Installation, Operating and Maintenance Manual	IOMM WSCWDC-2
	Group: **Chiller**
	Part Number: **736015420**
	Effective: **April 2001**
	Supersedes: **IOMM WSCWDC-1**

The McQuay *DISTINCTION SERIES* ä

Single/Dual Compressor Centrifugal Chillers

WSC/WDC 050, 063, 079, 087, 100, 126

McQuay® Air Conditioning

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ISO 9002 CERTIFIED

Introduction

General Description

The McQuay Centrifugal Water Chillers are complete, self-contained, automatically controlled fluid chilling units. Each unit is completely assembled and factory tested before shipment.

In the WSC series, each unit has one compressor connected to a condenser and evaporator. The WDC series are equipped with two compressors operating in parallel on a single evaporator and condenser.

The chillers use refrigerant R-134a to reduce the size and weight of the package compared to negative pressure refrigerants and since R-134a operates at a positive pressure over the entire operation range, no purge system is required.

The controls are pre-wired, adjusted and tested. Only normal field connections such as piping, electrical and pump interlocks, etc. are required thereby simplifying installation and increasing reliability. All necessary equipment protection and operating controls are factory installed in the control panel.

The basic sizes of units are the WSC/WDC 050, 063, 076, 079, 087, 100 and 126. They provide a capacity range from 80 tons to 2500 tons. In this manual all references to the WSC models will equally apply to other models unless specifically referenced otherwise.

Application

The operation and maintenance procedures presented in this manual apply to the standard WSC/WDC family of chillers. Reference to the Installation Manual, OM 200MIRCO (latest version) should be made for details pertaining to operation of the MicroTech control.

All McQuay centrifugal chillers are factory tested prior to shipment and must be initially started at the job site by a factory trained McQuay service technician. Failure to follow this startup procedure will affect the equipment warranty.

The standard warranty on this equipment covers parts that prove defective in material or workmanship. Specific details of this warranty can be found in the warranty statement furnished with the equipment.

Cooling towers used with McQuay centrifugal chillers are normally selected for maximum condenser inlet water temperatures between 75°F and 90°F (24°C and 32°C). Lower entering water temperatures are desirable from the standpoint of energy reduction but a minimum does exist. For recommendations for optimum entering water temperature and cooling tower fan control, consult McQuay Product Manual PM WSC/WDC-1, Applications Section.

Receiving and Handling

The unit should be inspected immediately after receipt for possible damage.

All McQuay centrifugal water chillers are shipped FOB factory and all claims for handling and shipping damage are the responsibility of the consignee.

Insulation corners from the evaporator's rigging hole locations is shipped loose and should be glued in place after the unit is finally placed. Neoprene vibration pads are also shipped loose. Check to be sure that these items are delivered with the unit.

Leave the shipping skid in place until the unit is in its final position. This will aid in handling the equipment.

Extreme care should be used when rigging the equipment to prevent damage to the control center, or refrigerant piping. See certified dimension sheets for the center of gravity of the unit.

The unit can be lifted by fastening the rigging hooks to the four corners of the unit where the rigging eyes are located (see Figure 1) Spreader bars should be used between the rigging lines to prevent damage to the control center and motor terminal boxes on WDC dual compressor units.

Figure 1, Unit Components

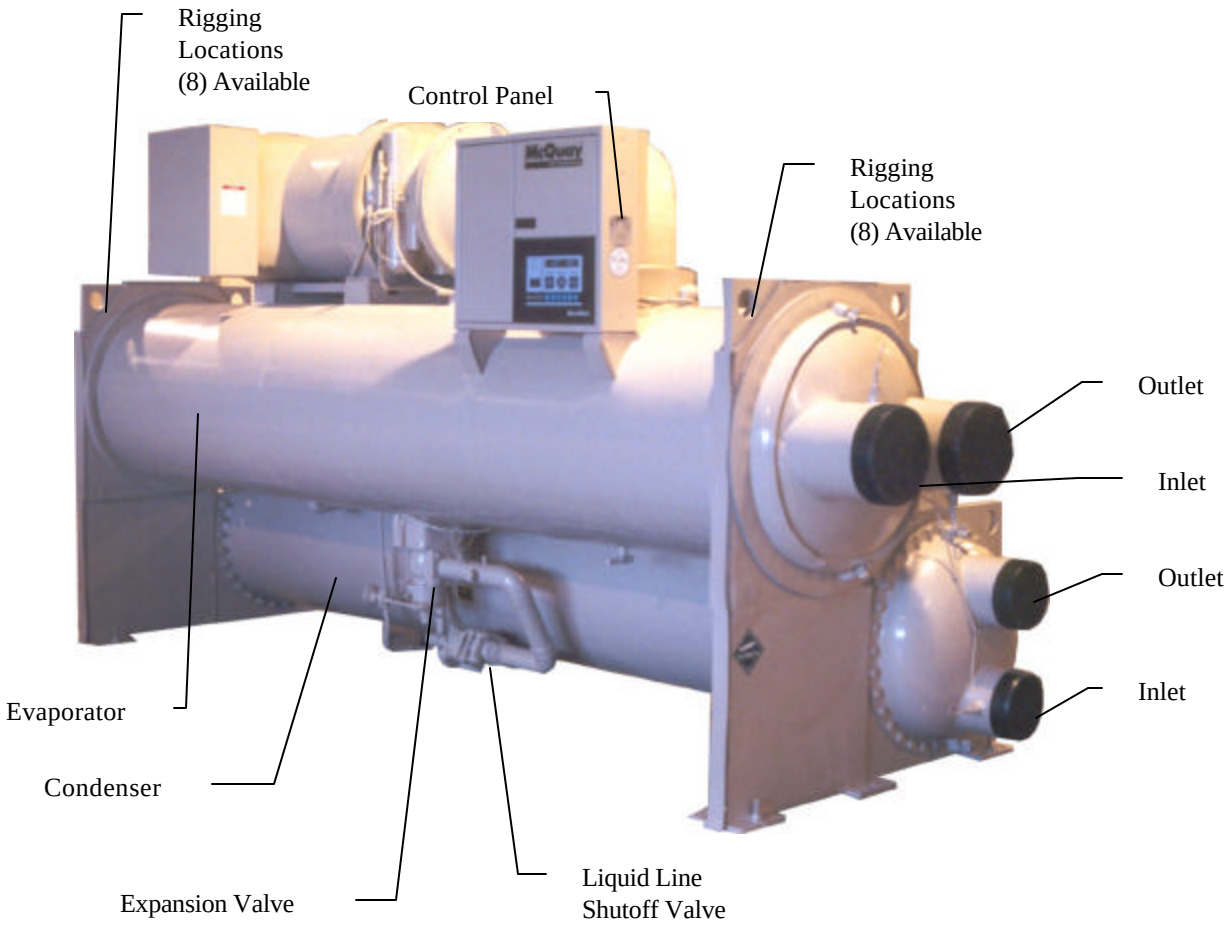
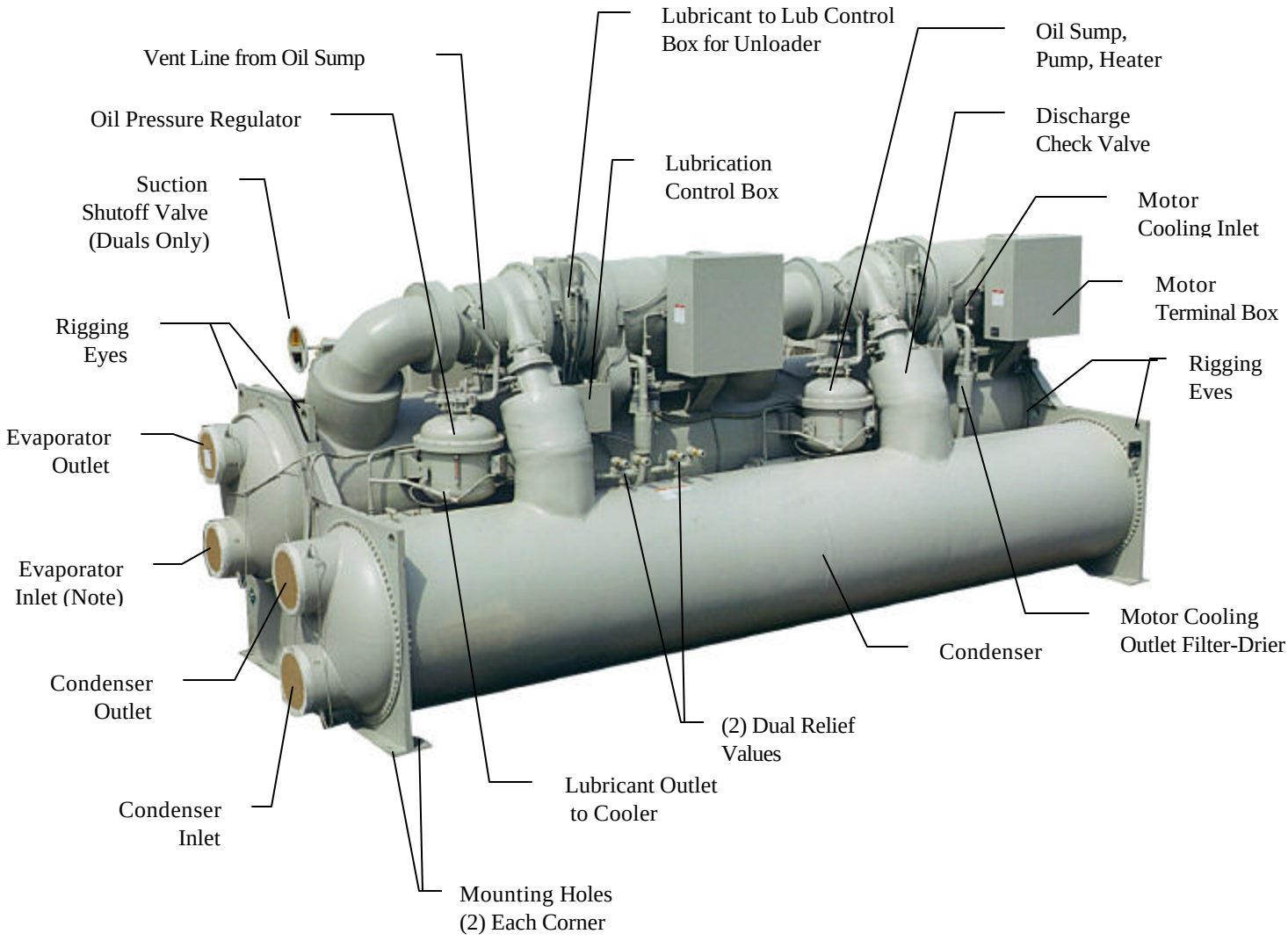


Figure 2, Major Component Location



Note: The WDC 126 Dual Compressor Chiller shown has the evaporator inlet in the bottom. Location can vary on other units. Check markings on unit or consult unit certified drawings for connection locations on specific units.

Location and Mounting

Clearance

The unit should be mounted on a level concrete or steel base and should be located so as to provide service clearance at one end of the unit for possible removal of evaporator tubes and/or condenser tubes. Tube clearances required are 18 feet (5.5 meters) for units with 16 foot (4.9 meters) long shells, 16 feet (4.9 meters) for units with 14-foot (4.3 meters) long shells, 14 feet (4.3 meters) for units with 12-foot (3.7 meters) long shells, and 10 feet (3 meters) for units with 8-foot (2.4 meters) long shells. Evaporator/condenser tubes are rolled into the tube sheets to permit replacement if necessary. Clearance at all other points, including the top, is 3 feet (1 meter).

Vibration Pads

The shipped loose neoprene vibration pads should be located under the corners of the unit (unless the job specifications state otherwise). They are installed to be flush with the sides and outside edge of the feet. Most WSC units have six mounting feet although only the outer four are required. Six pads are shipped and the installer can place pads under the middle feet if desired.

Mounting

Make sure that the floor or structural support is adequate to support the full operating weight of the complete unit.

It will not be necessary to bolt the unit to the mounting slab or framework; but should this be desirable, 1 1/8" (28.5 mm) mounting holes are provided in the unit support at the four corners.

Note: Units are shipped with refrigerant and oil valves closed to isolate these fluids for shipment. Valves must remain closed until start-up by McQuay technician.

Water Piping

Water Pumps

Note: Avoid the use of 3600/3000 rpm (two-pole motor) pump motors.

