Installation, Operating and Maintenance Instructions

For Use With Low-Pressure Centrifugal Liquid Chillers

SAFETY CONSIDERATIONS

Refrigerant recovery devices are designed to provide safe and reliable service when operated within design specifications. When operating this equipment, use good judgment and safety precautions to avoid damage to equipment and property or injury to personnel.

Be sure you understand and follow the procedures and safety precautions contained in this guide.

⚠ DANGER

DO NOT VENT refrigerant relief valves within a building. Outlet from rupture disc or relief valve must be vented outdoors in accordance with the latest edition of ASHRAE 15 (Safety Code for Mechanical Refrigeration). The accumulation of refrigerant in an enclosed space can displace oxygen and cause asphyxiation.

PROVIDE adequate ventilation in accordance with ASHRAE 15, especially for enclosed and low overhead spaces. Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Misuse can be fatal. Vapor is heavier than air and reduces the amount of oxygen available for breathing. Product causes eye and skin irritation. Decomposition products are hazardous.

DO NOT USE OXYGEN to purge lines or to pressurize a machine for any purpose. Oxygen gas reacts violently with oil, grease, and other common substances.

NEVER EXCEED specified test pressures, VERIFY the allowable test pressure by checking the instruction literature and the design pressures on the equipment nameplate.

DO NOT USE air for leak testing. Use only tracer gases and dry nitrogen.

DO NOT VALVE OFF any safety device.

BE SURE that all pressure relief devices are properly installed and functioning before operating any machine.

⚠ WARNING

DO NOT WELD OR FLAMECUT any refrigerant line or vessel until all refrigerant *(liquid and vapor)* has been removed from chiller. Traces of vapor should be displaced with dry air or nitrogen and the work area should be well ventilated. *Refrigerant in contact with an open flame produces toxic gases.*

DO NOT USE eyebolts or eyebolt holes to rig machine sections or the entire assembly.

DO NOT work on high-voltage equipment unless you are a qualified electrician.

DO NOT WORK ON electrical components, including control panels, switches, starters, or oil heater until you are sure ALL POWER IS OFF and no residual voltage can leak from capacitors or solid-state components.

LOCK OPEN AND TAG electrical circuits during servicing. IF WORK IS INTERRUPTED, confirm that all circuits are de-energized before resuming work.

DO NOT siphon refrigerant by mouth.

AVOID SPILLING liquid refrigerant on skin or getting it into the eyes. USE SAFETY GOGGLES. Wash any spills from the skin with soap and water. If any enters the eyes, IMMEDIATELY FLUSH EYES with water and consult a physician.

NEVER APPLY an open flame or live steam to a refrigerant cylinder. Dangerous overpressure can result. When necessary to heat refrigerant, use only warm (110 F [43 C]) water.

DO NOT REUSE disposable (nonreturnable) cylinders or attempt to refill them. It is DANGEROUS AND ILLEGAL. When cylinder is emptied, evacuate remaining gas pressure, loosen the collar and unscrew and discard the valve stem. DO NOT INCINERATE.

CHECK THE REFRIGERANT TYPE before adding refrigerant to the machine. The introduction of the wrong refrigerant can cause damage or malfunction to this machine.

Operation of this equipment with refrigerants other than those cited herein should comply with ASHRAE-15 (latest edition). Contact Carrier for further information on use of this machine with other refrigerants.

DO NOT ATTEMPT TO REMOVE fittings, covers, etc., while machine is under pressure or while machine is running. Be sure pressure is at 0 psig (0 kPa) before breaking any refrigerant connection.

CAREFULLY INSPECT all relief devices, rupture discs, and other relief devices AT LEAST ONCE A YEAR. If machine operates in a corrosive atmosphere, inspect the devices at more frequent intervals.

DO NOT ATTEMPT TO REPAIR OR RECONDITION any relief device when corrosion or build-up of foreign material (rust, dirt, scale, etc.) is found within the valve body or mechanism. Replace the device.

DO NOT install relief devices in series or backwards.

USE CARE when working near or in line with a compressed spring. Sudden release of the spring can cause it and objects in its path to act as projectiles.

⚠ CAUTION

DO NOT STEP on refrigerant lines. Broken lines can whip about and cause personal injury.

DO NOT climb over a machine. Use platform, catwalk, or staging. Follow safe practices when using ladders.

USE MECHANICAL EQUIPMENT (crane, hoist, etc.) to lift or move inspection covers or other heavy components. Even if components are light, use such equipment when there is a risk of slipping or losing your balance.

BE AWARE that certain automatic start arrangements CAN ENGAGE THE STARTER. Open the disconnect *ahead of* the starter in addition to shutting off the machine or pump.

USE only repair or replacement parts that meet the code requirements of the original equipment.

DOUBLE-CHECK that coupling nut wrenches, dial indicators, or other items have been removed before rotating any shafts.

DO NOT LOOSEN a packing gland nut before checking that the nut has a positive thread engagement.

PERIODICALLY INSPECT all valves, fittings, and piping for corrosion, rust, leaks, or damage.

CONTENTS

INTRODUCTION

The 19QA Refrigerant Management System (RMS) has been designed to help owners and operators of centrifugal chillers conserve low pressure refrigerants and prevent the release of excessive amounts of refrigerant into the atmosphere. The proper use of this equipment will minimize the loss of CFCs and HCFCs. The 19QA will also recycle refrigerant contaminated with water, oil, or acid. See Fig. 1 and Table 1 for component information.

