank
- 4– Expansion Tank
- 5– Fan Coil Unit
- 6– Chiller
- 7– Pump



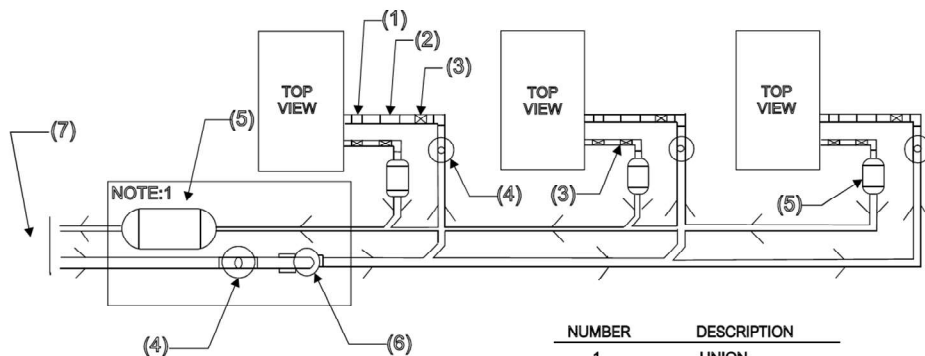
An adjustable valve must be used to throttle the discharge liquid solution flow rate to appropriate levels based on capacity and glycol mix percentages.

Below is an example of three chillers, associated piping and accessory valves.



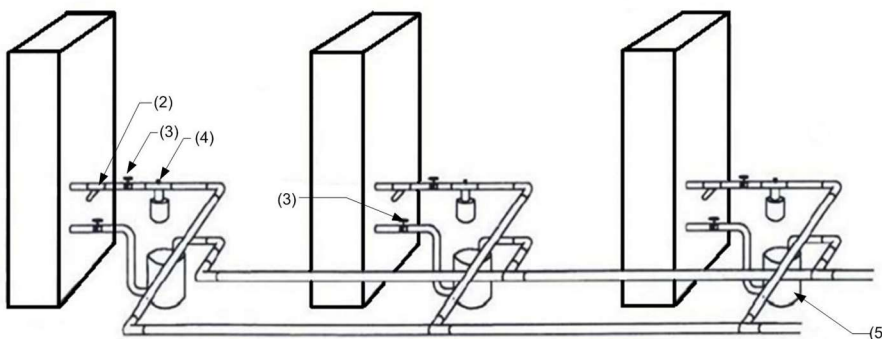
If installing multiple Multiaqua chillers, it is recommended they are piping in parallel. Piping multiple chillers in series is not recommended.

Banked Chiller Configuration



* ARROWS DESIGNATE THE SOLUTION CIRCULATING DIRECTION

NUMBER	DESCRIPTION
1	UNION
2	"Y" STAINER
3	GATE VALVE
4	EXPANSION TANK WITH AIR SCOOP AND PURGE
5	STORAGE TANK
6	EXTERNAL PUMP
7	SOLUTION IN/OUT TO LOAD



The circulation pump is the key performer in the piping system. The pump must circulate the liquid solution through the heat exchanger and piping system to the air handlers. Pumps are designed to deliver a flow rate measured in gallons per minute (GPM). The pump must be able to overcome the resistance to flow (pressure drop) imposed by the chiller components, piping system, and air handlers while maintaining the necessary flow rates in gallons per

minute. Pump capacities in gallons per minute and pressure drop (feet of head) are listed in Table 1.

Table 1

Chiller System Data

MAC SERIES		MAC120HE-xx-32
Min. Liquid Solution Flow Rate	GPM	18.00
Max. Liquid Solution Flow Rate	GPM	28.80
Min. Liquid Solution Content in System	Gallons	50
Storage Tank Size	Gallons	Total Liquid Volume - 50
Expansion Tank Size	Gallons	3% of Total Gallons
Internal Chiller Pressure Loss	Ft.of Hd	18
Chiller Liquid Solution Content	Gallons	1.5
Max. Liquid Solution Pressure	PSI	125
Min. Liquid Solution Pressure	PSI	20
Liquid Solution Connection sizes	In.	1 3/8" OD
Maximum Liquid Solution Temperature	F	70 Degrees
Minimum Liquid Solution temperature	F	35 Degrees
MAC SERIES		MAC060HE-xx-32
Min. Liquid Solution Flow Rate	GPM	14.40
Max. Liquid Solution Flow Rate	GPM	10.00
Min. Liquid Solution Content in System	Gallons	25
Storage Tank Size	Gallons	Total Liquid Volume - 25
Expansion Tank Size	Gallons	3% of Total Gallons
Internal Chiller Pressure Loss	Ft.of Hd	8.5
Chiller Liquid Solution Content	Gallons	1
Max. Liquid Solution Pressure	PSI	60
Min. Liquid Solution Pressure	PSI	20
Liquid Solution Connection sizes	In.	1" Supply (MPT) 1.25" Return (MPT)
Maximum Liquid Solution Temperature	F	70 Degrees
Minimum Liquid Solution temperature	F	35 Degrees
MAC SERIES		MAC048HE-xx-32
Min. Liquid Solution Flow Rate	GPM	11.50
Max. Liquid Solution Flow Rate	GPM	8.00
Min. Liquid Solution Content in System	Gallons	25
Storage Tank Size	Gallons	Total Liquid Volume - 25
Expansion Tank Size	Gallons	3% of Total Gallons
Internal Chiller Pressure Loss	Ft.of Hd	8.5
Chiller Liquid Solution Content	Gallons	1
Max. Liquid Solution Pressure	PSI	60
Min. Liquid Solution Pressure	PSI	20
Liquid Solution Connection sizes	In.	1" Supply (MPT) 1.25" Return (MPT)
Maximum Liquid Solution Temperature	F	70 Degrees
Minimum Liquid Solution temperature	F	35 Degrees
MAC SERIES		MAC036HE-xx-32
Min. Liquid Solution Flow Rate	GPM	8.00
Max. Liquid Solution Flow Rate	GPM	6.00
Min. Liquid Solution Content in System	Gallons	60
Storage Tank Size	Gallons	Total Liquid Volume - 25
Expansion Tank Size	Gallons	3% of Total Gallons
Internal Chiller Pressure Loss	Ft.of Hd	8.5
Chiller Liquid Solution Content	Gallons	1
Max. Liquid Solution Pressure	PSI	60
Min. Liquid Solution Pressure	PSI	20
Liquid Solution Connection sizes	In.	1" Supply (MPT) 1.25" Return (MPT)
Maximum Liquid Solution Temperature	F	70 Degrees
Minimum Liquid Solution temperature	F	35 Degrees

Piping resistance or pressure drop is measured in feet of head. A foot of head is the amount of pressure drop imposed in lifting liquid solution one foot.

Expansion Tank and Air/Gas Purge



The Expansion Tank and Air/Gas Purge must be installed outside of the chiller's cabinet and outside of any building. This device must be installed at an elevation above the height of the chiller's brazed plate heat exchanger. This device will automatically vent out micro air bubbles that are trapped in the system.

In the event of a rupture in the refrigerant/ liquid solution brazed plate heat exchanger, the air purge will vent the refrigerant out of the liquid solution lines in order to prevent the refrigerant from entering the condition space via the liquid solution piping.