It is not uncommon to find these pumps operate with objectionable noise and vibration.

It is also possible to build up a frequency beat due to the slight difference in the operating rpm of the pump motor and the McQuay centrifugal motor. McQuay encourages the use of 1750/1460 rpm or four-pole pump motors whenever possible.

Evaporator and Condenser Water Piping

All WSC and WDC evaporators and condensers come standard with groove-type nozzles for Victaulic couplings (also suitable for welding) or optional flange connections. The installing contractor must provide matching mechanical connections of the sizes given in the system dimension and capacity tables.

Important Notes on Welding

1. If welding is to be performed on the mechanical or flange connections, the solid-state temperature sensor and thermostat bulbs must be removed from the wells to prevent damage to those components.
2. The unit must be properly grounded or severe damage to the MicroTech Controller can occur.

Small water pressure test valves or pipe plugs are provided at both the inlets and outlets of the vessel heads. The test valves permit the water flow pressure drops to be checked. The pressure drops and flow rates for the various evaporators and condensers are shown in McQuay Product Manual PM WSC/WDC. Refer to the nameplate on the vessel shell for identification.

Evaporator inlet and outlet water connections have been reversed over time with design changes in the vessel. Be sure that water inlet and outlet connections match certified drawings and stenciled nozzle markings. The condenser is connected with the coolest water entering at the bottom to maximize subcooling.

Note: When common piping is used in connection with a heating system, care should be taken to provide that water flowing through the evaporator cannot exceed 110°F which can cause the relief valve to discharge refrigerant or damage controls.

The piping should be supported to reduce the weight and strain on the fittings and connections. Piping should also be adequately insulated. A cleanable 20-mesh water strainer should be installed at both inlets. Sufficient shutoff valves should be installed to permit draining the water from the evaporator or condenser without draining the complete system.

Flow Switch

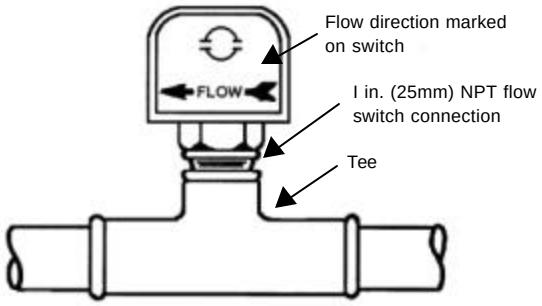
A water flow switch must be mounted in either the entering or leaving water line to provide adequate water flow to the evaporator before the unit can start. This will safeguard against slugging the compressors on

start-up. It also serves to shut down the unit in the event that water flow is interrupted to guard against evaporator freeze-up.

A flow switch is available from McQuay under Part Number 017503300. It is a "paddle" type switch and adaptable to any pipe size from 1 inch to 8 inches.

Consult the manufacturer's data for the minimum flow rates required to close the switch. Installation should be as shown in Figure 3.

Figure 3, Flow Switch Mounting



Electrical connections in the unit control center should be made at terminals 62 and 63. The normally open contacts of the flow switch should be wired between these two terminals. Flow switch contact quality must be suitable for 24 VAC, low current (16ma). Flow switch wire must be in separate conduit from any high voltage conductors (115 VAC and higher).

CAUTION

Freeze Notice: Neither the evaporator nor the condenser is self-draining; both must be blown out.

The piping should also include thermometers at the inlet and outlet connections and air vents at the high points.

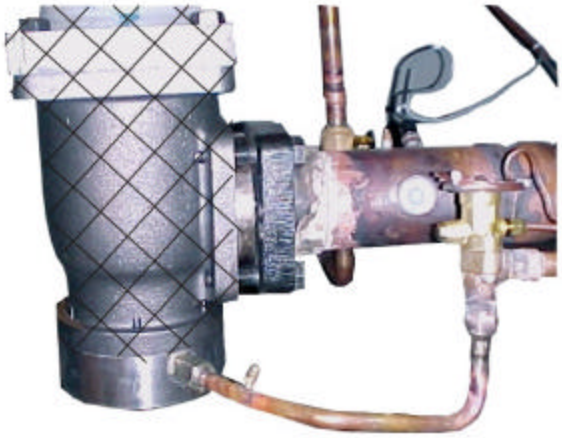
The water heads can be interchanged (end for end) so that the water connections can be made at either end of the unit. If this is done, new head gaskets must be used and control sensors relocated.

In cases where the water pump noise can be objectionable, rubber isolation sections are recommended at both the inlet and outlet of the pump. In most cases, it will not be necessary to provide vibration eliminator sections in the condenser inlet and outlet water lines; but where noise and vibration are critical (for example, where a pipe chase goes through walls adjoining living quarters in an apartment building), they can be required.

Where a cooling tower is used to supply condenser water, a flow balancing valve is required. Some form of temperature control is required if tower water becomes too cold.

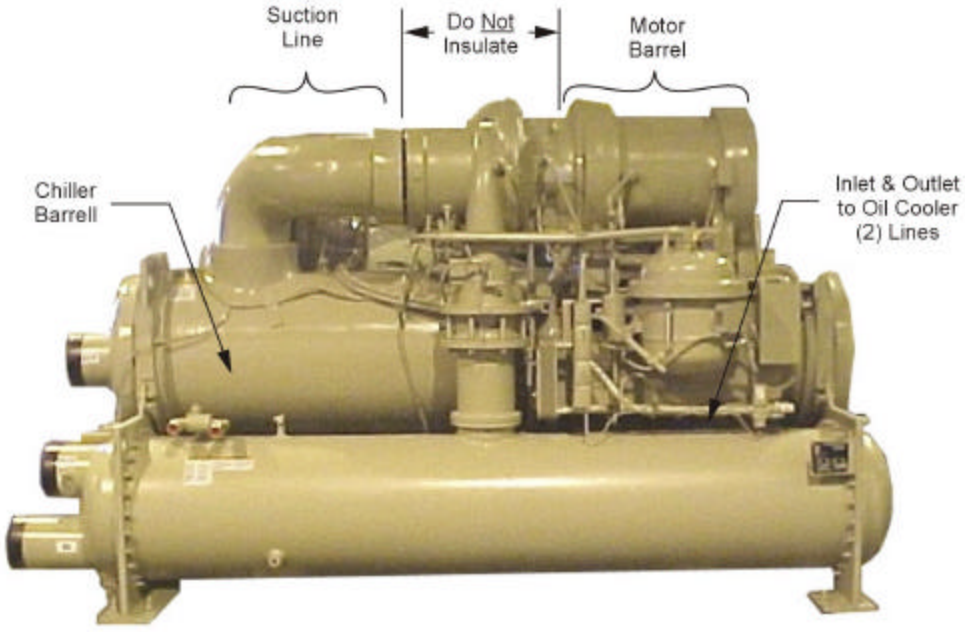
Field Insulation Guide

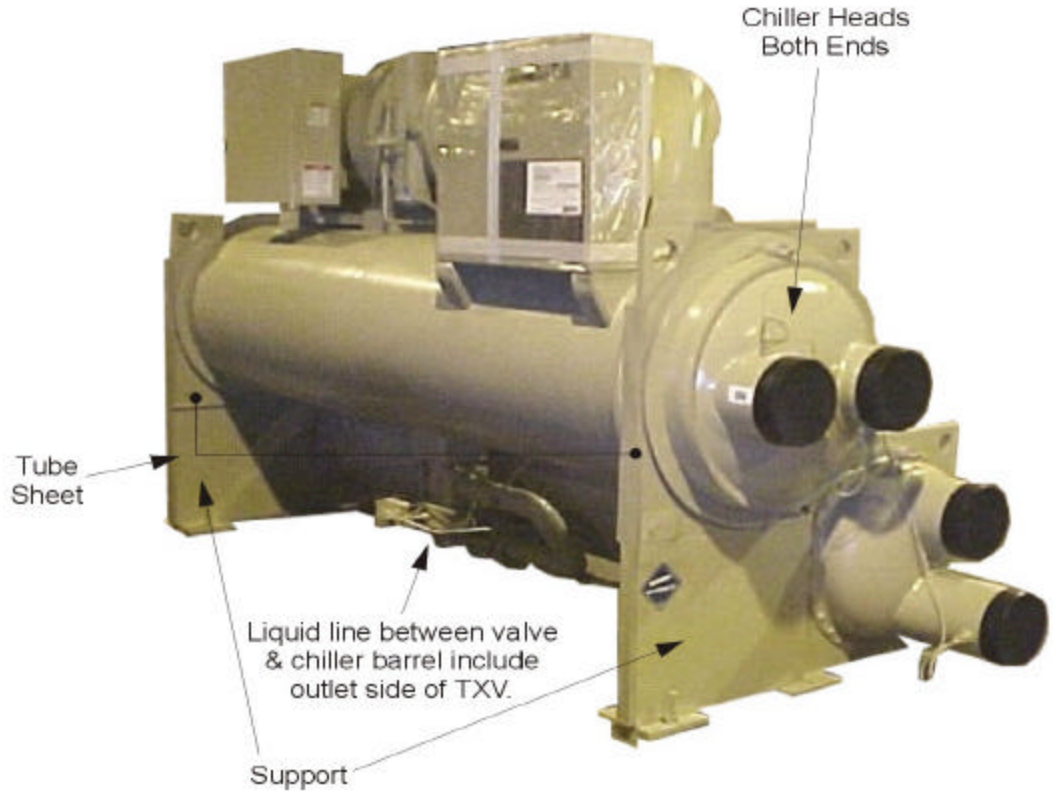
Figure 4, Insulation Requirements

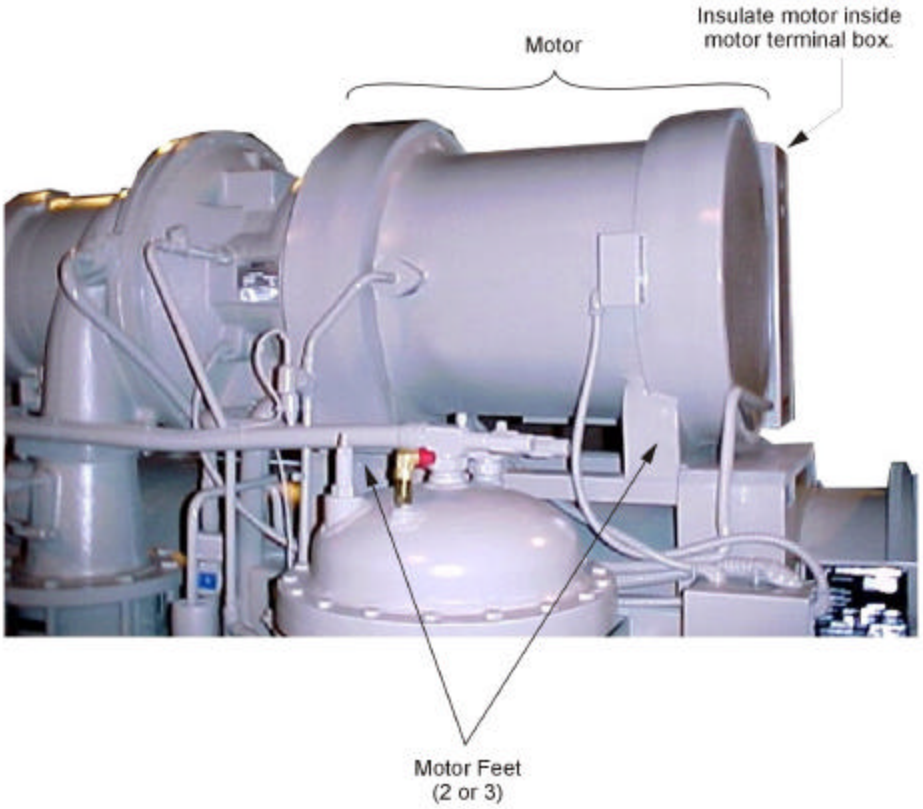


Expansion Valve -
Insulate crosshatch area
& up to the chiller insulation.

Note: Stop at motor / gearcase boundry.
Do not insulate compressor!




Chiller Heads
Both Ends
Tube
Sheet
Liquid line between valve
& chiller barrel include
outlet side of TXV.
Support


Motor
Insulate motor inside
motor terminal box.
Motor Feet
(2 or 3)

Physical Data and Weights

Evaporator

The standard insulation of cold surfaces includes the evaporator and non-connection water head, suction piping, compressor inlet, motor housing, and motor coolant suction line.