The 19QA is ARI (Air Conditioning & Refrigeration Institute) certified as a refrigerant recovery/recycling device and is registered with ETL (Electrical Testing Laboratory) for safety. The Refrigerant Management System's storage tanks are rated for 20, 30, or 40 cu ft (.57, .85, 1.13 cu meters). See Table 2. Casters are available as an option on all storage tanks. See Fig. 1-3. See Fig. 4 and 5 for additional RMS component descriptions and dimensions.

Table 1 — Interconnecting Refrigerant Hoses, Valves, and Fittings

NUMBER	PART NUMBER	PART
1	KA73PS003	3 ft (.91 m) Hose
2	KA73PS006	6 ft (1.88 m) Hose
1	KA73PS012	12 ft (3.66 m) hose
1	19QA020-152	Liquid Indicator
8	19QA020-132	Valve and Coupler
1	19QA015-142	Chiller Vapor Valve

NOTE: Refer to Fig. 1 for model number description and accessory caster package part numbers.

INSTALLATION

Complete Pre-Installation Checks

IDENTIFY UNIT — Identify the model number and serial number printed on the nameplate. Check this information against the job requirements.

INSPECT SHIPMENT — Inspect unit for damage before removing unit from shipping conveyance. If unit appears damaged, it should be inspected by a shipping inspector before removal. File claim with shipping company if shipment is damaged or incomplete. The manufacturer is not responsible for damage incurred during transit.

Check all components. Notify the supplier immediately if any item is missing. To prevent loss or damage, leave all parts in their original package until they are needed.

Make Piping Connections — All connections between the pump, tube-in-tube condenser, storage tank, and chiller can be made using the factory supplied refrigerant hoses. A hand valve with coupler is factory supplied, but must be field installed at each end of the 4 hoses. See Fig. 5. Field supplied copper tubing and valve manifolds must be used if a permanent installation is required.

The 19QA is factory equipped with a dual relief valve assembly. See Fig. 4. The outlet of the valves is 1-1/2 in. MPT. Vent the dual relief assembly outdoors in accordance with ASHRAE 15 (Safety Code for Mechanical Refrigeration), latest edition, and all applicable local codes. Use a minimum 1-1/2 in. pipe for the relief valve outlet. Provide fittings so vent piping can be disconnected periodically for inspection and testing of valves.

Cover the outdoor vent with a rain cap and place a field supplied condensate drain at the low point in vent piping to prevent water build up on the atmospheric side of the valve.

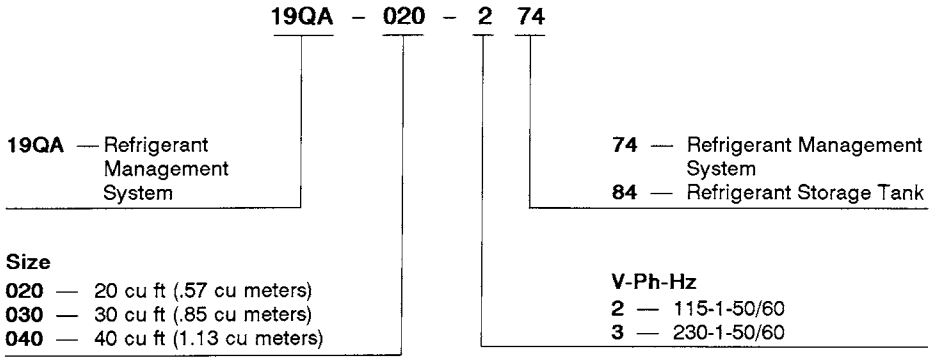
Make Electrical Connections — The 19QA has 2 electrical cords. See Table 3 and Fig. 6. One electrical cord is attached to the pump and the other is attached to the storage tank heater. If both electrical cords are used at the same time, separate outlets are required. Connect electrical power in accordance with minimum circuit amps (MCA) and maximum overcurrent protection amps (MOCP) as specified on the unit nameplate. Be sure that the unit is connected and grounded in accordance with all applicable electrical codes.

Optional Caster Installation — If optional casters have been provided, bolt the 4 caster assemblies to the storage tank. See Fig. 1-3. Size 020 and 030 storage tanks have 2 rigid casters mounted on one end of the tank and 2 swivel casters with brakes mounted on the other end of the storage tank. The size 040 storage tanks have 2 swivel casters with brakes mounted on one end of the storage tank and 2 swivel casters with locks mounted on the other end of the storage tank.

Table 2 — Physical Data

19QA	ENGLISH				SI			
	Size	020	030	040	Size	020	030	040
DRY WEIGHT OF RMS	lb	740	841	942	kg	336	382	428
DRY WEIGHT OF RST	lb	495	546	586	kg	225	248	266
TANK SIZE	cu ft	20	30	40	cu m	.57	.85	1.13
TANK STORAGE CAPACITY CFC-11 Liquid	lb	1600	2450	3300	kg	727	1114	1500
DESIGN PRESSURE	psig	15			kPa	103		
MAX. OPERATING PRESSURE	psig	10			kPa	69		
CONNECTION SIZES	in.	½ Flare			in.	½ Flare		
HIGH-PRESSURE SWITCHES Tank Heater and Pump Cutout Manual Reset	 psig psig	 10 <4			 kPa kPa	 69 <28		
PUMP Motor Hp		¾				¾		
Max. Discharge Pressure	psig	10			kPa	69		
Min. Vacuum (Gage)	in. Hg	29			kPa	−98		
Flow Rate 60 Hz 50 Hz	cfm	 10.5 8.8			L/s	 4.96 4.16		