Ensure that the purge device does not vent near any continuously operating ignition source (for example: Open flames, an operating gas appliance or an operating electric heater.)



Liquid solution expansion and contraction within the closed system must be compensated for with an expansion tank. The expansion tank used with the Multiaqua system is a steel tank with a rubber bladder internally attached. There is air pressure on one side of the rubber bladder that keeps the bladder pushed against the sides of the tank before the system is filled with liquid solution (illustration above). As the liquid solution heats up, the bladder will be pushed further away from the tank walls allowing for expansion and contracting as the liquid solution temperature changes. By flexing, the bladder controls the system pressure adjusting to temperature variations of the chilled liquid solution system.



It is critical that the expansion tank's air bladder pressure be less than the system solution pressure. Air pressure can be measured with an automotive tire gauge at the Schrader valve port on the expansion tank. Bleeding air out of the bladder or increasing the pressure with an air pump will adjust pressure.

Filling System with Liquid Solution



Before filling the system with liquid solution (Propylene Glycol and water), pressure test the piping system with compressed air. Testing should be done at a maximum of 50 PSI. The system should hold air pressure for a minimum of one(1) hour with no leakage.



Concentrations of Propylene Glycol in excess of 50% will destroy O-rings in fittings and pumps. Water should be added to the system first or a solution of diluted Propylene Glycol mix.

System that contains 50 or more U.S. gallons should have a tee fitting with a stop valve installed in the return line close to the chiller. The stop valve can be opened and attached to a hose with a female-by-female hose fitting. In the open end of the hose section (1 - 1.5 feet long) insert a funnel and pour the liquid solution mixture or add water first and then the appropriate quantity of Propylene Glycol (refer to Table 6). After adding the liquid solution mixture, proceed to add enough water to the system to achieve 15 PSI gauge pressure. To measure system pressure, shut off the stop valve, remove hose, and attach a water pressure gauge. Open the stop valve and read system pressure. Systems that use a chilled liquid solution storage tank should be filled at the tee/stop valve fitting in the outlet fitting of the storage tank.

Air Elimination

Once the system is filled, any air left in the system must be eliminated. Briefly open each bleed valve at the air handler(s) and allow trapped air to escape. This will eliminate much of the air left in the system.

Start the pump and continue bleeding air from the system. Set the chilled liquid solution control up to 100°F which will ensure that only the pump will run at this point. Should the pump stop at any time during this process, it is an indication that the flow switch had air move across it allowing the circuit to be interrupted. Continue to bleed air out of the system at the highest points before resetting the pump bypass timer. Open and close the power supply switch to the chiller to restart the pump. Continue bleeding air with the pump operating. You may have to start and re-start the pump several times to complete air removal.



If you continue having air entrapment issues, it will be necessary to install a micro bubble remover device.



ALL PIPING SYSTEMS SHOULD HAVE A MINIMUM OF 10% PROPYLENE GLYCOL IN THE SYSTEM EVEN IN CLIMATES WITH NON-FREEZING AMBIENT TEMPERATURES.



USING LESS THAN THE RECOMMENDED PROPYLENE GLYCOL PERCENTAGE CONTENT VOIDS EQUIPMENT WARRANTY.

Description of Piping Components



Supply Storage Tank: A supply storage tank must be used in a system with less than 50 gallons or 5 gallons per ton - whichever is greater-of liquid solution. The tank prevents rapid cycling of the compressors and acts as a reservoir for chilled liquid solution.

Part Number: WX202H (20 Gallon)
ERTG42S (42 Gallon)



Supply storage tank must be insulated in the field.



Expansion Tank and Air/Gas Purge: The expansion tank and air scoop assembly are used to compensate for the expansion and contraction of liquid solution in the system. The air/gas scoop eliminates air/gas entrained in the liquid solution.

It must be installed outside of the chiller's cabinet and outside of any building. This device must be installed at an elevation above the height of the chiller's brazed plate heat exchanger. This device will automatically vent out micro air bubbles/gas that are trapped in the system.

In the event of a rupture in the refrigerant/ liquid solution brazed plate heat exchanger, the air purge will vent the refrigerant out of the liquid solution lines in order to prevent the refrigerant from entering the condition space via the liquid solution piping.

Ensure that the purge device does not vent near any continuously operating ignition source (for example: Open flames, an operating gas appliance or an operating electric heater.)



Liquid Solution Bypass Valve: The liquid solution bypass valve relieves system pressure from the liquid solution supply line to the return line as the system air handler controls are cycled off.



Motorized Valve: The air handler motorized valve controls the flow of liquid solution to the systems air handlers. Each air handler in the system should have a motorized valve.

Electrical Data

The information contained in this manual has been prepared to assist in the proper installation, operation, and maintenance of the chiller. Improper installation or installation not made in accordance with these instructions can result in unsatisfactory operation and/or dangerous conditions which can void the related warranty.

Read this manual and any instructions included with all additional equipment that is required to make up the system prior to installation. Retain this manual for future reference.



A field supplied and installed line voltage disconnects must be installed per prevailing codes on each chiller and or each independent power supply. This must be installed as to disconnect all line voltage from entering the chiller.



The MAC120HE-01-32 requires two separate independent power supplies and disconnects. These chillers have separate and discreet power requirements within one cabinet. The phasing of the two power supplies must be phase with each other. If the phasing is not the same between L1 on first stage and L1 on the second stage and the same for L2 on first stage and L2 on second stage a direct short will occur.

All power to the chiller must be turned off prior to opening cabinet and/or servicing.

All other models of the MACxxxHE-xx-32 chillers have a single point connection for the power supply.

Failure to properly ground chiller can result in death.

Disconnect all power wiring to chiller before any maintenance or service work. Failure to do so can cause electrical shock resulting in personal injury or death.



All wiring must be done in accordance with NEC (National Electric Code), as well as state and local codes, by qualified electricians.



Product warranty does not cover any damages or defect to the chiller caused by the attachment or use of any components, accessories, or devices (other than those authorized by the manufacturer) into, onto, or in conjunction with the chiller. You should be aware that the use of unauthorized components, accessories, or devices may adversely affect the operation of the chiller and may also endanger life and property. The manufacturer disclaims any responsibility for such loss or injury resulting from the use of unauthorized components, accessories, or devices.

MAC-120HE-xx-32 Electrical Data

Electrical Data							
Model Number	Volts/Phase/Hertz	Compressor (Qty 2)		Condenser Fan Motor (Qty 2)		Fuse or HACR Circuit Breaker	
		(RLA)	(LRA)	(RLA)	(RPM)	MCA	MOC
MAC-120HE-01	208/230-1-50/60	30.0 x 2	174.1 x 2	2.5 x 2	1050	44 x 2 * See note 1.	71 x 2 * See note 1
MAC-120HE-02	208/230-3-50/60	21.4 x 2	156 x 2	2.5 x 2	1050	60 * See note 1.	75 * See note 2
MAC-120HE-03	380/415/460-3-50/60	10 x 2	74.8 x 2	1.7 x 2	1050	29 * See note 1.	35 * See note 2

Note 1:

The MAC120HE-01-32 requires two separate independent power supplies and disconnects. These chillers have separate and discreet power requirements within one cabinet. The phasing of the two power supplies must be phase with each other. If the phasing is not the same between L1 on first stage and L1 on the second stage and the same for L2 on first stage and L2 on second stage a direct short will occur.