The insulation used is UL recognized (Card No. E61978). It is 3/4" thick vinyl nitrate polymer having a K factor of 0.28 at 75°F. The sheet insulation is fitted and cemented in place forming a vapor barrier, then painted with a resilient epoxy finish that resists cracking.

The insulation complies to appropriate requirements or has been tested in accordance with the following:

HH-I-573 (GSA-FSS)	ASTM-D-1149	ASTM-C-177
ASTM-C-534	ASTM-D-1056	UL 94-5V
ASTM-C-355		

Refrigerant side design pressure is 200 psi (1380 kPa) on WSC units and 180 psi (1242 kPa) on WDC units. Water side is 150 psi (1034 kPa) on both.

In the event insulation is to be field installed, none of the cold surfaces identified above will be factory insulated. Approximate total square footage of insulation surface required for individual packaged chillers is tabulated by evaporator code and can be found below.

Table 1, Evaporator Physical Data

Evaporator Code	WSC	WDC	Refrigerant Charge lb (kg)	Evaporator Water Capacity, gal (L)	Insulation Area Sq Ft (m^2)	Vessel Weight lb (kg)	Number of Relief Valves
E1809	X		434 (197)	37 (138)	75 (7.0)	2734 (1239)	1
E1812	X		347 (158)	27 (103)	78 (7.2)	2370 (1075)	1
E2009	X		561 (254)	34 (164)	82 (7.6)	3026 (1371)	1
E2012	X		420 (190)	37 9139)	84 (7.8)	2713 (1231)	1
E2209	X		729 (331)	54 (206)	66 (6.1)	3285 (1488)	1
E2212	X		500 (227)	45 (170)	90 (8.3)	2877 (1305)	1
E2212		X	645 (291)	63 (240)	90 (8.3)	3550 (1609)	1
E2216		X	1312 (595)	79 (301)	144 (13.4)	4200 (1903)	1
E2412		X	1005 (456)	88 (335)	131 (12.1)	4410 (1999)	1
E2416		X	1424 (646)	110 (415)	157 (14.6)	5170 (2343)	1
E2609	X		531 (249)	54 (295)	76 (7.1)	2730 (1238)	1
E2612	X		708 (321)	72 (273)	102 (9.4)	3640 (1651)	1
E2612		X	925 (418)	101 (381)	102 (9.4)	4745 (2150)	1
E2616		X	1542 (700)	126 (478)	162 (15.0)	5645 (2558)	1
E3009	X		676 (307)	67 (252)	86 (8.0)	3582 (1625)	1
E3012	X		901 (409)	89 (336)	115 (10.6)	4776 (2166)	1
E3016		X	2117 (960)	157 (594)	207 (19.2)	7085 (3211)	2
E3609	X		988 (720)	118 (445)	155 14.4)	5314 (2408)	1
E3612	X		1317 (597)	152 (574)	129 (11.9)	6427 (2915)	1
E3616		X	3320 (1506)	243 (918)	239 (22.2)	9600 (4351)	2
E4212	X		1757 (797)	222 (841)	148 (13.7)	8679 (3937)	1
E4216		X	4422 (2006)	347 (1313)	264 (24.5)	12215	2
E4220		X	4713 (2138)	481 (1819)	330 (30.6)	15045	2
E4812	X		2278 (1033)	327 (1237)	169 (15.6)	10943	2
E4816		X	4690 (2128)	556 (2106)	302 (28.1)	16377	2
E4820		X	5886 (2670)	661 (2503)	377 (35.0)	17190	2

Notes:

1. Refrigerant charge is approximate since the actual charge will depend on other variables. Actual charge will be shown on the unit name plate.
2. Water capacity is based on standard tube configuration and standard dished heads.
3. The evaporator charge includes the maximum condenser charge available with that evaporator and is therefore the maximum charge for a total unit with the evaporator. Actual charge for a specific selection can vary with tube count and can be obtained from the McQuay Selection Program. The program will not allow a selection where the unit charge exceeds the condenser pumpdown capacity.

Condenser

With positive pressure systems, the pressure variance with temperature is always predictable, and the vessel design and relief protection are based upon pure refrigerant characteristics. HFC-134a requires ASME vessel design, inspection and testing and uses spring-loaded pressure relief valves. When an over pressure condition occurs spring-loaded relief valves purge only that refrigerant required to reduce system pressure to a safe level and then close.

Refrigerant side design pressure is 200 psi (1380 kPa) on WSC units and 225 psi (1552 kPa) on WDC units. Water side design is 150 psi (1034 kPa) on both.

Pumpdown

To facilitate compressor service, all McQuay centrifugal chillers are designed to permit pumpdown and isolation of the entire refrigerant charge in the unit's condenser. Dual compressor units and single compressor units equipped with the optional suction shutoff valve can also be pumped down into the evaporator.

Table 2, Condenser Physical Data

Condenser Code	WSC	WDC	Pumpdown Capacity lb (kg)	Water Capacity gal (L)	Vessel Weight lb (kg)	Number of Relief Valves
C1609	X		468 (213)	33 (125)	1645 (746)	2
C1612	X		677 (307)	33 (123)	1753 (795)	2
C1809	X		597 (271)	43 (162)	1887 (856)	2
C1812	X		845 (384)	44 (166)	2050 (930)	2
C2009	X		728 (330)	47 (147)	1896 (860)	2
C2012	X		971 (440)	62 (236)	2528 (1147)	2
C2209	X		822 (372)	73 (278)	2596 (1169)	2
C2212	X		1183 (537)	76 (290)	2838 (1287)	2
C2212		X	1110 (504)	89 (337)	3075 (1395)	2
C2216		X	1489 (676)	114 (430)	3861 (1751)	2
C2416		X	1760 (799)	143 (540)	4647 (2188)	2
C2609	X		1242 (563)	83 (314)	2737 (1245)	2
C2612	X		1656 (751)	111 (419)	3650 (1660)	2
C2616		X	2083 (945)	159 (603)	5346 (2425)	2
C3009	X		1611 (731)	108 (409)	3775 (2537)	2
C3012	X		2148 (975)	144 (545)	5033 (3383)	2
C3016		X	2789 (1265)	207 (782)	6752 (3063)	4
C3612	X		2963 (1344)	234 (884)	7095 (3219)	2
C3616		X	3703 (1725)	331 (1251)	9575 (4343)	4
C4212	X		3796 (1722)	344 (1302)	9984 (4529)	2
C4216		X	5010 (2273)	475 (1797)	12662 (5743)	4
C4220		X	5499 (2494)	634 (2401)	17164 (7785)	4
C4812	X		4912 (2228)	488 (1848)	12843 (5826)	4
C4816		X	5581 (2532)	717 (2715)	18807 (8530)	4
C4820		X	7034 (3191)	862 (3265)	23106 (10481)	4

Notes:

1. Condenser pumpdown capacity based on 90% full at 90°F.
2. Water capacity based on standard configuration and standard heads and can be less with lower tube counts.
3. See Relief Valves section on following page for additional information.

Compressor

Table 3, Compressor Weights

Compressor Size ⇒	050	063	079	087	100	126
Weight lb (kg) ⇒	870 (390)	3200 (1440)	3200 (1440)	3200 (1440)	6000 (2700)	6000 (2700)

Oil Coolers

McQuay centrifugal chillers, sizes 063 through 126, have a factory mounted water-cooled oil cooler, temperature controlled water regulating valve and solenoid valve per compressor. Models WSC and WDC 050 chillers have refrigerant-cooled oil coolers and require no cooling water connection.

Single compressor cooling water connections are located near the compressor and are shown on the specific unit certified drawings. Dual compressor chillers, WDC 063, 079, 087, 100 and 126 are equipped as above but the water piping for the two oil coolers is factory piped to a common inlet and outlet connection located in the tube sheet under the evaporator. The exception to this is the WDC 100 and 126 with 16 foot shells where the common connections are centered at the rear of the unit.

Field water piping to the inlet and outlet connections must be installed according to good piping practices and should include stop valves to isolate the cooler for servicing. A 1" minimum cleanable filter (40 mesh maximum), and drain valve or plug should also be field installed. The water supply for the oil cooler should be from the chilled water circuit or from an independent source such as city water. When using chilled water it is important that the water pressure drop across the evaporator is greater than the pressure drop across the oil cooler or insufficient oil cooler flow will result. If the pressure drop across the evaporator is less than the oil cooler, the oil cooler must be piped across the chilled water pump provided that its pressure drop is sufficient. The water flow through the oil cooler will be adjusted by the unit's regulating valve so that the temperature of oil supplied to the compressor bearings (leaving the oil cooler) is between 80°F and 110°F (27°C and 43°C).

Compressors using chilled water for oil cooling will often start with warm "chilled water" in the system until the chilled water loop temperature is pulled down. Data given here is for that condition. With cooling water in the 40°F to 55°F (4°C to 13°C) range considerably less water will be used and the pressure drop will be greatly reduced.

Oil Cooler Data

Unit Model	Flow (gpm)	Press. Drop (ft)	Water Temp.	
			Inlet (°F)	Outlet (°F)
063-087	12	32	80.0	87.0
100-126	22	31	80.0	87.3

Note:
1. Pressure drops include valve on the unit.

When supplied with city water, the oil piping should discharge through a trap into an open drain to prevent draining the cooler by siphoning. The city water can also be used for cooling tower makeup by discharging it into the tower sump from a point above the highest possible water level.

NOTE: Particular attention must be paid to chillers with variable chilled water flow through the evaporator. The pressure drop available at low flow rates can very well be insufficient to supply the oil cooler with enough water. In this case an auxiliary booster pump can be used or city water employed.

CONNECTION SIZES: WDC 100/126 are 1 1/2 in. FPT, all other WDC and WSCs are 1 in. FPT.