RMS — Refrigerant Management System
RST — Refrigerant Storage Tank

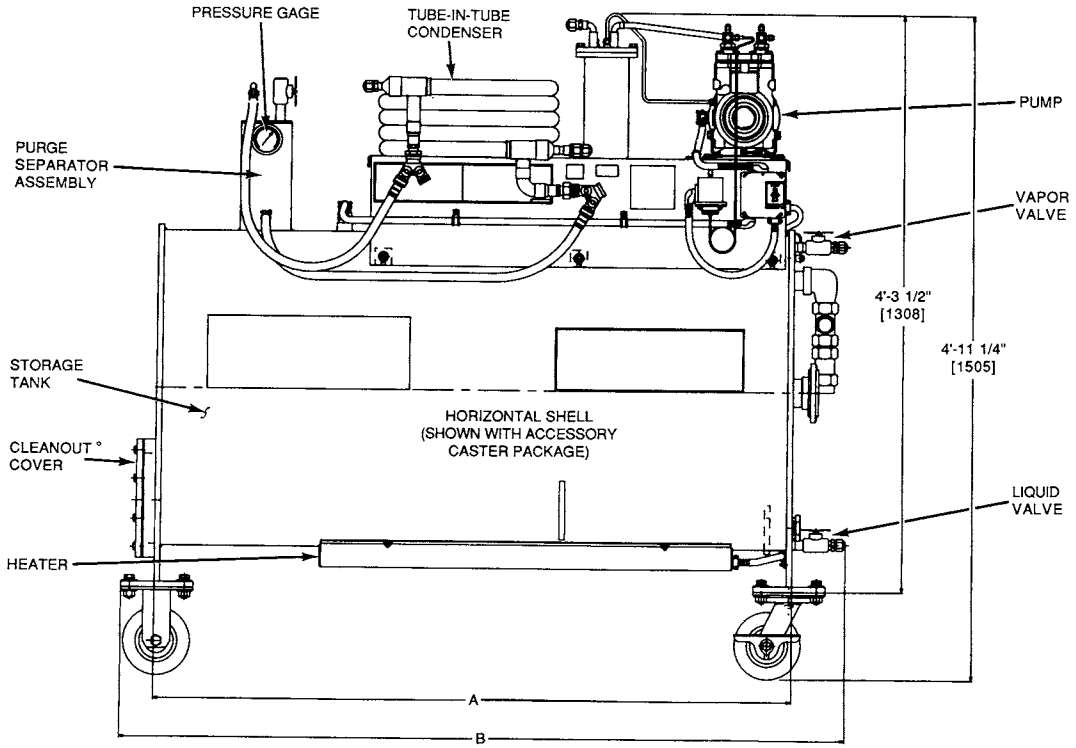


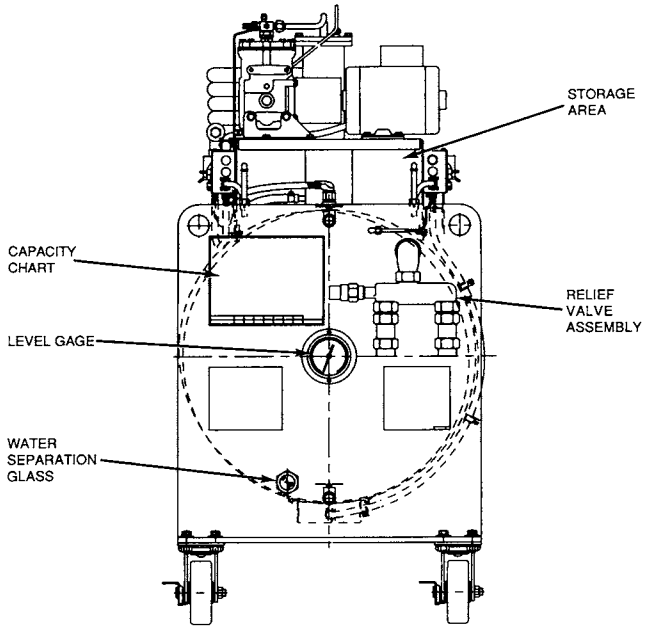
NOTE: Accessory caster packages are available for use with the 19QA. Refer to the following table for specific part numbers.