Note 2:

The MAC120HE-02-32 and the MAC120HE-03-32 chillers have a single point connection for the power supply.

MAC-060HE-xx-32 Electrical Data

Electrical Data							
Model Number	Volts/Phase/Hertz	Compressor (Qty 2)		Condenser Fan Motor (Qty 2)		Fuse or HACR Circuit Breaker	
		(RLA)	(LRA)	(RLA)	(RPM)	MCA	MOC
MAC-060HE-01	208/230-1-50/60	32.5	174.1	2.5	1050	41	70
MAC-060HE-02	208/230-3~50/60	21.4	156	2.5	1050	30	50
MAC-060HE-03	380/460-3~50/60	10.0	74.8	1.7	1050	15	25

MAC-048HE-xx-32 Electrical Data

Electrical Data							
Model Number	Volts/Phase/Hertz	Compressor (Qty 2)		Condenser Fan Motor (Qty 2)		Fuse or HACR Circuit Breaker	
		(RLA)	(LRA)	(RLA)	(RPM)	MCA	MOC
MAC-048HE-01	208/230-1-50/60	26.7	150.7	2.5	1050	34	55
MAC-048HE-02	208/230-3~50/60	18.9	156.4	2.5	1050	24	40

MAC-036HE-xx-32 Electrical Data

Electrical Data							
Model Number	Volts/Phase/Hertz	Compressor (Qty 2)		Condenser Fan Motor (Qty 2)		Fuse or HACR Circuit Breaker	
		(RLA)	(LRA)	(RLA)	(RPM)	MCA	MOC
MAC-036HE-01	208/230-1-50/60	22.0	121.5	2.5	1050	28	45
MAC-036HE-02	208/230-3~50/60	15.4	102.8	2.5	1050	20	30

Description of Electrical Controls



Control Transformer: The control transformer is rated at 24 vac, 40 va (1.6 amps @ 24vac). The chiller's control transformer comes wired for 208vac primary voltage. If your incoming voltage to the chiller is 220vac or more, the primary taps on the transformer will need to be changed.



Pump Bypass Timer: The pump bypass timer is a 24 vac, 3-wire control. When energized the timer will bypass the flow switch for 10 seconds by creating a circuit to the pump relay, energizing the pump relay, and allowing the pump to operate long enough to close the flow switch. In a normally operating system, the flow switch will stay closed powering the pump relay in series with the low- and high-pressure switches. Should the flow switch open, the timer can only be reset by opening and closing the chiller's line voltage disconnect.



System Delay Timer: The refrigerant timer is a 24 vac, 5-minute delay on break timer. The normally closed contacts of the timer energize the compressor contactor through the chilled liquid solution control. When the chilled liquid solution control contact opens, the timer delays by opening its contact for 5 minutes before resetting to the closed position.



High Pressure Switch: The high-pressure switch is an automatic reset control that senses compressor discharge line pressure. It opens at 400 PSIG and closes at 300 PSIG.



Low Pressure Switch: The low-pressure switch is an automatic reset that senses compressor suction line pressure. In early production models, it opens at 40 PSIG and control closes at 80 PSIG. In the latest productions models, it opens at 10 PSIG and control closes at 25 PSIG.



Flow Switch: The flow switch senses liquid solution flow. The paddle of the switch is inserted through a fitting into the pump discharge line. Liquid solution flow deflects the paddle and closing the switch. The flow switch is position sensitive. The arrow ↑ on the switch must point in the direction of liquid solution flow. Maximum flow is not to exceed 28.8GPM



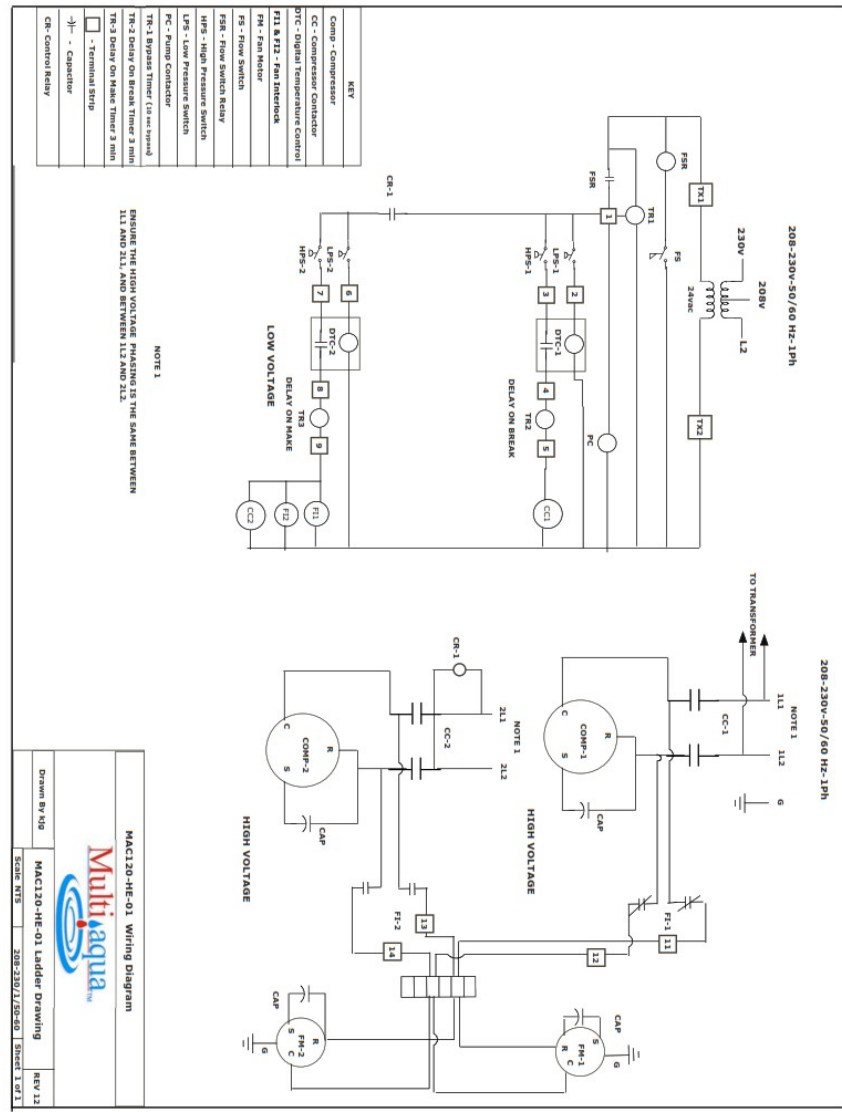
Compressor Contactor: The compressor contactor energizes the compressor through the two or three normally open contacts. The contactor coil operates by closing the contacts when energized by 24vac.



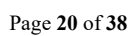
Liquid Solution Temperature Control: The liquid solution temperature control is an adjustable, microprocessor-based temperature control. This control receives temperature information from a thermistor located on the liquid solution supply line. A liquid crystal display continually indicates the liquid solution temperature. The control is mounted inside the chiller cabinet.