Figure 5, Oil Cooler Piping Across Chilled Water Pump

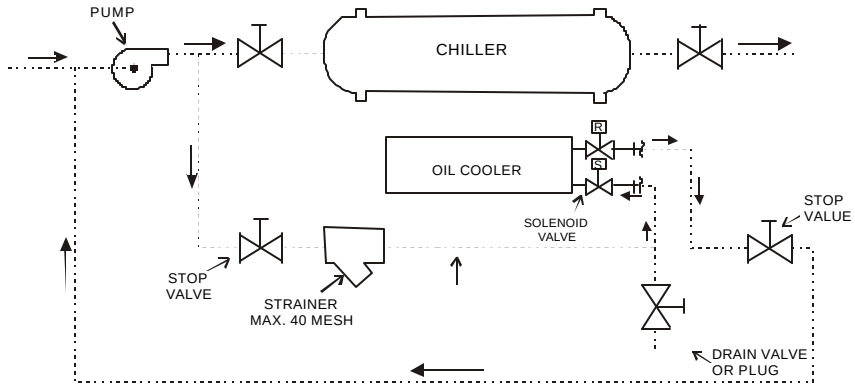


Figure 6, Oil Cooler Piping With City Water

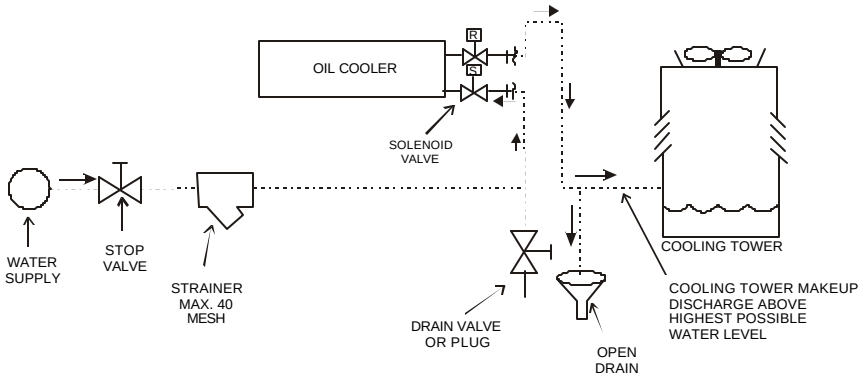


Figure 7, Oil Cooler Connections, WSC Units

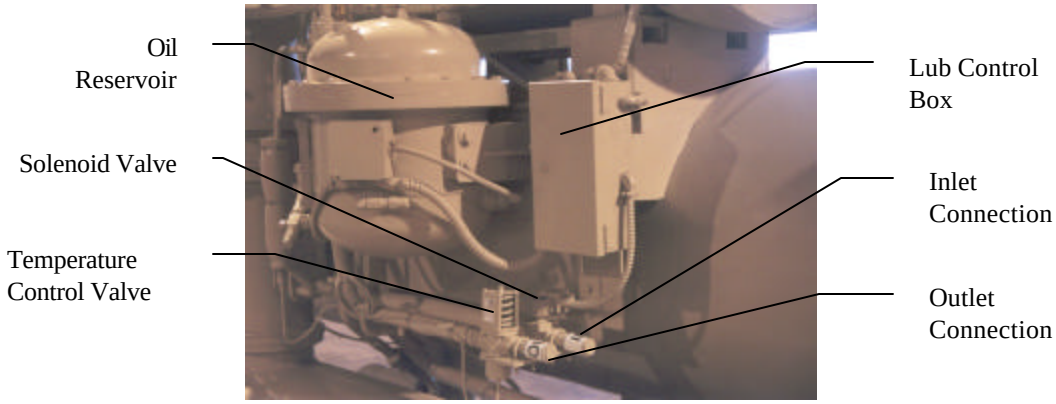
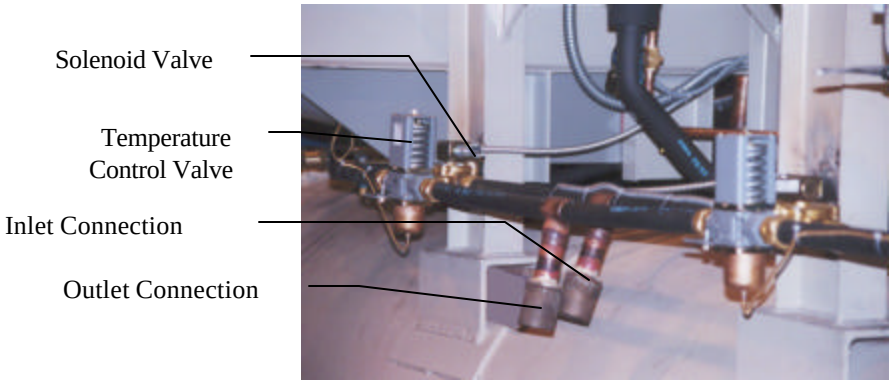


Figure 8, Oil Cooler Connections, WDC 100/126, 16 Foot Shells



Note:
All Other WDC Units Have Oil Cooler Connections Located on the Right Hand Tube Sheet Under the Evaporator

Refrigerant Vent Piping

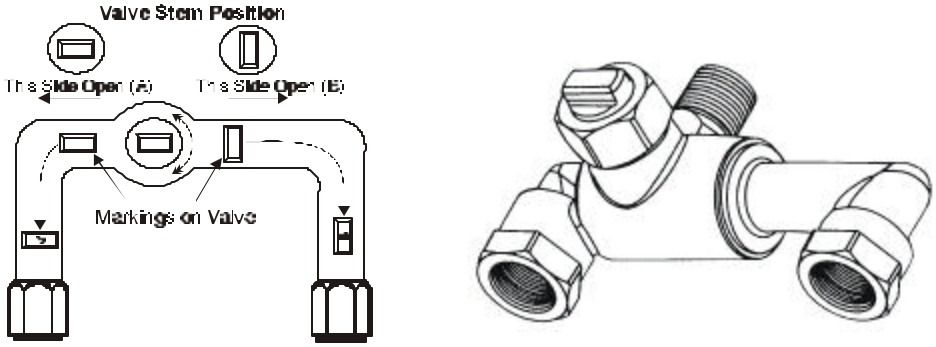
As a safety precaution, each system is equipped with pressure relief valves located on the condenser, evaporator, and oil sump vessel for the purpose of relieving excessive refrigerant pressure to the atmosphere. Most codes require that relief valves be vented to the outside, and this is a desirable practice for all installations.

Note: Remove plastic shipping plugs (if installed) from the inside of the valves prior to making pipe connections. Whenever vent piping is installed, the lines should be run in accordance with local code requirements; where local codes do not apply, ANSI/ASHRAE Standard 15-1994 code recommendations should be followed.

The condenser design incorporates two relief valves (one set) with a three-way shutoff valve separating the two valves (see Figure 9). Large condensers will have two such sets. One valve remains in the system at all times and the second valve acts as a standby.

If one relief valve of the two-valve set fails, the shutoff valve can be used to isolate the faulty relief valve, while the other valve provides pressure protection.

Figure 9, Condenser Relief Valve Set



When piping the vent line to a dual valve set, it can be sized for one relief valve and piped to both valves. On large capacity condenser designs, two separate sets of dual relief valves are used. The vent line must be sized to the total of two valves but piped to all four.

Relief Valves

Vessel Relief Valves

Relief valve connection sizes are 1 inch FPT and are in the quantity shown in Table 1 and Table 2. Relief valves must be piped to the outside of the building in accordance with ANSI/ASHRAE 15. Twin relief valves mounted on a transfer valve are used on the condenser so that one relief valve can be shut off and removed leaving the other in operation. Only one of two is in operation at any time. Where 4 valves are shown, they consist of two valves mounted on two transfer valves. Only two relief valves of the four are active at any time.

Vent piping is sized for only one valve of the set since only one can be in operation at a time. In no case would a combination of evaporator and condenser sizes require more refrigerant than the pumpdown capacity of the condenser. Condenser pumpdown capacities are based upon ANSI/ASHRAE Standard 15-1992 recommendations of 90% full at 90°F (32°C). To convert values to the older ARI standard, multiply pumpdown capacity by 0.888.

Relief Valve Pipe Sizing

Relief valve pipe sizing is based on the discharge capacity for the given evaporator or condenser and the length of piping to be run. Discharge capacity for HFC-134a vessels is calculated as follows:

$$C = 0.133xDxL$$

Where: C=Minimum discharge capacity, lbs of air/min

D=Vessel diameter, in.

L=Vessel length, ft.

Example: E3016 Evaporator, HFC-134a Refrigerant, 75 equivalent feet of piping

$$C = 0.133x30x16 = 63.8 \ Lbs\ of\ air \ / \ \text{min}$$

From the table below, 75 feet of piping for 63.8 lb. of air/min. at 180 psig valve setting requires a 2" diameter pipe.

Table 4, Discharge Capacity, lbs of Air/Min

EQUIVALENT LENGTH OF DISCHARGE	DIAMETER STANDARD WALL IRON PIPE																	
	1" (25mm)			1.25" (32mm)			1.5" (38mm)			2" (50mm)			2.5" (64mm)			3" (76mm)		
	RELIEF VALVE PRESSURE SETTNG (psi)																	
PIPING, FT. (m)	180	200	225	180	200	225	180	200	225	180	200	225	180	200	225	180	200	225
50 (15.2)	21.4	24.1	26.8	42.8	48.2	53.6	62.7	66.6	78.4	117.0	131.6	146.3	182.2	204.9	227.7	315.4	354.5	393.7
75 (22.9)	17.5	19.7	21.9	35.0	39.4	43.8	51.5	57.9	64.4	95.4	107.3	119.3	150.5	169.3	188.1	257.4	289.6	321.8
100 (30.5)	15.2	17.1	19.1	30.2	29.0	27.8	44.3	49.9	55.4	82.6	92.9	103.3	129.6	145.8	162.0	222.5	250.3	278.1
150 (45.7)	12.4	14.0	15.6	24.7	27.8	30.9	36.0	40.5	45.0	67.3	75.7	84.2	105.1	118.5	131.9	182.2	204.9	227.7
200 (61.0)	10.6	12.1	13.6	21.4	24.1	26.8	31.4	35.3	39.3	58.4	65.7	73.1	91.1	102.5	113.9	157.7	177.4	197.1
300 (91.4)	8.8	10.0	11.1	17.5	19.7	21.9	25.5	28.7	32.0	47.6	53.6	59.6	75.6	85.0	94.5	128.5	144.6	160.7

Note: Standard relief valve settings:

1. WDC units; evaporator=180 psig, condenser=225 psig
2. WSC units; evaporator=200 psig, condenser=200 psig

Note: Per ASHRAE Standard 15, the pipe size can not be less than the relief device, meaning a minimum 1" diameter pipe is required. The discharge from more than one relief valve can be run into a common header, the area of which shall not be less than the sum of the areas of the connected pipes. For further details, refer to ASHRAE Standard 15. The common header can be calculated by the formula:

$$D_{Common} = \left(D_1^2 + D_2^2 .... D_n^2 \right)^{0.5}$$

WARNING**: The above information is a guide only. Consult local codes and/or latest version of ASHRAE Standard 15 for sizing data.**

Electrical

Wiring, fuse and wire size must be in accordance with information located in the electrical data. Standard NEMA motor starters require modification to meet McQuay specifications. Refer to electrical data supplied with the unit or McQuay Product Manual PM WSC/WDC.

Important: The voltage to these units should be within the limitation of +10%, and the voltage unbalance between phases must not exceed 3%. Since a 3 1/2% voltage unbalance will cause an approximate 25% increase in motor temperature, it is most important that the unbalance between phases be kept at a minimum.

Power Wiring

CAUTION

Qualified and licensed electricians must perform wiring. Shock hazard exists.

Power wiring to compressors must be in proper phase sequence. Motor rotation is set up for clockwise rotation facing lead end with phase sequence of 1-2-3. Care should be taken that proper phase sequence is carried through the starter to compressor. With the phase sequence of 1-2-3 and L1 connected to T1 and T6, L2 connected to T2 and T4, and L3 connected to T3 and T5, rotation is proper. See diagram in terminal box cover.

Proper phase sequence will be determined by the McQuay start-up technician.

CAUTION

Connections to terminals must be made with copper lugs and copper wire.

Care should be taken when attaching leads to compressor terminals.

Note: Do not make final connections to motor terminals until wiring has been checked and approved by a McQuay technician.

Under no circumstances should a compressor be brought up to speed unless proper sequence and rotation have been established. Serious damage can result if compressor starts in wrong direction.

It is the installing contractor's responsibility to insulate the compressor motor terminals when the unit voltage is 600 volts or greater. This is to be done after the McQuay start-up technician has checked for proper phase sequence and motor rotation.

Following this verification by the McQuay technician, the contractor should apply the following furnished items.

Materials required:

1. Locktite brand safety solvent (12 oz. package available as McQuay part number 350A263H72)
2. 3M Co. Scotchfil brand electrical insulation putty (available in a 60-inch roll as McQuay part number 350A263H81)
3. 3M Co. Scotchkote brand electrical coating (available in a 15 oz. can with brush as McQuay Part Number 350A263H16)
4. Vinyl plastic electrical tape

The above items are also available at most electrical supply outlets.

Application procedure:

1. Disconnect and lock out the power source to the compressor motor.
2. Using the safety solvent, clean the motor terminals, motor barrel adjacent to the terminals, lead lugs, and electrical cables within the terminal 4OX to remove all dirt, grime, moisture and oil.
3. Wrap the terminal with Scotchfil filling in all irregularities. The final result should be smooth and cylindrical.
4. Doing one terminal at a time, brush the Scotchkote on the motor barrel to a distance of up to '/2" around the terminal and, on the wrapped terminal, the rubber insulation next to the terminal and the lug and cable for approximately 10". Wrap additional Scotchfil insulation over the Scotchkote.
5. Tape the entire wrapped length with electrical tape to form a protective jacket.
6. Finally, brush on one more coat of Scotchkote to provide an extra moisture barrier.

Unit Mounted Starter Power Wiring

Some units are supplied with a factory wired and mounted starter equipped with ambient compensated quick trip overloads. Wiring, fuse and wire size must be in accordance with information located in the electrical data supplied with the unit or the electrical data pertaining to your unit.

Important: See reference above to maximum voltage unbalance limitation of 3%.

The transition timer in the starter is factory set to disconnect the star winding connection and connect the delta winding, when the motor comes up to speed and before any speed reduction occurs.

Control Wiring

The control circuit on the McQuay WSC/WDC packaged chiller is designed for 115 volts. Power can be supplied from a separate circuit and fused at 20 amps inductive load. If the unit is supplied with a factory-mounted starter or VFD then the control circuit power supply is provided through a transformer located in the starter or VFD. A free-standing starter or VFD furnished by McQuay will have a control transformer and requires field wiring.

The disconnect switch should be tagged to prevent current interruption. **Switch is to remain on at all times in order to keep oil heaters operative and prevent refrigerant from diluting in oil.**

The control center off-on switch should be turned to the "off" position at any time compressor operation is not desired.