ACCESSORY CASTER PACKAGE PART NUMBER	RMS/RST SIZE
19QA 020 213	020
19QA 030 213	030
19QA 040 213	040

RMS — Refrigerant Management System
RST — Refrigerant Storage Tank

Fig. 1 — Model Number Description

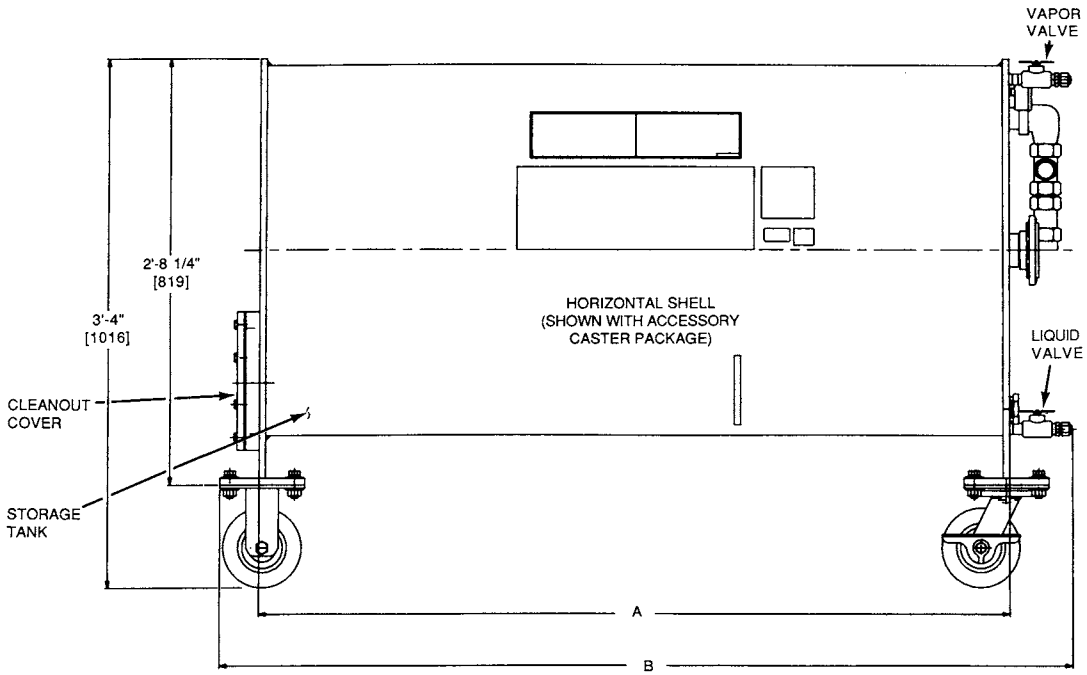


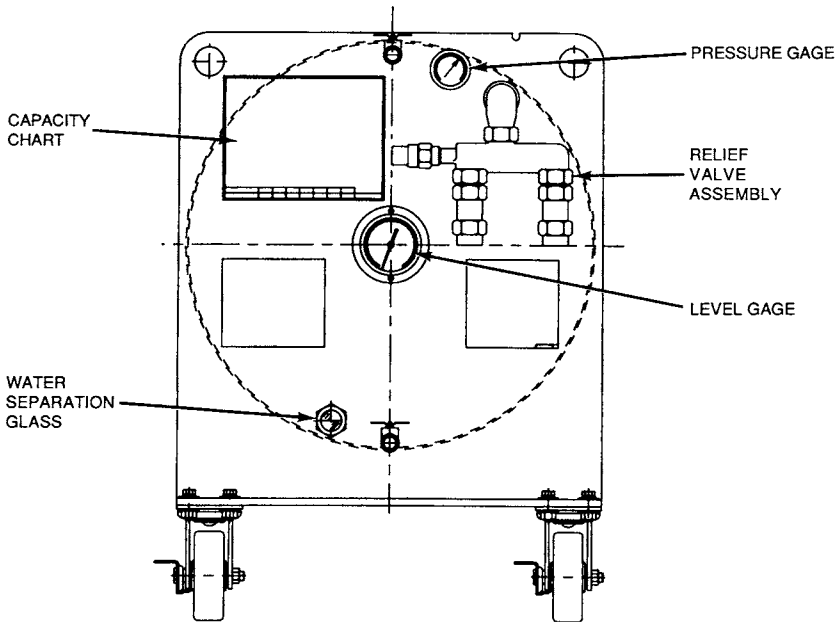


UNIT SIZE	A	B	WEIGHT EMPTY		MAXIMUM REFRIGERANT CHARGE		ACCESSORY CASTERS	
			lbs	kg	lbs	kg	lbs	kg
19QA020	4′-9″ [1448]	5′-4⅞″ [1648]	740	336	1600	727	34	15
19QA030	7′-3″ [2209]	7′-10⅞″ [2410]	841	382	2450	1114	48	22
19QA040	9′-9″ [2972]	10′-4⅞″ [3172]	942	428	3300	1500	62	28

NOTE: Dimensions in [ ] are in mm.