Electrical Ladder Wiring Diagrams

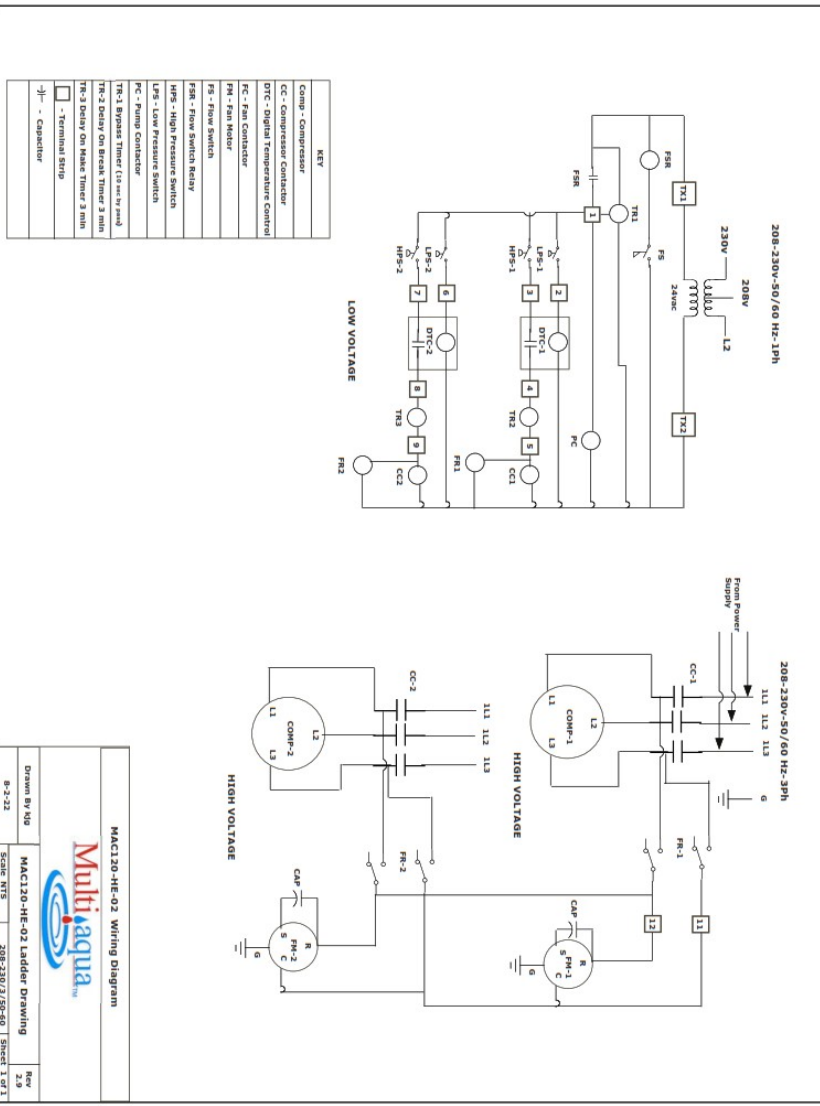
MAC120HE-01-32



With Low Ambient Control

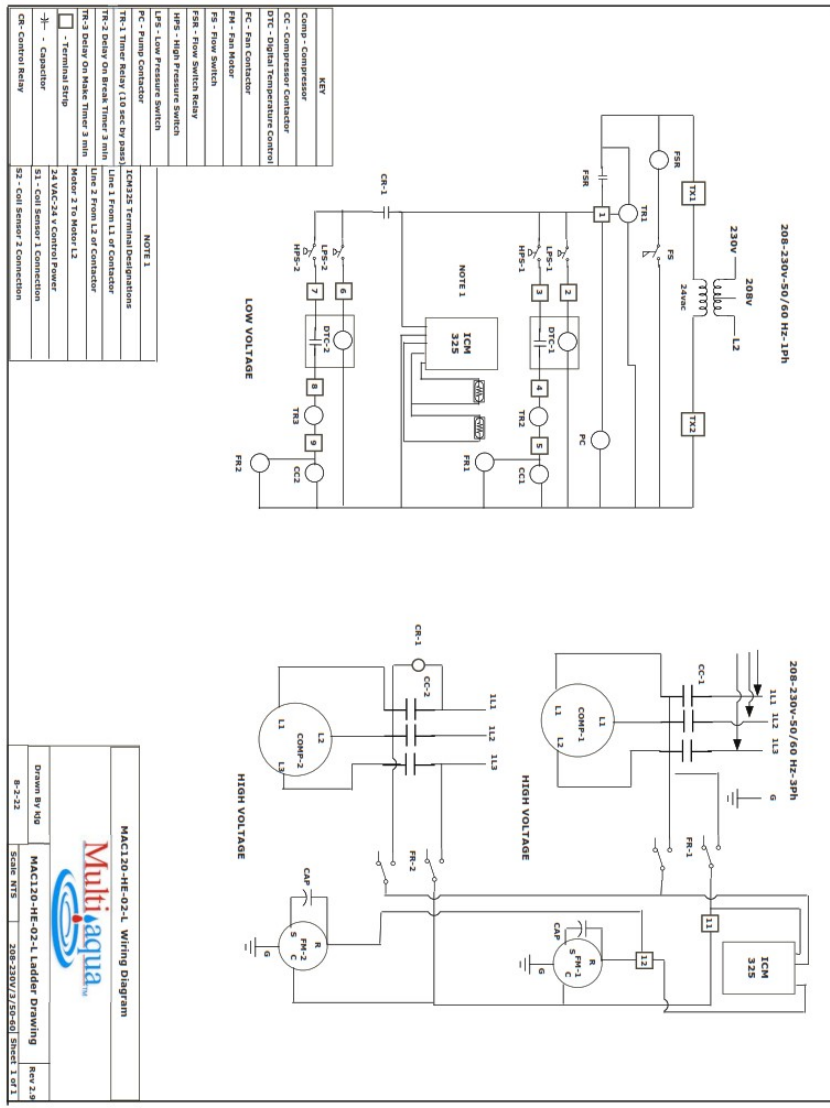


MAC120HE-02-32

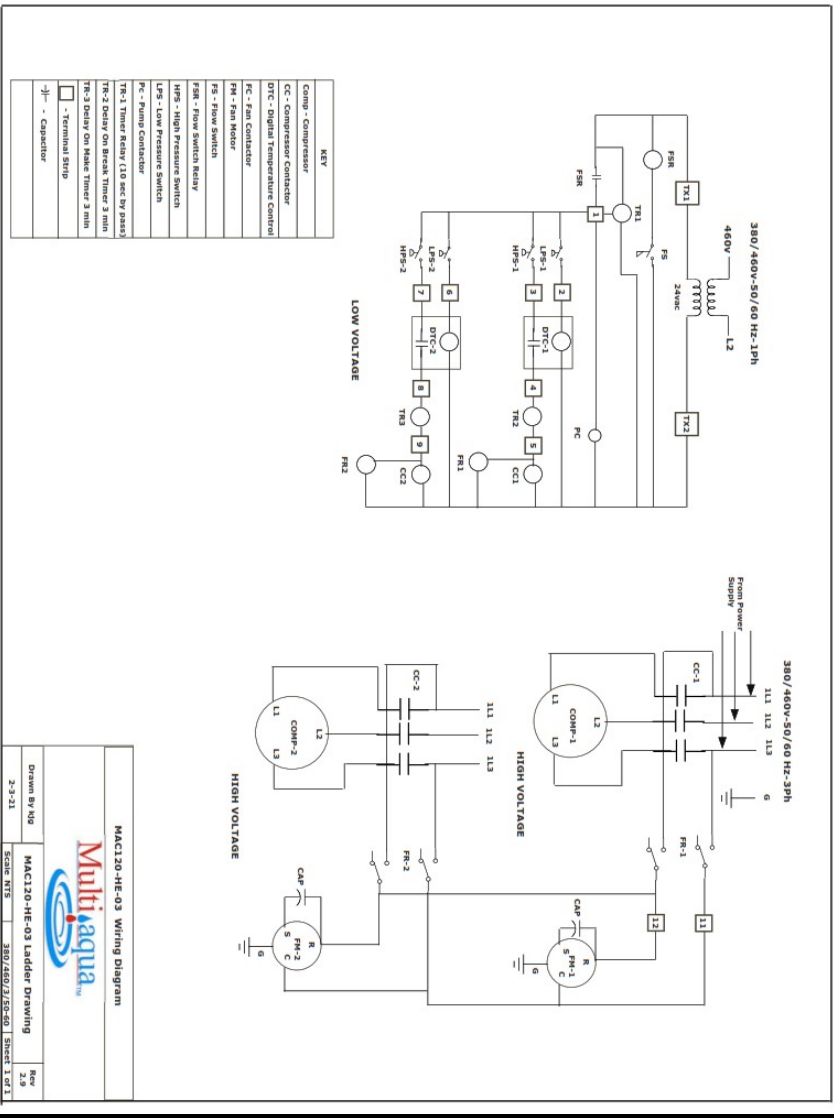


MAC120HE-02-32-L

With Low Ambient Control

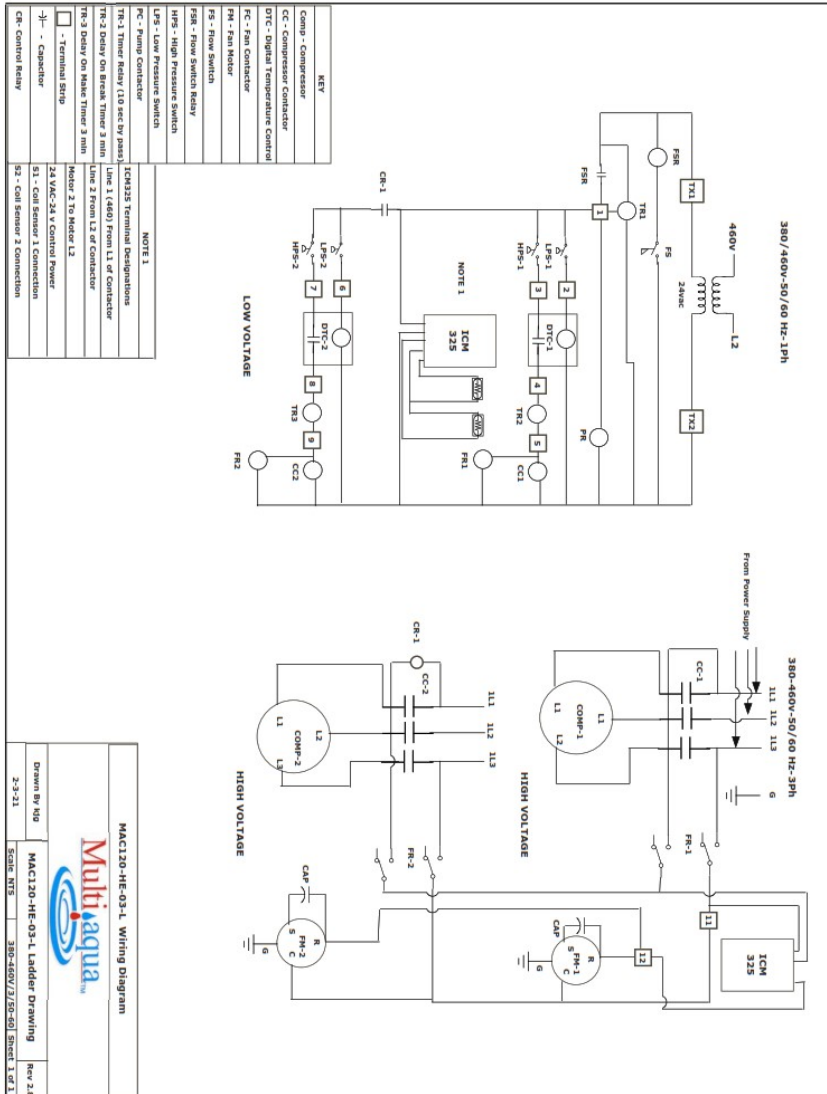


MAC120HE-03-32

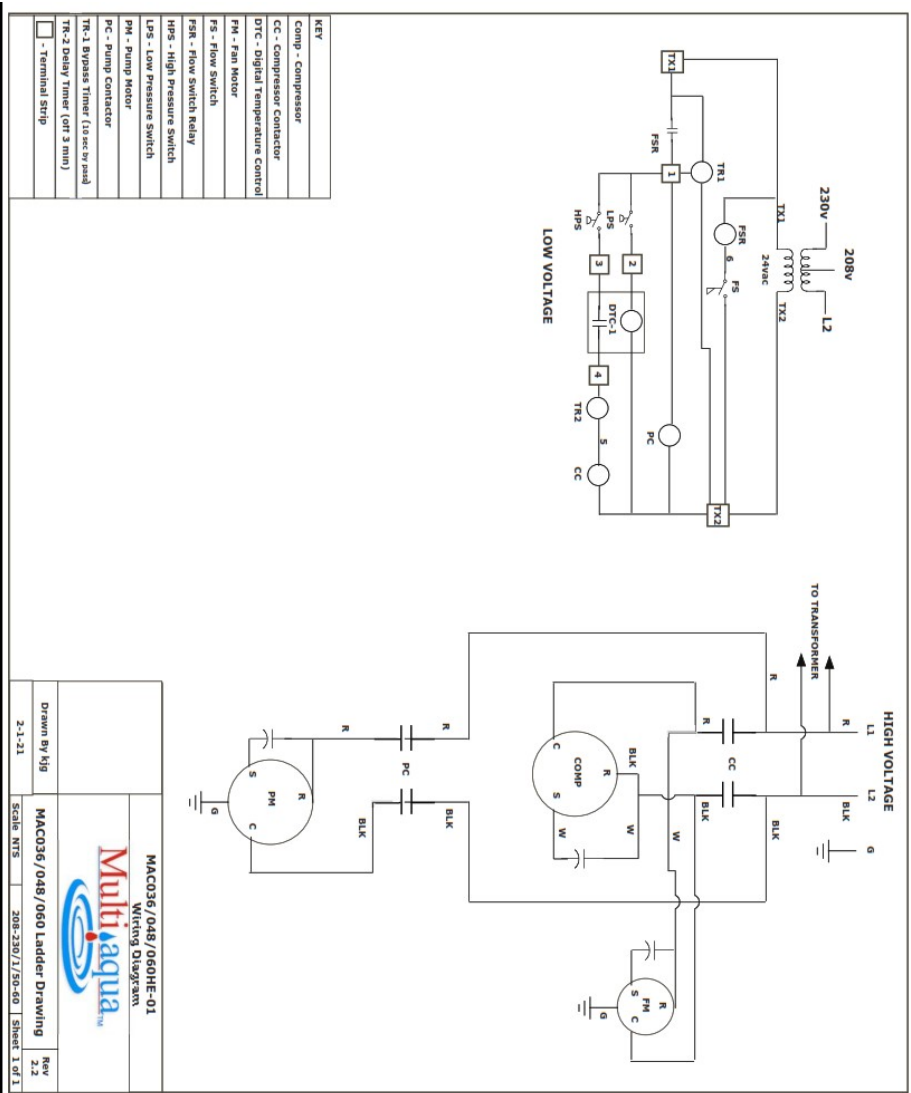


MAC120HE-03-32-L

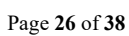
With Low Ambient Control



MAC036/048/060HE-01-32



With Low Ambient Control



HIGH VOLTAGE

L1 L2 L3 0

TO TRANSFORMER

R W BLK W BLK W

COMP

L1 L2 L3

PM

R S C

LOW VOLTAGE

TX1 TX2

FSR

FS

PC

TR1

TR2

CC

230V 208V

L2

24VDC

1 2 3 4 5 6

FSR

FS

PC

TR1

TR2

CC

230V 208V

L2

24VDC

1 2 3 4 5 6

FSR

FS

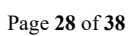
PC

TR1

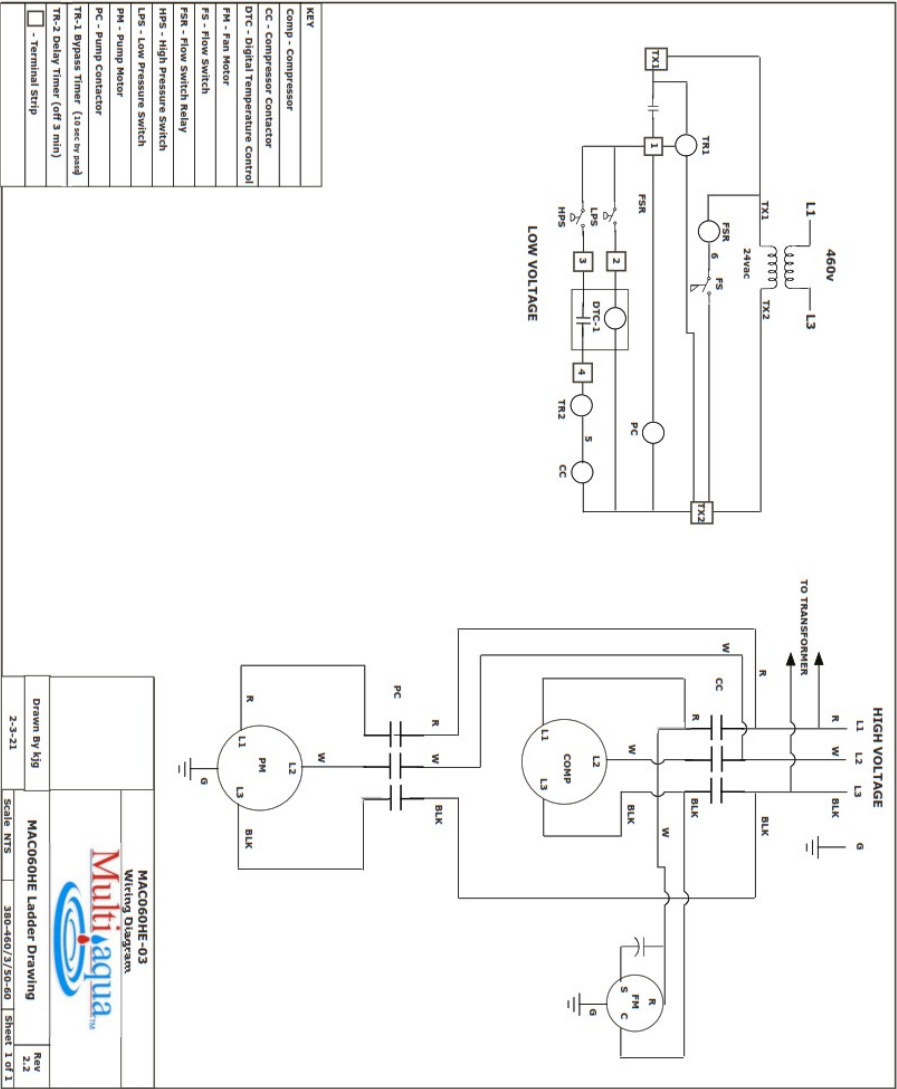
TR2

CC

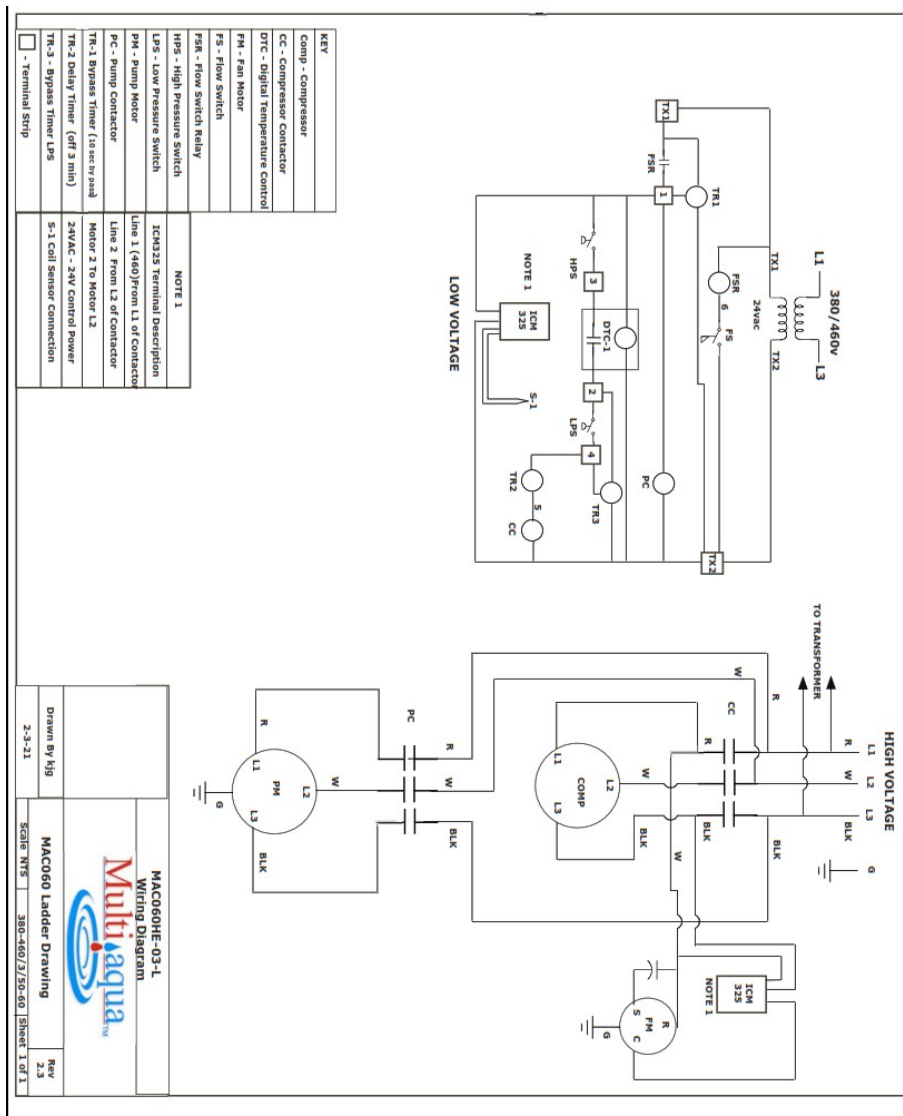
With Low Ambient Control



MAC060HE-03-32



With Low Ambient Control



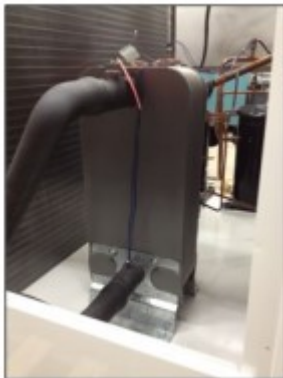
Description of Refrigerant Components



Scroll Compressor: All Multiaqua chillers feature scroll compressors. Scroll technology ensures reliable, high performance at a low sound level over a wide range of operating conditions.



Caution: The top half of the scroll compressor operates at a temperature high enough to cause burns and serious injury.



Brazed Plate Heat Exchanger: The heat exchanger (or evaporator) is of a brazed copper and stainless-steel design. Refrigerant and liquid solution are channeled through the narrow openings between the plates and flow in opposite directions. The counter flow design and fluid turbulence ensures maximum heat exchange at minimal pressure drops.



Thermal Expansion Valve: Multiaqua chillers are equipped with thermal expansion valves. The valves feature a liquid charged sensing bulb for consistent superheat at various load conditions.



Condenser Coil: The air-cooled condenser coil is made of copper tube with an aluminum fin construction. The coil is protected by a painted, metal condenser grille.

Refrigeration System Operation