In the event control voltage is supplied by a transformer, the transformer should be rated at 2 KVA, with an inrush rating of 12 KVA minimum at 80% power factor and 95% secondary voltage. For control wire sizing, refer to N.E.C. Articles 215 and 310. In the absence of complete information to permit calculations, the voltage drop should be physically measured. Again, the disconnect switch should be marked to prevent control circuit from being de-energized. Water flow interlock terminals are provided on the control center terminal strip. See field connection diagram in the Electrical Data Section or in the cover of control center for proper connections.

The purpose of the water flow interlocks is to prevent compressor operation until such time as both the evaporator water and condenser water pumps are running. If flow or pressure differential switches are not furnished factory installed and wired, they must be furnished and installed by others before the unit can be started.

WARNING

On older style units severe damage to the compressor can result if the anti-recycle timer is turned to the "off" position and the flow switches operate intermittently.

Operation of the chilled water pump can be to cycle the pump with the compressor, operate continuously, or start automatically by a remote source. The cooling tower pump must cycle with the machine. The holding coil

of the cooling tower pump motor starter must be rated at 115 volts, 60 Hz with a maximum volt-amperage rating of 100. If the voltage-amperage rating is exceeded, a control relay is required.

All interlock contacts must be rated for no less than 10 inductive amps. The alarm circuit provided in the control center utilizes 115 volts AC. The alarm used should not draw more than 10 volt amperes.

See OM 200MICRO for MicroTech control details.

Testing Control Circuit

McQuay will test the circuits upon completion of power and control wiring during unit's initial start-up.

Surge Capacitors

All units (except those supplied with solid state starters or VFDs) are supplied with surge capacitors to protect compressor motors from electrical damage resulting from high voltage spikes. The capacitors may or may not be wired depending upon whether or not the starter was furnished by McQuay or whether or not it was factory mounted. Surge capacitors should be enclosed, either inside the starter (on terminal box mounted starters) or in the compressor motor terminal box, and should be connected on the motor terminals with leads less than 18 inches (460 mm).

Prestart System Checklist

	Yes	No	N/A
Chilled Water			
Piping complete	☐	☐	☐
Water system filled, vented	☐	☐	☐
Pumps installed, (rotation checked), strainers cleaned	☐	☐	☐
Controls (3-way, face and bypass dampers, bypass valves, etc.) operable	☐	☐	☐
Water system operated and flow balanced to meet unit design requirements	☐	☐	☐
Condenser Water			
Cooling tower flushed, filled and vented	☐	☐	☐
Pumps installed, (rotation checked), strainers cleaned	☐	☐	☐
Controls (3-way, bypass valves, etc.) operable	☐	☐	☐
Water system operated and flow balanced to meet unit requirements	☐	☐	☐
Electrical			
115 volt service completed, but not connected to control panel	☐	☐	☐
Power leads connected to starter; load leads run to compressor ready for connection when service engineer is on hand for start-up	☐	☐	☐
(Do not connect starter or compressor terminals)			
All interlock wiring complete between control panel and complies with specifications	☐	☐	☐
Starter complies with specifications	☐	☐	☐
*Oil cooler solenoid wired to control panel as shown on wiring diagram Pump starter and interlock wired	☐	☐	☐
Cooling tower fans and controls wired	☐	☐	☐
Wiring complies with National Electrical Code and local codes	☐	☐	☐
Condenser pump starting relay (CWR) installed and wired	☐	☐	☐
Miscellaneous			
Oil cooler water piping complete (units with water cooled oil coolers only)	☐	☐	☐
Relief valve piping complete	☐	☐	☐
Thermometer wells, thermometers, gauges, control wells, controls, etc., installed	☐	☐	☐
Minimum system load of 80% of machine capacity available for testing and adjusting controls	☐	☐	☐

Note: This checklist must be completed and sent to the local McQuay service location two weeks prior to start-up.

Operation

Operator Responsibilities

It is important that the operator become familiar with the equipment and the system before attempting to operate the chiller. In addition to reading this manual the operator should study operation manual OM 200MICRO (latest edition) and the control diagram furnished with the unit so that he understands the starting, operating and shutdown sequences as well as the safety shutdown modes.

During the initial startup of the chiller the McQuay technician will be available to answer any questions and instruct in the proper operating procedures.

It is recommended that the operator maintain an operating log for each individual chiller unit. In addition, a separate maintenance log should be kept of the periodic maintenance and servicing activities.

This McQuay centrifugal chiller represents a substantial investment and deserves the attention and care normally given to keep this equipment in good working order. If the operator encounters abnormal or unusual operating conditions, it is recommended that a McQuay service technician be consulted.

McQuay International conducts training for centrifugal operators at its factory Training Center several times a year. These sessions are structured to provide basic classroom instruction and include hands-on operating and troubleshooting exercises. For further information, contact your McQuay representative.

Nomenclature

Each centrifugal chiller is assigned a set of identifying numbers that are used to describe the unit features and to identify each individual unit. These number groups are stamped on each unit nameplate.

All inquiries pertaining to operating and servicing of this unit should include the unit serial number which is on the nameplate located on the unit control panel.

Each of the major individual components also has a nameplates to provide certain necessary information to the installer and the operator.

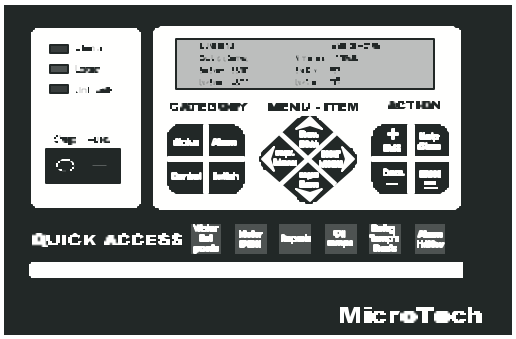
Compressors are designated as model CE. For example a model CE 050 compressor is used on a model WSC 050 chiller unit. The compressor nameplate identifies the compressor model, style and serial number and includes the electrical characteristics of the compressor motor. The CE 050 compressor nameplate also shows the oil pump electrical characteristics.

The condenser and evaporator vessels have nameplates stamped with the maximum working pressure of the vessel, the National Board Number, and the vessel style number. Note that the vessel relief valve maximum settings coincides with the maximum refrigerant side vessel working pressure.

MicroTech Control Panel

The chiller can have one of two different controllers. They are microprocessor based controls designed to initiate the step-by-step start functions of its host centrifugal compressor unit, monitor and regulate the compressors capacity, protect it, and sequence the compressor shutdown on lack of load or in response from a remote signal. On dual compressor units, each compressor has its own controller. They are interconnected to provide lead-lag and load-balance functions.

Figure 10, MicroTech Control Panels



If the controller is like the one shown on the right, the full information on the features, installation, operation and problem analysis of the microprocessor control is in Operators Manual, OM 200MICRO (latest version). The MicroTech panel provides a wide range of control options and data reporting and recording capability. Familiarity with the control system is important for optimum unit operation.

If the controller is like the one shown on the right, the full information on the features, operation and problem analysis of the microprocessor control is in Operators Manual, OM CentrifMicro Ⅱ (latest version). This control system consists of the Operator Interface Touch-screen (shown on left), a separate unit control panel, and a compressor control panel, one for each compressor on dual compressor units. Familiarity with the control system is important for optimum unit operation.

Capacity Control System

The movement of the inlet vanes, opening or closing to permit the correct quantity of refrigerant to enter the impeller, controls the compressor capacity. The vane movement occurs in response to oil flow from the SA or SB solenoid valves which, in turn, respond to a control module signal. This oil flow activates a piston to rotate the vanes.

Vane Operation

The hydraulic system for the inlet guide vane capacity control operation consists of a 4-way normally open solenoid valve located in the oil management control panel or on the compressor close to the suction connection. Oil under pressure from the oil filter is directed by the 4-way valve to either or both sides of the piston depending on whether the control signal is to load, unload, or hold.

To open the vanes (or load the compressor) solenoid SA is de-energized and solenoid SB is energized, allowing oil flow from port SA to one side of the piston then drain through port SB.

To close the vanes (unload compressor) valve SB is de-energized and valve SA is energized to move the piston and vanes toward the unload position.

When both solenoid valves SA and SB are de-energized, full oil pressure is directed to both sides of the piston through ports SA and SB, thus the vanes are held in that position. Refer to Figure 13 and Figure 14 for solenoid action. Note that both solenoids cannot be energized simultaneously.

Metering Valves

The speed at which the capacity control vanes are opened or closed can be adjusted to suit system operating requirements. Adjustable needle valves in the oil drain lines are used to control the rate of bleed-off and consequently the "vane speed". These needle valves are part of the 4-way solenoid valve assembly located in the compressor lube box (Figure 12).

The valves are normally factory set so the vanes will move from fully closed to fully opened in approximately 3 minutes and from fully open to fully closed in 1 minute (except CE126). The speed should be slow enough to prevent over-controlling and hunting.

Vane Speed Adjustment

The vane speed at which the capacity control vanes open or close is controlled by the rate of oil bleed-off from the vane actuating position. This bleed-off rate is adjustable by positioning the needle valves on SA and SB solenoid valves located in the lube box.

Screwdriver openings in the left side of the lube box permit access. The upper opening accesses the SB needle valve for adjusting the vane OPENING speed for loading the compressor (refer to Figure 12). Turn this screw clockwise to decrease the vane opening and counterclockwise to increase the opening speed.

The lower opening accesses the SA needle valve for adjusting the CLOSING speed for unloading the compressor. The same adjustment applies . . . clockwise to decrease closing, counterclockwise to increase vane closing.

The vane speed is factory set and varies by compressor size:

Compressor Model	Opening Time	Closing Time
CE048 - CE050	2 - 2 1/2 min.	3/4 - 1 min.
CE063 - CE100	3 - 5 min.	1 - 2 min
CE126	5 - 8 min.	1 - 2 min.