Fig. 2 – 19QA Refrigerant Management System Dimensions

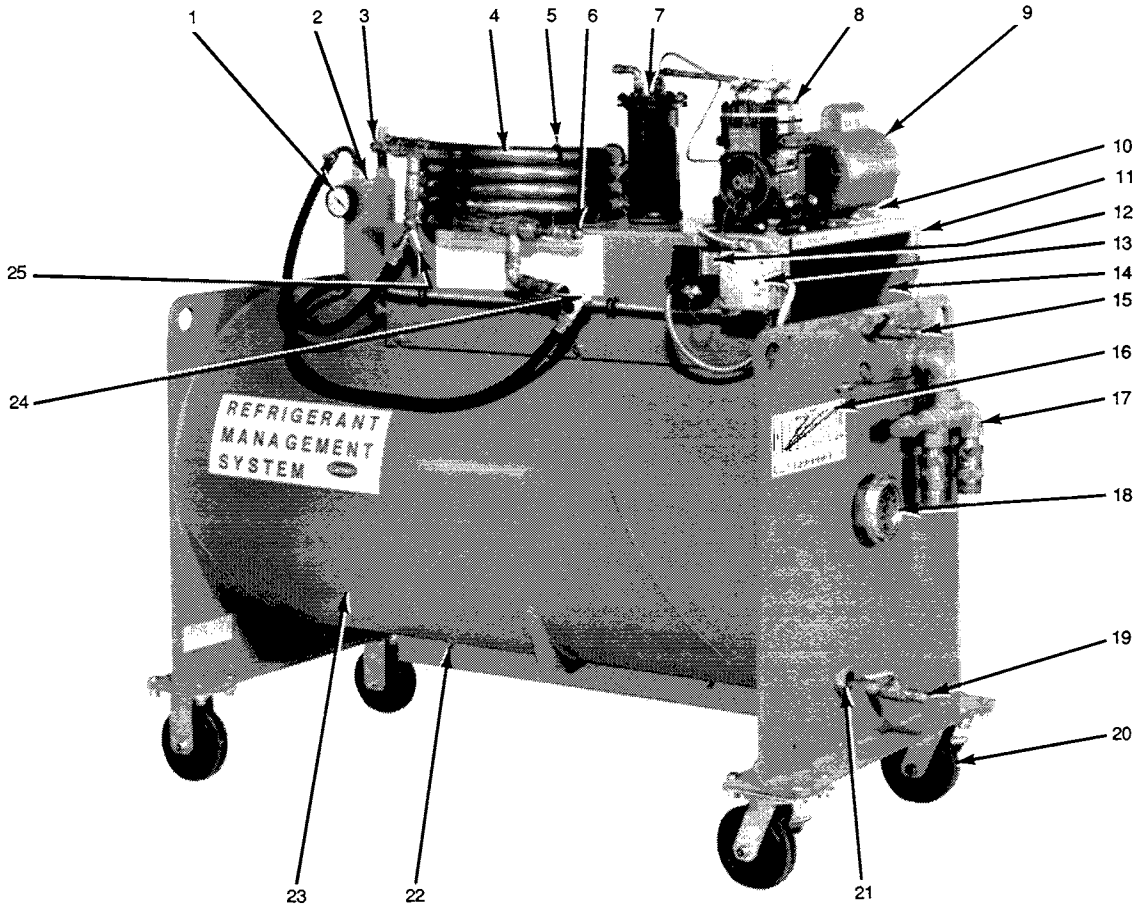




UNIT SIZE	A	B	WEIGHT EMPTY		MAXIMUM REFRIGERANT CHARGE		ACCESSORY CASTERS	
			lbs	kg	lbs	kg	lbs	kg
19QA020	4′-9″ [1448]	5′-4⅞″ [1648]	495	225	1600	727	34	15
19QA030	7′-3″ [2209]	7′-10⅞″ [2410]	546	248	2450	1114	48	22
19QA040	9′-9″ [2972]	10′-4⅞″ [3172]	586	266	3300	1500	62	28

NOTE: Dimensions in [ ] are in mm.

Fig. 3 – 19QA Refrigerant Storage Tank Dimensions



NO.	ITEM
1	— Pressure Gage
2	— Purge Separator Assembly
3	— Refrigerant (Vapor) In
4	— Tube-in-Tube Condenser
5	— Filter Drier ½ SAE Flare (Hidden)
6	— Refrigerant (Liquid) Out
7	— Oil Separator
8	— Pump
9	— Pump Motor
10	— Heater High-Pressure Cutout Switch (Hidden)
11	— Heater ON/OFF Switch (Hidden)
12	— Pump High-Pressure Cutout Switch
13	— Pump ON/OFF Switch
14	— Storage Area Components Included: Refrigerant Hose, 3 ft Refrigerant Hose, 6 ft (2) Refrigerant Hose, 12 ft Valve With Coupler (8) Chiller Vapor Valve Liquid Indicator With Coupler
15	— Vapor Valve
16	— Refrigerant Capacity Chart
17	— Relief Valve Assembly
18	— Level Gage
19	— Liquid Valve
20	— Accessory Casters (Available On All Tank Sizes)
21	— Water Separation Sight Glass
22	— Heater With Cover
23	— Storage Tank
24	— Water In
25	— Water Out