The refrigeration system is a closed loop system consisting of one or two compressors, dual or single circuit, brazed plate heat exchanger (evaporator), metering devices (TXV's), and a condenser coil. The refrigerant circulated is R32 (A2L). Hot gas is pumped from the compressors to the condenser coil where one or two condenser fans pull air across the coil condensing and sub-cooling the hot gas into liquid refrigerant. The liquid refrigerant flows through the liquid lines to the thermal expansion valves where the refrigerant pressure drops causing the refrigerant to boil at a much lower temperature (34°- 40°F). The refrigerant leaves the expansion valves and swirls through the plates of the brazed plate heat exchanger absorbing heat from the circulating liquid solution.

The evaporating heat exchanger is designed to operate with a 10°- 20°F superheat. The condenser is designed to condense the refrigerant and sub-cool it to 10°F below condensing temperature.

Chiller Controls Sequence of Operation

When powered up, the Multiaqua chiller system energizes the control transformer creating 24 vac control voltage.

First, the pump bypass timer is energized and temporarily bypasses the flow switch energizing the pump relay. In a properly filled and air purged system, the pump then starts to move liquid solution through the piping system. The movement of liquid solution from the pump is charge keeps the flow switch closed. After a 10 second delay, the pump bypass timer contacts open connecting the flow switch in series with the high- and low-pressure switches. The pump will now run continually unless the power supply is interrupted or the flow switch opens.

If the liquid solution temperature controller is calling for cooling, the control circuit is routed through the short cycle timer, the three safety switches (flow, high-, and low-pressure switches), and to the compressor contactor. This will energize the compressor and condenser fan motors. The liquid solution temperature controller will open at the user programmed set point causing the refrigerant short-cycle, 5-minute delay timer to open its contact before resetting to the closed position. This will de-energize the compressor. Power fluctuations will also initiate the 5 minute time delay. The 5-minute delay allows the refrigerant system a period for pressure equalization in order to protect the compressor(s) from short cycling.