Figure 11, Lube Box, WDC Units

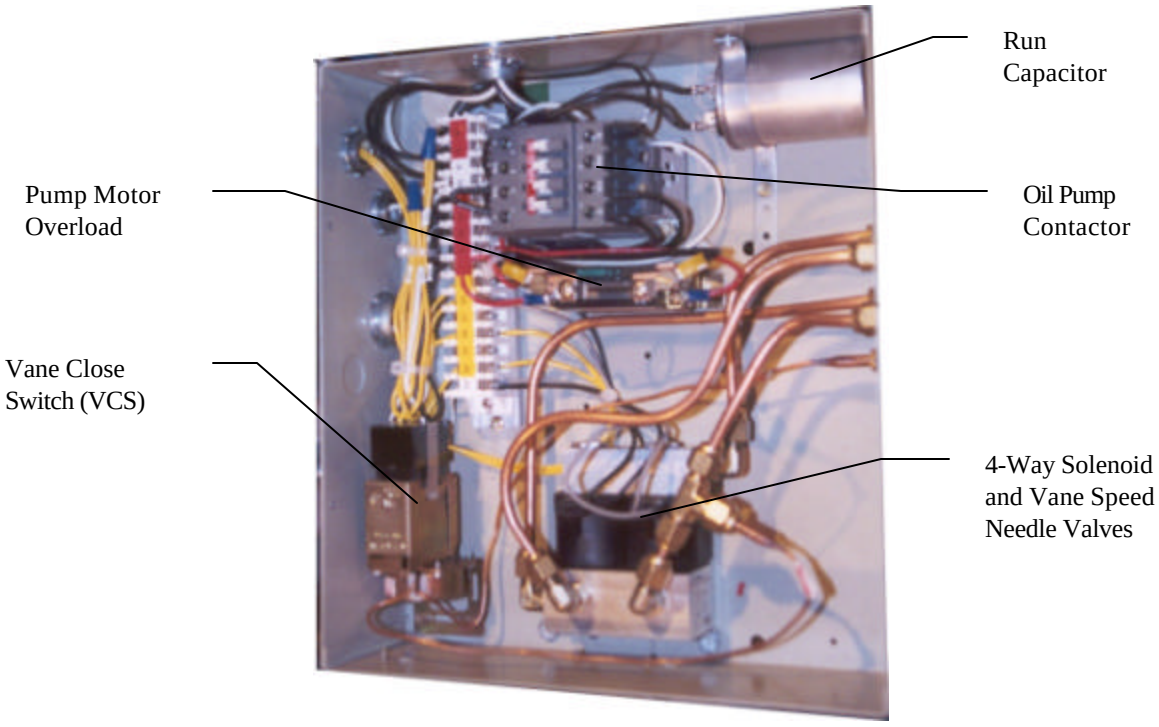


Figure 12, Lube Box, WSC Units

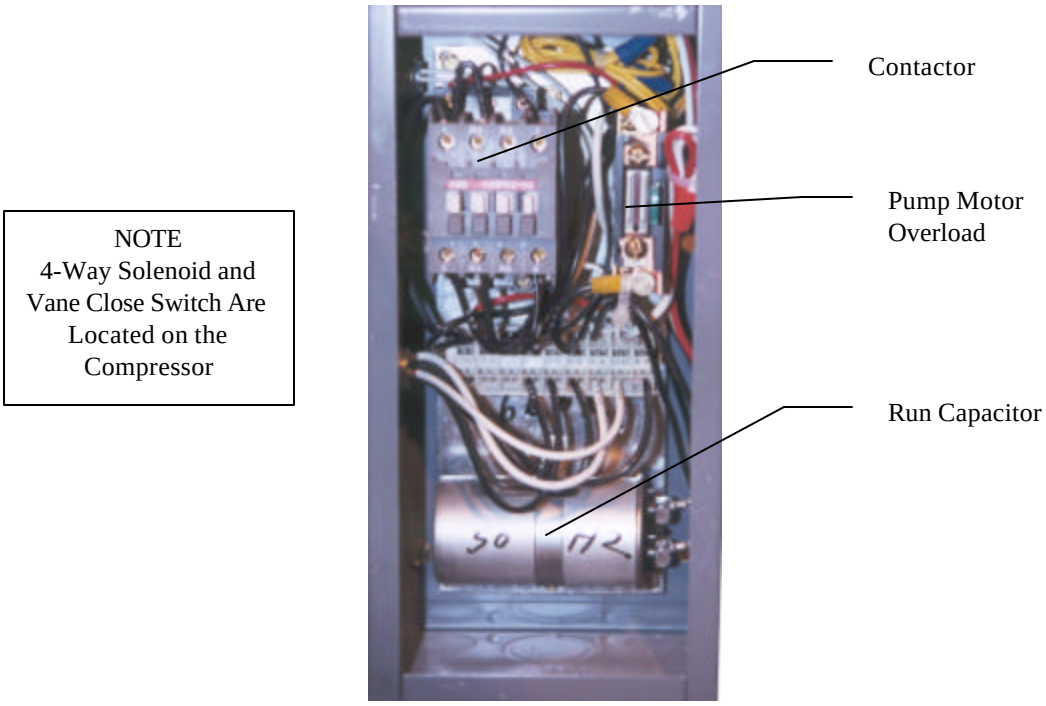


Figure 13, Vane Control Solenoid Operation

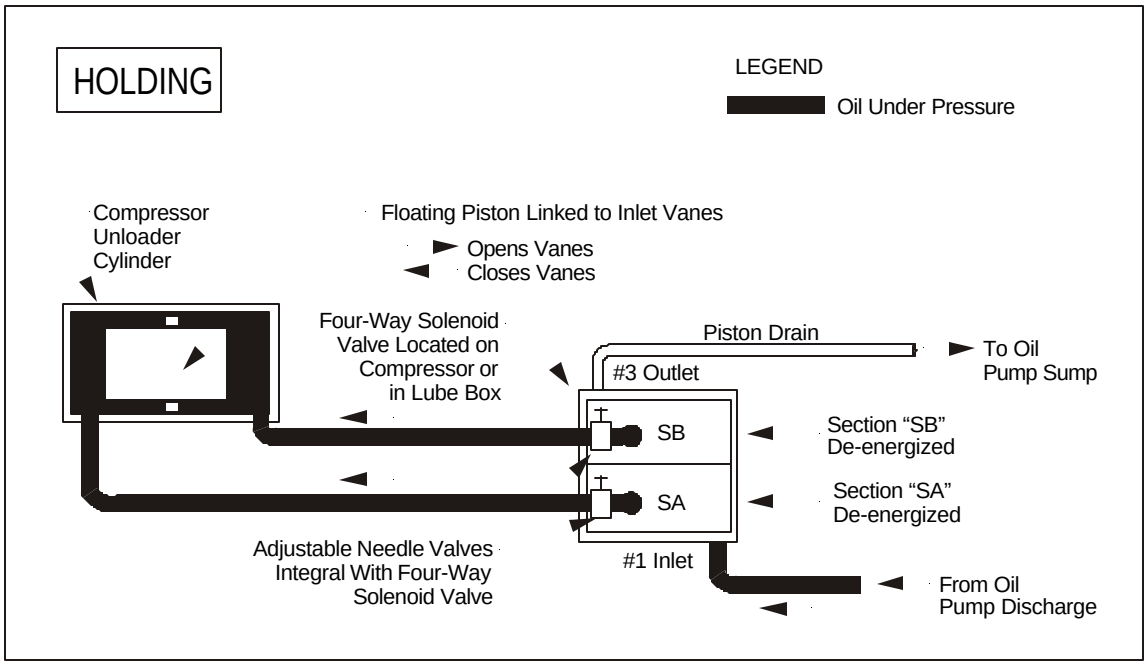
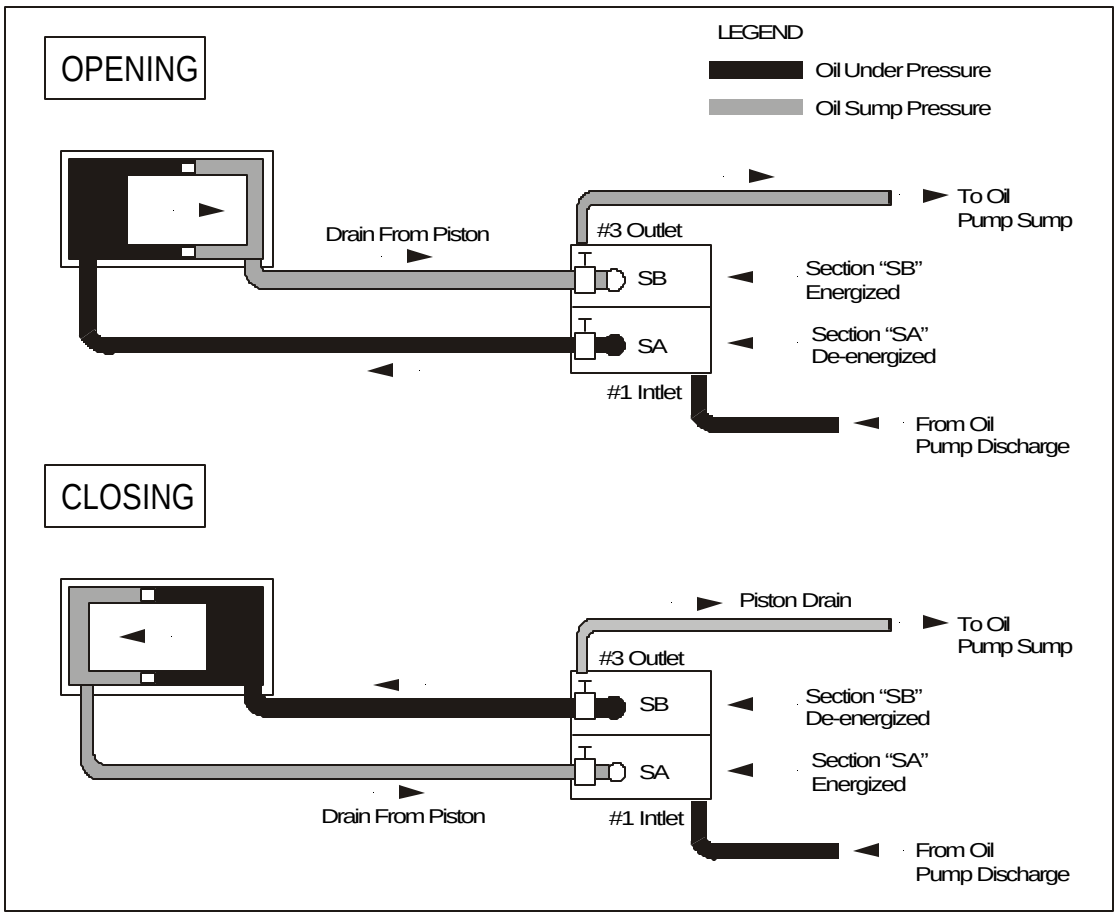


Figure 14, Vane Control Solenoid Operation, Continued



Lubrication System

The lubrication system for the family of centrifugal units provides lubrication and heat removal for compressor bearings and internal parts. In addition, the system provides oil under pressure to hydraulically operate the unloading piston for positioning the inlet guide vanes for capacity control. WDC dual compressor chillers have completely independent lubrication systems for each compressor.

Proper operation of the hydraulic system and bearing lubrication system can be assured only if recommended oil is used, recommended oils are shown in Table 5. Each unit is factory charged with the correct amount of the recommended oil. Under normal operation, no additional lubricant is needed. Oil should be visible in the oil sump sight glass at all times.

The oil pump for the CE048/050 compressor is completely self-contained within the compressor housing. The assembly includes the pump, pump motor, oil heater and oil separator. The oil is pumped through the oil discharge line to the oil filter in the compressor casting and then to the internal refrigerant-cooled oil cooler.

The other compressor sizes-CE063, through CE126-utilize a separate oil pump contained in the oil reservoir. The reservoir includes pump, motor, heater and oil/vapor separator system. Oil is pumped through the external oil cooler and then to the oil filter located inside the compressor housing. WSC/WDC 063-126 units, single or dual compressor, utilize a water-cooled oil cooler.

The oil coolers maintain the proper oil temperature under normal operating conditions. The coolant flow control valve should maintain 90°F-100°F (32°C-38°C). Lubrication protection for coast down in the event of a power failure is accomplished by a spring-loaded piston in models CE050 through 100. When the oil pump is started, the piston is forced back by the oil pressure, compressing the spring

and filling the piston cavity with oil. When the pump stops, the spring pressure on the piston forces the oil out to the bearings.

In model CE126 the compressor coast down lubrication is supplied from a gravity feed oil reservoir.

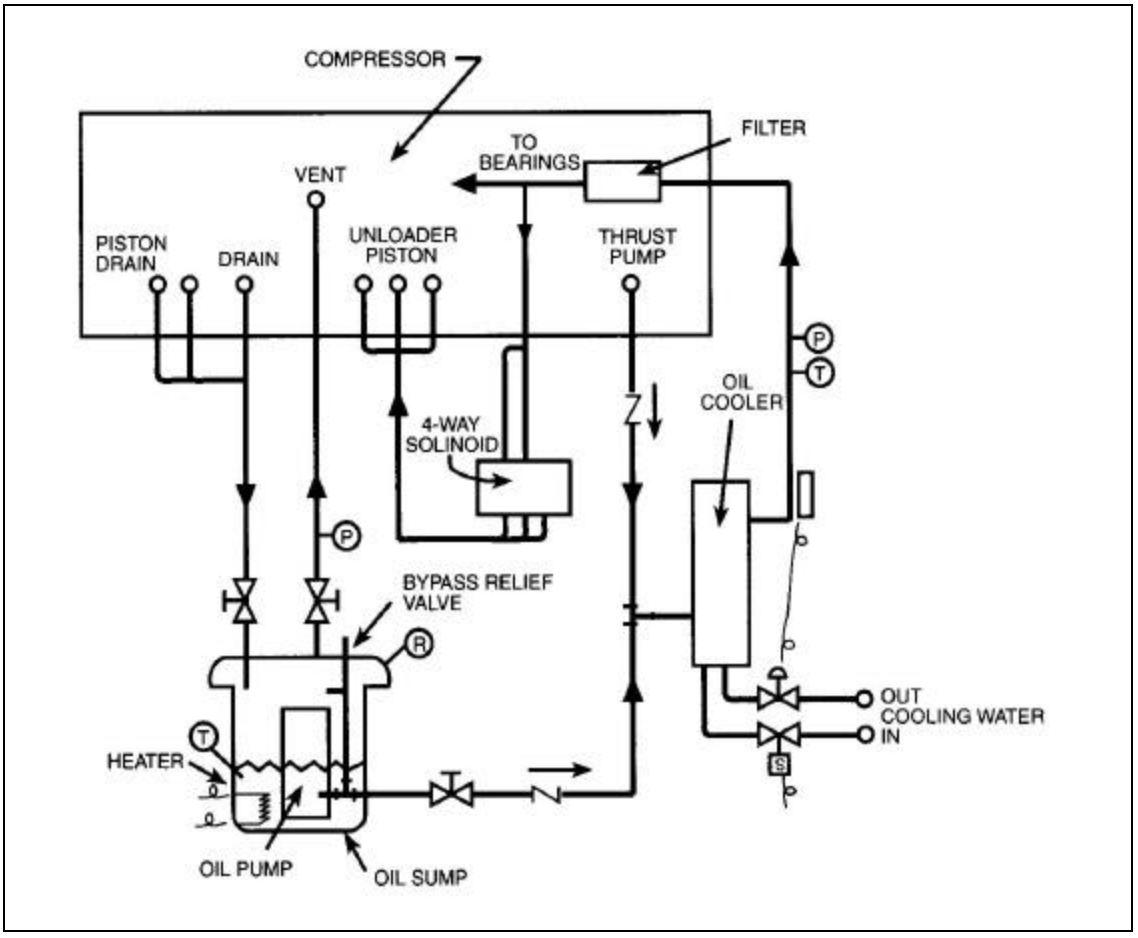
A typical flow diagram is shown in Figure 15.