Fig. 4 — 19QA Refrigerant Management System Components

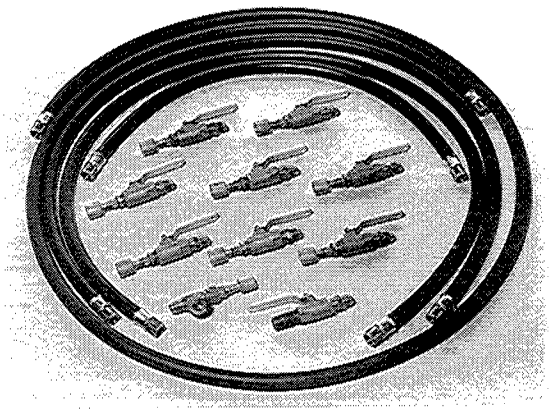


Fig. 5 — Interconnecting Refrigerant Hoses, Valves, and Fittings

Table 3 — Electrical Data

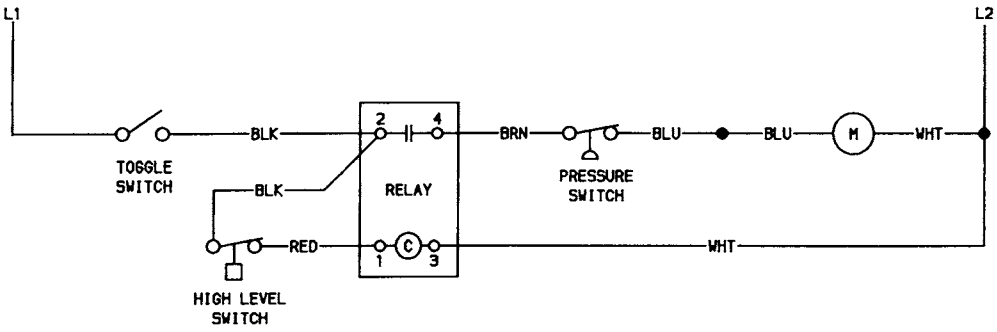
VOLTS-PH-HZ	115-1-50	115-1-60	230-1-50	230-1-60
PUMP MOTOR				
Hp	¾	¾	¾	¾
Amps	9.6	8.6	4.8	4.3
MCA	10	10	5	5
HEATER				
Amps	12	12	6	6
MCA	12	12	11	11
MOCP	15*	15*	15	15

LEGEND

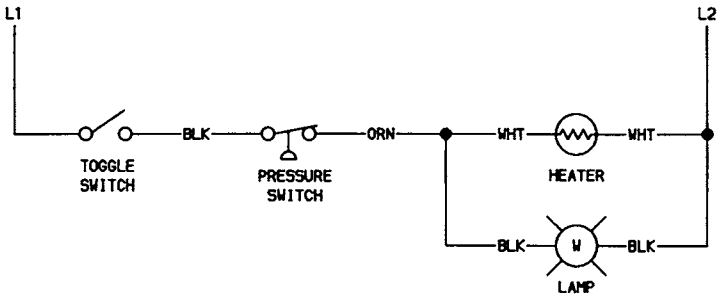
MCA — Minimum Circuit Amps
MOCP — Maximum Overcurrent Protection (Amps)

*Two circuits required for simultaneous operation.

NOTE: Use time-delay fuses.



MOTOR WIRING SCHEMATIC



HEATER WIRING SCHEMATIC

NOTE: The 115 and 230 v control wiring are identical.

Fig. 6 — Typical Control Wiring Schematic

CONTROLS AND COMPONENTS

Pump and Motor — The pump is designed for vacuum and pressure duty. The pump is splash lubricated and operates in conjunction with an oil separator. It is directly coupled to and driven by a 3/4-hp motor. The coupling between the pump and motor has a rubber insert to compensate for slight misalignment. Start and stop the pump by using the toggle switch located next to the pump. A tank pressure switch set at 10 psig (69 kPa) and a tank level switch set 90% full will shut off the pump if either limit is reached. See Table 1 for additional information on the pump and motor.

Oil Separator — The oil separator removes the oil that is mixed with the discharge gas leaving the pump. The differential pressure between the oil separator and the pump crankcase returns the oil to the pump through the float valve in the oil separator when the specified oil level is achieved in the oil separator.

Heater — A 1500 watt, etched-foil, electric heater is attached to the bottom of the storage tank. See Fig. 2. The heater is encased in an insulated protective cover and is controlled by a toggle switch.

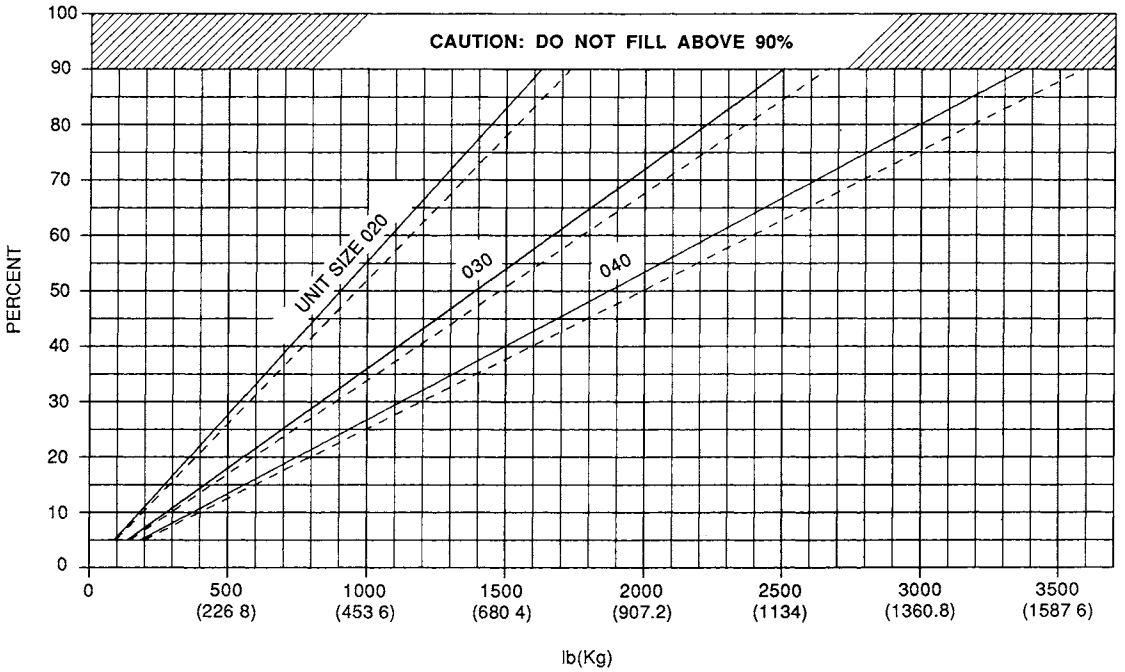
Use the heater when refrigerant recycling by distillation is necessary. When the heater toggle switch is in the ON position, the indicating light, located next to the toggle switch, will be lit. A pressure switch will shut off the heater if the tank pressure reaches 10 psig (69 kPa) when heating refrigerant.