The chiller temperature controller utilizes a thermistor to monitor the liquid solution temperature change. The temperature is then compared to both the set point and the differential temperatures programmed into the control by the user. The set point in the liquid solution temperature will cause the control switch to open. For example: The control set point is programmed at 44°F LWT with a 10°F differential which opens the controller contact at 44°F LWT and closes at 54°F. The differential temperature is the number of degrees above the set point temperature programmed into the controller. If the liquid solution temperature falls to the set point, the controller cycles the compressors off.



Chillers are shipped with the control set point adjusted to 44°F LWT and a 10°F differential. The liquid solution temperature set point should not be set below 35°F.

System Faults:

Flow Switch Opening: The flow switch is normally closed during pump operation. Should liquid solution flow be interrupted for any reason, the flow switch will open shutting down and locking out the chiller operation. The only exception to this is when power is first applied to the chiller and the pump bypass timer bypasses the flow switch for 10 seconds.



When the system is first filled with liquid solution and the pump is started, expect the system to cycle off as the flow is interrupted until all of the air is purged from the piping system. Before the chiller will restart, the system will have to be reset by opening and closing the disconnect switch (or circuit breaker) powering the chiller.

Low Pressure Switch Opening: Should the compressor suction pressure fall below 10 PSI; it will open the low-pressure switch and the compressor and condenser fan motors will shut down. Check for a refrigerant leak, inoperative thermal expansion valve, low liquid solution control setting, low ambient operation, or low liquid solution flow, etc.

High Pressure Switch Opening: Should the compressor discharge pressure go high enough to open the high-pressure switch; the compressor and condenser fan motors will shut down. Check for a dirty condenser coil, inoperable fan motor(s), or the recirculation of condenser air.