Table 5, Approved Polyolester Oils For R-134a Units

Compressor Models	CE050 - 126
Lubricant Designation	Mobil Artic EAL 46; ICI Emkarate RL32H[2]
McQuay Part Number 55 Gal. Drum 5 Gal. Drum 1 Gal. Can	 735030432, Rev 47 735030433, Rev 47 735030435, Rev 47
Compressor Oil Label	070200106, Rev OB

NOTE: Approved oil from two suppliers can be mixed.

Figure 15, Typical Oil Flow Diagram



NOTES:
1. Does not apply to CE 048,050 compressors
2. Connections not necessarily in correct relative location

Hot Gas Bypass

WSC and WDC units can be equipped with an optional hot gas bypass system used to feed discharge gas directly into the evaporator when the system load falls below 10% compressor capacity.

Light load conditions are signaled by measurement of a set percentage of RLA amps by the MicroTech control panel. When the RLA drops to the setpoint the hot gas bypass solenoid is energized making hot gas bypass available for use. This introduction of hot gas provides a stable refrigerant flow and keeps the chiller from short cycling under light load conditions. It also prevents surge during heat recovery operation.

The factory setpoint for bringing on hot gas bypass is 40% of RLA.

Maintenance

Pressure/Temperature Chart

HFC-134a Temperature Pressure Chart							
°F	PSIG	°F	PSIG	°F	PSIG	°F	PSIG
6	9.7	46	41.1	86	97.0	126	187.3
8	10.8	48	43.2	88	100.6	128	192.9
10	12.0	50	45.4	90	104.3	130	198.7
12	13.2	52	47.7	92	108.1	132	204.5
14	14.4	54	50.0	94	112.0	134	210.5
16	15.7	56	52.4	96	115.9	136	216.6
18	17.1	58	54.9	98	120.0	138	222.8
20	18.4	60	57.4	100	124.1	140	229.2
22	19.9	62	60.0	102	128.4	142	235.6
24	21.3	64	62.7	104	132.7	144	242.2
26	22.9	66	65.4	106	137.2	146	249.0
28	24.5	68	68.2	108	141.7	148	255.8
30	26.1	70	71.1	110	146.3	150	262.8
32	27.8	72	74.0	112	151.1	152	270.0
34	29.5	74	77.1	114	155.9	154	277.3
36	31.3	76	80.2	116	160.9	156	284.7
38	33.1	78	83.4	118	166.0	158	292.2
40	35.0	80	86.7	120	171.1	160	299.9
42	37.0	82	90.0	122	176.4	162	307.8
44	39.0	84	93.5	124	181.8	164	315.8

Routine Maintenance

Lubrication (See Caution)

After the system is once placed into operation, no other additional oil is required except in the event that repair work becomes necessary to the oil pump or unless a large amount of oil is lost from the system due to a leak.

If oil must be added with the system under pressure, use a hand pump with its discharge line connected to the service valve at the bottom of the oil pump. (The CE 050 compressor with its internal oil pump is equipped with an oil service valve on the compressor.) The POE oils used with R-134a are hygoscopic and care must be exercised to avoid exposure to moisture (air).

Changing Oil Filters (See Caution)

McQuay chillers are at positive pressure at all times and do not leak contaminated moist air into the refrigerant circuit eliminating the need for annual oil changes. An annual laboratory oil check is recommended to check overall compressor condition.

CE 050 Compressors - If the unit is equipped with a suction line service valve (dual compressor units are so equipped as standard), close this valve and close the valve on the motor cooling liquid line to isolate the compressor. Remove the refrigerant from the compressor using approved procedures. Remove the filter cover and the old filter and install the new filter, open end first. Replace the cover using a new gasket. Reopen the suction and liquid line valves.

If the unit is not equipped with a suction line service valve, the unit will have to be pumped down in order to remove the pressure in the compressor before removing the cover and changing the filter. Refer to later section for pumpdown procedure.

CE 063 and Larger Compressors - The oil filter in each of these machines can be changed by simply isolating the filter cavities. Close the oil discharge line service valve at the oil pump (at the filter on CE126). Remove the filter cover; some foaming can occur but the check valve should limit leakage from other compressor cavities. Remove the filter, replace with new element and replace filter cover using new gasket. Reopen the valve in pump discharge line and purge air from the oil filter cavity.

When machine is operated again, the oil level should be checked to determine if oil needs to be added to maintain the proper operating level.

CAUTION

**Improper servicing of the lubrication system,
including the addition of excessive or incorrect oil, substitute quality oil filter,
or mishandling of the equipment under pressure is hazardous.
Only authorized and trained service personnel should attempt this service.
For qualified assistance, contact your local McQuay service location.**

Refrigerant Cycle

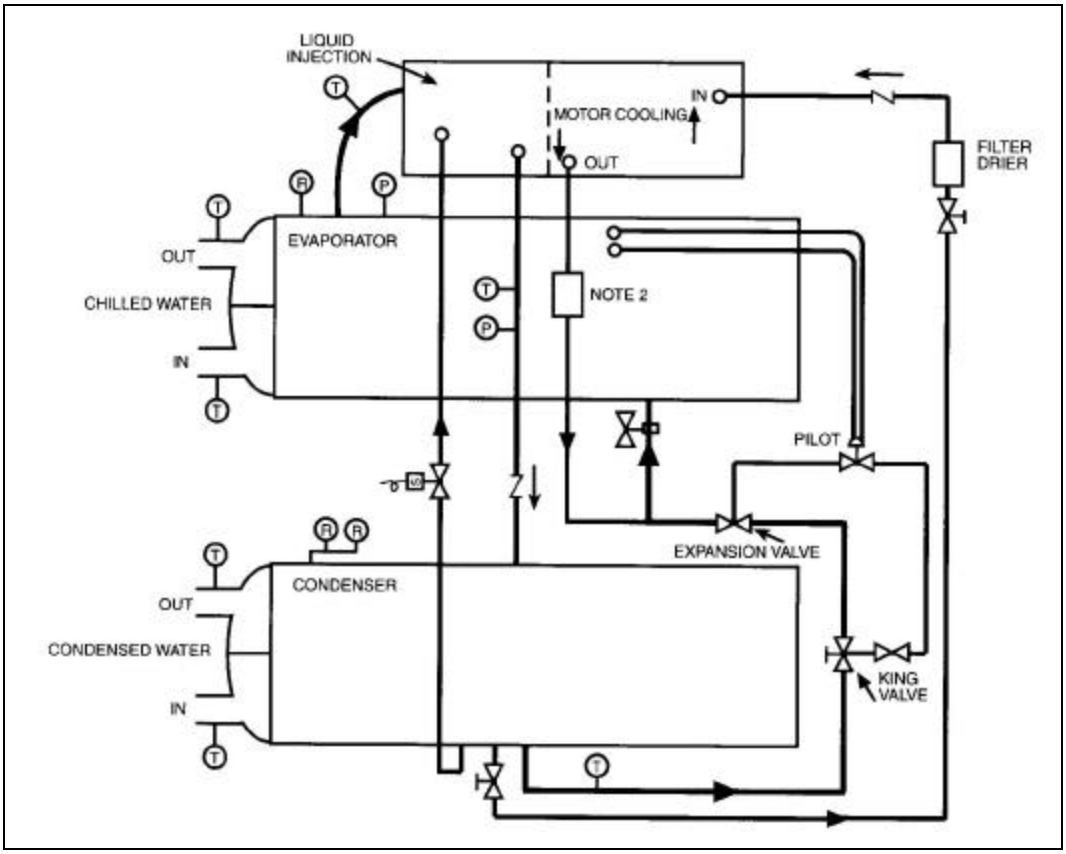
Maintenance of the refrigerant cycle consists of maintaining a log of the operating conditions, and assuring the unit has the proper oil and refrigerant charge. (See the maintenance schedule and the appropriate operating log at the end of this bulletin).

At every inspection, the oil, suction and discharge pressures should be noted and recorded, as well as condenser and chiller water temperatures.

The suction line temperature at the compressor should be taken at least once a month. Subtracting from this, the saturated temperature equivalent of the suction pressure will give the superheat. Extreme changes in subcooling and/or superheat over a period of time will indicate losses of refrigerant or possible deterioration of the expansion valves. Proper superheat setting is 0 to 1 degree F (0.5 degree C) at full load. Such a small temperature difference can be hard to measure accurately. Another method is to measure the compressor

discharge superheat, the difference between the actual discharge temperature and the saturated discharge temperature. The discharge superheat should be between 14 and 16 degrees F (8 to 9 degrees C) at full load with R-134a refrigerant. The liquid injection should be deactivated (remove relay #10) when taking the discharge temperature. The superheat will increase linearly to 55 degrees F (30 degrees C) at 10% load. The Series 200 MicroTech Control can display all superheat and subcooling temperatures.

Figure 8. Typical Refrigerant Flow Diagram



1. Connection not necessarily in correct relative location.
2. Filter on dual compressor units only.
3. Liquid injection does not apply to CE 048, 050, compressors.
4. The evaporator chilled water connections are correct for WDC 126 dual compressor units only. All other models have the chilled water inlet in the top connection.

Electrical System

Maintenance of the electrical system involves the general requirement of keeping contacts clean and connections tight and checking on specific items as follows:

1. The compressor current draw should be checked and compared to nameplate RLA value. Normally the actual current will be lower since the nameplate rating represents full load operation. Also check all pump and fan motor amperages and compare with nameplate ratings.
2. Inspection should verify that the oil heaters are operative. The heaters are insert cartridge type and can be checked by ammeter reading. They should be energized whenever power is available to the control circuit and when the compressor is inoperative). When the compressor starts the heaters are de-energized.
3. At least once a quarter, all equipment protection controls except compressor overloads should be made to operate and their operating points checked. Any control can shift its operating point as it ages, and this must be detected so the controls can be adjusted or replaced. Pump interlocks and flow switches should be checked to be sure they interrupt the control circuit when tripped.
4. The contactors in the motor starter should be inspected and cleaned quarterly. Tighten all terminal connections.

5. The compressor motor resistance to ground should be checked and logged semi-annually. This log will track insulation deterioration. A reading of 50 megohms or less indicates a possible insulation defect or moisture and should be further checked.

WARNING

Never Megger a motor while in a vacuum. Severe damage can result.

6. The centrifugal compressor must rotate in the direction indicated by the arrow on the casting near the rotation sightglass. If the operator has any reason to suspect that the power system connections may have been altered, (phases reversed) the compressor should be jogged to check rotation. For assistance, call the McQuay service location.

Cleaning and Preserving

A common cause of service calls and equipment malfunction is dirt. This can be prevented with normal maintenance. The system components most subject to dirt are:

1. Permanent or cleanable filters in the air handling equipment must be washed in accordance with the manufacturer's instructions; throwaway filters should be replaced. The frequency of this service will vary with each installation.
2. Remove and clean strainers in chilled water system, oil cooler line and condenser water system at every inspection.

Seasonal Servicing

Prior to shutdown periods and before starting up again, the following service procedures should be completed.

Annual Shutdown

Where the chiller may be subject to freezing temperatures, the condenser and chiller water piping should be disconnected and drained of all water. Dry air blown through the condenser will aid in forcing all water out. Removal of condenser heads is also recommended. The condenser and evaporator are not self-draining. Water permitted to remain in the piping and vessels will rupture these parts if subjected to freezing temperature.