Tube-in-Tube Condenser — A tube-in-tube condenser allows refrigerant vapor to be condensed when removing vapor from a chiller or when distilling refrigerant. Garden hose connections (3/4 in.) are provided for condensing water. Condensing water temperature should be as low as possible to minimize the time required to complete an operation. A water flow rate of 2 gpm (.012 L/s) at 70 F (21 C) is normally adequate.

Level Gage — A geared, float level gage displays the storage tank's percentage of full capacity of liquid refrigerant. The actual level of refrigerant will vary based upon temperature and the type of refrigerant used. See Fig. 4 and 7.

Water Separation Sight Glass — A water separation sight glass is located above the liquid valve. Use the water separation sight glass to view the refrigerant/water interface when separating water from the refrigerant. See Fig. 4.

Purge Separator Assembly — Use the manual hand valve on the purge separator assembly to remove noncondensable gases that may accumulate in the storage tank during vapor recovery. The purge separator assembly contains a water coil, 1/16-in. orifice, and 1/2-in. ball valve. The bottom of the purge separator assembly opens into the storage tank. See Fig. 8.



CFC-11 or HCFC-123 ———
CFC-113 – – – –

This graph is based on 70 F The following multipliers may be used to more accurately determine weights at temperatures other than 70 F

TEMPERATURE F (C)	40 (4.4)	50 (10)	60 (15 5)	70 (21.1)	80 (26.6)	90 (32 2)	100 (37 7)
MULTIPLIER	1 026	1 018	1 009	1 000	991	982	973

Fig. 7 — Storage Tank Capacity

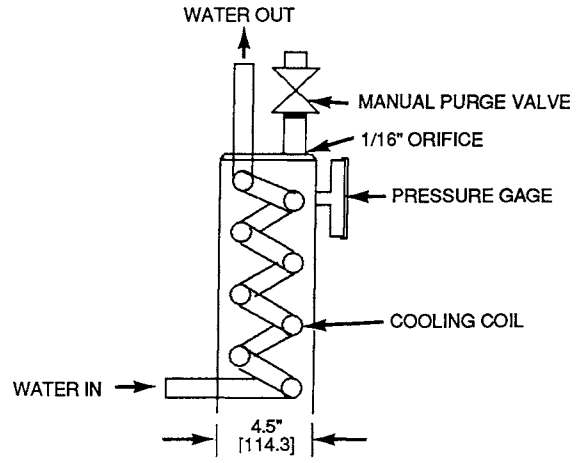
Refrigerant Hoses — Four, 1/2-in. refrigerant hoses and 8 ball valves with couplers are factory supplied with the RMS unit. See Table 1. The refrigerant hoses are used to transfer liquid and vapor through the Refrigerant Management System. They are designed to withstand high vacuum pressure without collapsing.

When used with the refrigerant hoses, the ball valve and coupler assembly prevent refrigerant loss. Connect the ball valve and coupler assembly to each end of the 4 refrigerant hoses. Hand tighten the ball valve and coupler assembly to the refrigerant hose. The ball valve and coupler assembly connect to the RMS unit or chiller, depending upon the type of operation. The coupler should be hand tightened to the RMS unit or chiller. Excessive tightening will damage the rubber gaskets.

Liquid Indicator — The 1/2 in. liquid indicator (in line sight glass) is factory supplied. Use the liquid indicator during either the liquid refrigerant transfer or the vapor condensing process to determine the end point of the process. When liquid is no longer visible in the glass, the process is almost complete.

Filter Drier — The filter drier should be used to recycle refrigerant. Use the factory supplied filter drier when removing moisture and small particles from the refrigerant. The filter drier is most effective when used with liquid refrigerant. The filter drier holds approximately .39 oz (11 g) of water. See Table 4.

When cleaning large quantities of saturated refrigerant, use a field supplied, replaceable core filter drier assembly. The assembly should have four, 100 $in.^3$ cores. It will remove approximately 4.2 oz (118 g) of water.



NOTE: [ ] indicates millimeters

Fig. 8 — Purge Separator Assembly

Table 4 — Water Solubility in Refrigerant

REFRIGERANT TYPE	TEMPERATURE	SOLUBILITY OF WATER IN REFRIGERANT (ppm)	GRAMS OF WATER PER 1000 LB	OZ
CFC-11, CFC-113, [HCFC-123]	60 F (16 C)	70 [660]	32 [303]	1.13 [10.7]
	70 F (21 C)	90 [770]	41 [349]	1.15 [12.3]
	80 F (27 C)	113 [900]	51 [408]	1 80 [14.4]
	90 F (32 C)	140 [1000]	64 [453]	2.26 [16 0]