Maintenance and Servicing



The Multiaqua chiller contains an A2L (R32) refrigerant.

Be aware that refrigerants may not contain an odor.

When handling A2L refrigerants, precautions must be taken to ensure the equipment used to recover and transport the refrigerant are manufactured to be used with A2L refrigerants. Do not use means to accelerate the defrosting process or to clean, other than those recommended by the manufacturer.



Only technicians with training carried out by national training organizations or manufacturers that are accredited to teach the relevant national competency standards that may be set in legislation may work on this equipment. The achieved competence must be documented by a certificate.

Before any maintenance or servicing. Ensure that the power supply to the chiller is turned off and lock out tag out procedures are followed.

Work shall be undertaken under a controlled procedure so as to minimize the risk of a flammable gas or vapor being present while the work is being performed.

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

The area shall be checked with an appropriate refrigerant detector prior to and during work, to ensure the technician is aware of potentially toxic or flammable atmospheres.

Ensure that the leak detection equipment being used is suitable for use with all applicable refrigerants, i. e. non-sparking, adequately sealed or intrinsically safe.

If any hot work is to be conducted on the refrigerating equipment or any associated parts, appropriate fire extinguishing equipment shall be available to hand. Have a dry powder or CO2 fire extinguisher adjacent to the charging area.

No person carrying out work in relation to a REFRIGERATING SYSTEM which involves exposing any pipe work shall use any sources of ignition in such a manner that it may lead to the risk of fire or explosion.

All possible ignition sources, including cigarette smoking, should be kept sufficiently far away from the site of installation, repairing, removing and disposal, during which refrigerant can possibly be released to the surrounding space.