Forced circulation of antifreeze through the water circuits is a sure method of avoiding freeze up.

1. Take measures to prevent the shutoff valve in the water supply line from being accidentally turned on.
2. If a cooling tower is used and if the water pump will be exposed to freezing temperatures, be sure to remove the pump drain plug and leave it out so any water that can accumulate will drain away.
3. Open the compressor disconnect switch, and remove the Fusetrons**. If the transformer is used for control voltage, the disconnect must remain on to provide power to the oil heater.** Set the manual stop/auto switch (SWI) to the stop position. To cover against the possibility of an accidental start, remove the fault relay from the left side of the MicroTech panel.
4. Check for corrosion and clean and paint rusted surfaces.
5. Clean and flush water tower for all units operating on a water tower. Make sure tower "blowdown" or bleed-off is operating. Set up and use a good maintenance program to prevent "liming up" of both tower and condenser. It should be recognized that atmospheric air contains many contaminants that increase the need for proper water treatment. The use of untreated water can result in corrosion, erosion, sliming, scaling or algae formation. It is recommended that the service of a reliable water treatment company be used. McQuay International assumes no responsibility for the results of untreated or improperly treated water.
6. Remove condenser heads at least once a year to inspect the condenser tubes and clean if required.

Annual Startup

A dangerous condition can exist if power is applied to a faulty compressor motor starter that has been burned out. This condition can exist without the knowledge of the person starting the equipment.

This is a good time to check all the motor winding resistance to ground. Semi-annual checking and recording of this resistance will provide a record of any deterioration of the winding insulation. All new units have well over 100 megohms resistance between any motor terminal and ground.

Whenever great discrepancies in readings occur or uniform readings of less than 50 megohms are obtained, the motor cover should be removed for inspection of the winding prior to starting the unit. Uniform readings of less than 5 megohms indicate motor failure is imminent and motor should be replaced or repaired. Repair before failure occurs can save a great deal of time and labor expended in the cleanup of a system after motor burnout.

1. The control circuit should be energized at all times. If the control circuit has been off and oil is cool, energize oil heaters and allow 24 hours for heater to remove refrigerant from the oil before starting.
2. Check and tighten all electrical connections.
3. Replace the drain plug in cooling tower pump if it was removed at shutdown time the previous season.
4. Install Fusetrons in main disconnect switch (if removed).
5. Reconnect water lines and turn on supply water. Flush out condenser and check for leaks.
6. Refer to Manual OM 125 before energizing the compressor circuit.

Repair of System

Pressure Relief Valve Replacement

Current condenser designs use two relief valves (1 set) separated by a three way shutoff valve. This valve allows either relief valve to be shut off, but at no time can both be shut off. In the event one of the relief valves are leaking in the two valve set, these procedures should be followed:

- If the valve closest to the valve stem is leaking, back seat the three-way valve all the way, closing the port to the leaking pressure relief valve. Remove and replace the faulty relief valve. The three-way shutoff valve should remain either fully back seated or fully forward to normal operation. If the relief valve farthest from the valve stem is leaking, front seat the three-way valve and replace the relief valve as stated above.
- The refrigerant must be pumped down into the condenser before the evaporator relief valve can be removed.

Pumping Down

If it becomes necessary to pump the system down, extreme care should be used to avoid damage to the evaporator from freezing. Always make sure that full water flow is maintained through the chiller and condenser while pumping down. To pump the system down, close all liquid line valves. With all liquid line valves closed and water flowing, start the compressor. Set the MicroTech panel to the manual load. The vanes must be open while pumping down to avoid a surge or other damaging condition. Pump the unit down until the MicroTech cuts out at approximately 20 psig. It is possible that the unit might experience a mild surge condition prior to cutout. If this should occur immediately shut off the compressor. Use a portable condensing unit to complete the pump down, condense the refrigerant, and pump it into the condenser or pumpout vessel using approved procedures.

A pressure regulating valve should always be used on the drum being used to build the system pressure. Also, do not exceed the test pressure given above. When the test pressure is reached disconnect the gas cylinder.

Pressure Testing

No pressure testing is necessary unless some damage was incurred during shipment. Damage can be determined upon a visual inspection of the exterior piping assuring no breakage occurred or fittings loosened. Service gauges should show a positive pressure. If no pressure is evident on the gauges, a leak may have occurred discharging the entire refrigerant charge. In this case, the unit should be leak tested to determine the location of the leak.

Leak Testing

In the case of loss of the entire refrigerant charge, the unit should be checked for leaks prior to charging the complete system. This can be done by charging enough refrigerant into the system to build the pressure up to approximately 10 psig (69 kPa) and adding sufficient dry nitrogen to bring the pressure up to a maximum of 125 psig (860 kPa) and then leak test with an electronic leak detector. Halide leak detectors do not function with R-134a. Water flow through the vessels should be maintained anytime refrigerant is added or removed from the system.

CAUTION

Do not use oxygen or a mixture of R-22 and air to build up pressure as a serious explosion can result.

A pressure regulating valve should always be used on the drum used to build up the system pressure. Also, do not exceed the test pressure given above. When the test pressure is reached, disconnect the gas cylinder.

If any leaks are found in welded or brazed joints or it is necessary to replace a gasket, relieve the test pressure in the system before proceeding. For copper joints, brazing is required.

After making any necessary repair, the system should be evacuated as described in the section following.

Evacuation

After it has been determined that there are no refrigerant leaks the system should be evacuated using a vacuum pump with a capacity that will reduce the vacuum to **at least 1000 microns of mercury**.

A mercury manometer, electronic or other type of micron gauge should be connected at the farthest point from the vacuum pump. For readings below 1000 microns, an electronic or other micron gauge should be used.

The triple evacuation method is recommended and is particularly helpful if the vacuum pump is unable to obtain the desired 1 millimeter of vacuum. The system is first evacuated to approximately 29 inches of mercury. Dry nitrogen is then added to the system to bring the pressure up to zero pounds.

Then the system is once again evacuated to approximately 29 inches of mercury. This is repeated three times. The first pulldown will remove about 90% of the noncondensables, the second about 90% of that remaining from the first pulldown and, after the third, only 1/10-1% noncondensables will remain.

Charging the System

WSC and WDC water chillers are leak tested at the factory and shipped with the correct charge of refrigerant as indicated on the unit nameplate. In the event the refrigerant charge was lost due to shipping damage, the system should be charged as follows after first repairing the leaks and evacuating the system.

a. Connect the refrigerant drum to the gauge port on the liquid line shutoff valve and purge the charging line between the refrigerant cylinder and the valve. Then open the valve to the mid-position.

b. Turn on both the cooling tower water pump and chilled water pump and allow water to circulate through the condenser and the chiller. (It will be necessary to manually close the condenser pump starter.)

c. If the system is under a vacuum, stand the refrigerant drum with the connection up and open the drum and break the vacuum with refrigerant gas to a saturated pressure above freezing.

d. With a system gas pressure higher than the equivalent of a freezing temperature, invert the charging cylinder and elevate the drum above the condenser. With the drum in this position, valves open, water pumps operating, liquid refrigerant will flow into the condenser. Approximately 75% of the total requirement estimated for the unit can be charged in this manner.

e. After 75% of the required charge has entered the condenser, reconnect the refrigerant drum and charging line to the service valve on the bottom of the evaporator. Again purge the connecting line, stand the drum with the connection up, and place the service valve in the open position.

IMPORTANT: At this point the charging position should be interrupted and prestart checks made before attempting to complete refrigerant charge. The compressor must not be started at this time. (Preliminary check must first be completed.)

Operation and maintenance manuals pertaining to the individual WSC or WDC unit are available from your local McQuay representative.

CAUTION

It is of utmost importance that all local, national, and international regulations concerning the handling and emission of refrigerants are observed.

Maintenance Schedule

	Monthly	Quarterly	Semi-Annually	Annually	As Required By Performance
I. Compressor					
A. Performance Evaluation (Log & Analysis) *	O				
B. Motor					
• Meg. Windings			X		
• Ampere Balance (within 10%)		X			
• Terminal Check (tight connections, porcelain clean)				X	
• Motor Cooling (check temperature)		X			
C. Lubrication System					
• Oil Lines Temperatures	O				
• Water (Refrigerant) Coolant Temperature	O				
• Oil Cooler Strainer (water)				X	
• Oil Cooler Solenoid Operation		X			
• Oil Analysis				X	
• Oil Appearance (clear color, quantity)	O				
• Oil Filter Change					X
• Oil change if indicated by oil analysis					X
D. Vane Operation					
• Compressor Loads:					
Operate Manual Switch		X			
Record Motor Amps		X			
• Compressor Unloads:					
Operate manual Switch		X			
Record Motor Amps		X			
• Vanes Will Hold (place manual switch in "hold")					
Observe Water Temp and Record Amps		X			
E. Internal Compressor Check					X
II. Controls					
A. Operating Controls					
• Check Settings and Operation			X		
• Check Vane Control Setting and Operation			X		
• Verify Motor Load Limit Control			X		
• Verify Load Balance Operation			X		
• Check Oil Pump Contactor			X		
B. Protective Controls					
• Test Operation of:					
Alarm Relay		X			
Pump Interlocks		X			
Hot and Cold Oil Temperature Cutouts		X			
Guardistor and Surgeguard Relays		X			
High and Low Pressure Cutouts		X			
High Suction Temperature Cutout		X			
High Discharge Temperature Cutout		X			
Low Pressure Override Switch		X			
Oil Pump Pressure Differential Cutout		X			
Oil Pump Safety Timer		X			
Oil Pump Time Delay		X			
Vane Closed Switch		X			

Key: O = Performed by in-house personnel X = Performed by McQuay Service personnel

Maintenance Schedule, Cont.

	Monthly	Quarterly	Semi-Annually	Annually	As Required By Performance
III. Condenser					
A. Performance Evaluation	O				
B. Test Water Quality		X			
C. Clean Condenser Tubes				X	
D. Eddycurrent Test - Tube Wall Thickness					X
E. Seasonal Protection					X
IV. Evaporator					
A. Performance Evaluation (Log Conditions And Analysis	O				
B. Test Water Quality		X			
C. Clean Evaporator Tubes (as required)					X
D. Eddycurrent Test - Tube Wall thickness (as required)					X
E. Seasonal Protection					X
V. Expansion Valves					
A. Performance Evaluation (Superheat Control)		X			
VI. Compressor - Chiller Unit					
A. Performance Evaluation	O				
B. Leak Test:					
• Compressor Fittings and Terminal		X			
• Piping Fittings		X			
• Oil Pump Joints and Fittings		X			
• Vessel Relief Valves		X			
C. Vibration Isolation Test		X			
D. General Appearance:					
• Paint				X	
• Insulation				X	
VII. Starter(s)					
A. Examine Contactors (hardware and operation)		X			
B. Verify Overload Setting and Trip		X			
C. Test Electrical Connections		X			
VIII. Optional Controls					
A. Hot Gas Bypass (verify operation)		X			
B. Liquid Injections Controls (verify operation)		X			

Key: O = Performed by in-house personnel X = Performed by McQuay Service personnel

Note: Some compressors use power factory correction capacitors and all have a surge capacitor (excepting units with solid state starters). The surge capacitor can be installed out of sight in the compressor motor terminal box. In all cases, capacitors must be disconnected from the circuit to obtain a useful Megger reading. Failure to do so will produce a low reading. In handling electrical components, only fully qualified technicians should attempt service.

Service Programs

It is important that an air conditioning system receive adequate maintenance if the full equipment life and full system benefits are to be realized.

Maintenance should be an ongoing program from the time the system is initially started. A full inspection should be made after 3 to 4 weeks of normal operation on a new installation and on a regular basis thereafter.

McQuay offers a variety of maintenance services through the local McQuay service office, its worldwide service organization, and can tailor these services to suit the needs of the building owner. Most popular among these services is the McQuay Comprehensive Maintenance Contract.

For further information concerning the many services available, contact your local McQuay service office.

Operator Schools

Training courses for Centrifugal Maintenance and Operation are held through the year at the McQuay Training Center in Verona, Virginia. The school duration is three and one-half days and includes instruction on basic refrigeration, MicroTech controls, enhancing chiller efficiency and reliability, MicroTech troubleshooting, system components, and other related subjects. Further information can be found on www .mcquay. com or call McQuay at 540-248-0711 and ask for the Training Department.

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