Prior to work taking place, the area around the equipment is to be surveyed to make sure that there are no flammable hazards or ignition risks.

No smoking signs shall be displayed around the area.

Where electrical components are being changed, they shall be fit for the purpose and to the correct specification. At all times the manufacturer's maintenance and service guidelines shall be followed. If in doubt, consult the manufacturer's technical department for assistance.

Ensure the markings to the equipment continues to be visible and legible. Markings and signs that are illegible shall be corrected.

It is recommended that the chiller be inspected and serviced before the start of every cooling season and twice a year if the chiller is run during the winter months.

Ensure the interior cabinet is clean of debris or other items that would cause decreased airflow through the chiller.



The condenser coils must be kept clean to ensure proper airflow through the chiller. If the condenser coils need to be washed, ensure the power is disconnected and the proper lock out tag out procedures are followed. Use only cleaners that designed to clean aluminum and copper materials. Ensure all residue is removed from the coils and the chiller cabinet.

Repair and maintenance to electrical components shall include initial safety checks and component inspection procedures. If a fault exists that could compromise safety, then no electrical supply shall be connected to the circuit until it is satisfactorily dealt with. If the fault cannot be corrected immediately but it is necessary to continue operation, an adequate temporary solution shall be used. This shall be reported to the owner of the equipment so all parties are advised.

Initial safety checks shall include that capacitors are discharged safely, no live electrical components or wiring is exposed while charging, recovering or purging the system and that there is continuity of earth bonding.

During repairs to sealed components, all electrical supplies shall be disconnected from the equipment being worked upon prior to any removal of sealed covers, etc. If it is absolutely necessary to have an electrical supply to equipment during servicing, then a permanently operating form of leak detection shall be located at the most critical point to warn of a potentially hazardous situation.

Particular attention shall be paid to the following to ensure that by working on electrical components, the casing is not altered in such a way that the level of protection is affected. This shall include damage to cables, excessive number of connections, terminals not made to original specification, damage to seals, incorrect fitting of glands, etc.

Ensure that the apparatuses are mounted securely and per the manufacture's specifications.

Ensure that seals or sealing materials have not degraded to the point that they no longer serve the purpose of preventing the ingress of flammable atmospheres. Replacement parts shall be in accordance with the manufacturer's specifications.

Check that cabling will not be subject to wear, corrosion, excessive pressure, vibration, sharp edges or any other adverse environmental effects. The check shall also take into account the effects of aging or continual vibration from sources such as compressors or fans.

Under no circumstances shall potential sources of ignition be used in the searching for or detection of refrigerant leaks. A halide torch (or any other detector using a naked flame) shall not be used.

Electronic leak detectors may be used to detect refrigerant leaks but, in the case of FLAMMABLE REFRIGERANTS, the sensitivity may not be adequate, or may need re-calibration. (Detection equipment shall be calibrated in a refrigerant-free area.) Ensure that the detector is not a potential source of ignition and is suitable for the refrigerant used.

Leak detection equipment shall be set at a percentage of the LFL of the refrigerant and shall be calibrated to the refrigerant employed, and the appropriate percentage of gas (25 % maximum) is confirmed.

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

NOTE Examples of leak detection fluids are

- bubble method,
- fluorescent method agents.

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

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

When breaking into the refrigerant circuit to make repairs – or for any other purpose – conventional procedures shall be used. However, for FLAMMABLE REFRIGERANTS it is important that best practice is followed since flammability is a consideration. The following procedure shall be adhered to:

- safely remove refrigerant following local and national regulations;
- evacuate;
- purge the circuit with inert gas
- evacuate
- continuously flush or purge with inert gas when using flame to open circuit; and open the circuit.

The refrigerant charge shall be recovered into the correct recovery cylinders if venting is not allowed by local and national codes. For appliances containing flammable refrigerants, the system shall be purged with oxygen-free nitrogen to render the appliance safe for flammable refrigerants. This process might need to be repeated several times.

Compressed air or oxygen shall not be used for purging refrigerant systems.

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

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

- Ensure that contamination of different refrigerants does not occur when using charging equipment.
- Hoses or lines shall be as short as possible to minimize the amount of refrigerant contained in them.
- Cylinders shall be kept in an appropriate position according to the instructions.
- Ensure that the REFRIGERATING SYSTEM is earthed prior to charging the system with refrigerant.
- Label the system when charging is complete (if not already).
- Extreme care shall be taken not to overfill the REFRIGERATING SYSTEM.

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

Decommissioning



When handling A2L refrigerants, take precautions. Do not pierce or burn. Be aware that refrigerants may not contain an odor. When handling A2L refrigerants, precautions must be taken to ensure the equipment used to recover and transport the refrigerant are manufactured to be used with A2L refrigerants.

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

Before starting the recovery process:

- Become familiar with the equipment and its operation.
- Isolate system electrically.

Before attempting the procedure, ensure that:

- Mechanical handling equipment is available, if required, for handling refrigerant cylinders.
- all personal protective equipment is available and being used correctly.
- the recovery process is supervised at all times by a competent person.
- recovery equipment and cylinders conform to the appropriate standards.

If a vacuum is not possible, make a manifold so that refrigerant can be removed from various parts of the system.

Make sure that cylinder is situated on the scales before recovery takes place.

Start the recovery machine and operate in accordance with instructions.

Do not overfill cylinders (no more than 80 % volume liquid charge).

Do not exceed the maximum working pressure of the cylinder, even temporarily.

When the cylinders have been filled correctly and the process completed, make sure that the cylinders and the equipment are removed from site promptly and all isolation valves on the equipment are closed off.

Recovered refrigerant shall not be charged into another REFRIGERATING SYSTEM unless it has been cleaned and checked.

Equipment shall be labelled stating that it has been de-commissioned and emptied of refrigerant. The label shall be dated and signed. For appliances containing FLAMMABLE REFRIGERANTS, ensure that there are labels on the equipment stating the equipment contains FLAMMABLE REFRIGERANT.

When removing refrigerant from a system, either for servicing or decommissioning, it is recommended good practice that all refrigerants are removed safely.

When transferring refrigerant into cylinders, ensure that only appropriate refrigerant recovery cylinders are employed.

Ensure that the correct number of cylinders for holding the total system charge is available

All cylinders to be used are designated for the recovered refrigerant and labelled for that refrigerant (i. e. special cylinders for the recovery of refrigerant).

Cylinders shall be complete with pressure- relief valve and associated shut-off valves in good working order.

Empty recovery cylinders are evacuated and, if possible, cooled before recovery occurs.

The recovery equipment shall be in good working order with a set of instructions concerning the equipment that is at hand and shall be suitable for the recovery of the flammable refrigerant.

If in doubt, the manufacturer should be consulted. In addition, a set of calibrated weighing scales shall be available and in good working order. Hoses shall be complete with leak-free disconnect couplings and in good condition.

The recovered refrigerant shall be processed according to local legislation in the correct recovery cylinder, and the relevant waste transfer note arranged. Do not mix refrigerants in recovery units and especially not in cylinders.

If compressors or compressor oils are to be removed, ensure that they have been evacuated to an acceptable level to make certain that flammable refrigerant does not remain within the lubricant.

The compressor body shall not be heated by an open flame or other ignition sources to accelerate this process. When oil is drained from a system, it shall be carried out safely.



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