LEGEND

ppm — Parts Per Million

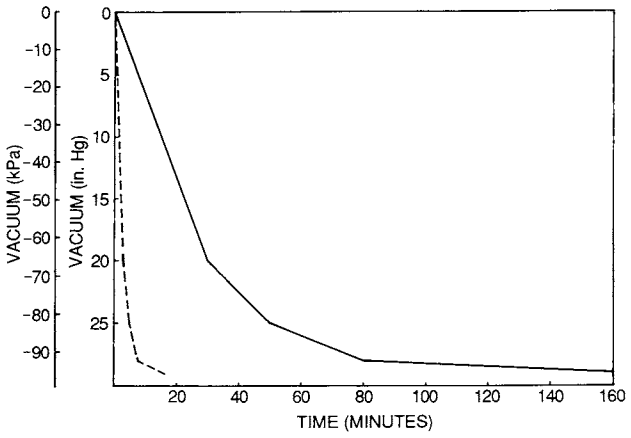
NOTE: [ ] indicates HCFC-123 refrigerant

OPERATION

Evacuation — To minimize refrigerant loss, air must not be allowed to mix with the refrigerant vapor. All spaces that could contain refrigerant (such as chillers, storage tanks, and refrigerant hoses) must be completely evacuated before charging the RMS with refrigerant.

To evacuate air from the storage tank or chiller, connect the suction service valve of the pump to a vapor valve on the storage tank or chiller using the shortest possible 1/2-in. diameter refrigerant hose. Use of hoses or fittings smaller than 1/2 in. diameter will greatly increase the time required to pull a complete vacuum of 29 in. Hg (25 mm Hg absolute). Refer to Table 5 for additional information. See Fig. 9.

Once the connections are made, turn on the pump and discharge the air into the atmosphere.



NOTE: A 29 in. Hg vacuum (25 mm Hg absolute) may be obtained at a rate of approximately 1 minute per cu ft of volume.

Fig. 9 — Evacuation of Chiller and Storage Tank

Liquid Refrigerant Transfer

⚠ CAUTION

To prevent release of refrigerant from the dual relief valve assembly due to expansion, the storage tank must not be filled above 90% full at 90 F (32 C).

The storage tank is 90% full when the level gage is reading 100%. See Fig. 7.

BEFORE TRANSFERRING LIQUID REFRIGERANT — Before using the pump for liquid or vapor transfer, run the pump using air only for approximately 15 minutes. Running the pump on air will allow it to achieve a normal operating temperature of 120 F (49 C). If refrigerant is used when the pump is cold, excessive amounts of refrigerant will be absorbed into the oil, causing dilution of the oil. This condition may cause oil loss and shorten the life of the pump.

⚠ WARNING

Do not connect the pump suction service valve directly to a liquid refrigerant source. Liquid refrigerant will cause damage to the pump.

Use the same process when transferring liquid refrigerant from the chiller to the storage tank or from the storage tank to the chiller. Completely evacuate any vessel that will have refrigerant transferred to it.

⚠ WARNING

Do not transfer liquid refrigerant into an evacuated chiller that contains water in the cooler tubes. Freezing water will cause the cooler tubes to rupture.

NOTE: Make sure the ball valve and coupler assembly are connected to all refrigerant hoses.

Prior to transferring liquid refrigerant from the storage vessel to the chiller, make sure all water is completely drained from the cooler tubes or raise the chiller pressure by using refrigerant gas (24 in. Hg [−81 kPa] for CFC-113, 18 in. Hg [−61 kPa] for HCFC-123, and 15 in. Hg [−51 kPa] for CFC-11).

TO TRANSFER LIQUID REFRIGERANT

Storage Tank to Chiller — To transfer liquid refrigerant from the storage tank to the chiller, connect a 6-ft refrigerant hose from the liquid valve on the storage tank to the chiller charging valve. Install the liquid indicator on the refrigerant hose. See Fig. 10. Connect a 12-ft refrigerant hose to the vapor service valve on the chiller and the suction service valve on the pump. Copper tubing is factory installed from the pump to the oil separator. Connect another 6-ft refrigerant hose from the discharge connection on the oil separator to the vapor valve on the storage tank. Open the liquid valve on the storage tank, the charging valve on the chiller, and the two interconnecting hose valves.

Once liquid refrigerant enters the chiller, open the chiller vapor valve, the storage tank vapor valve, all valves between the chiller vapor valve and the storage tank vapor valve. Turn on the pump. The pump will remove refrigerant gas from the chiller and discharge it into the storage tank. This will create a pressure differential between the chiller and the storage tank and provide the specified flow rate.

The end of the liquid refrigerant transfer can be determined by observing the liquid indicator. When liquid is no longer visible, the transfer is complete. Close the liquid valve on the chiller and turn off the pump.

Chiller to Storage Tank — To transfer liquid refrigerant from the chiller to the storage tank, connect a 6-ft refrigerant hose from the storage tank liquid valve to the chiller charging valve. Install the liquid indicator to determine when liquid transfer is complete. Connect a 12-ft refrigerant hose to the vapor service valve on the chiller and the suction service valve on the pump. Copper tubing is factory installed from the pump to the oil separator. Connect another 6-ft refrigerant hose from the discharge connection on the oil separator to the vapor valve on the chiller. Open the charging valve on the chiller, the liquid valve on the storage tank, and the two interconnecting hose valves.

Once liquid refrigerant enters the storage tank, open the storage tank vapor valve, chiller vapor valve, and all valves between the storage tank vapor valve and chiller vapor valve. Turn on the pump. The pump will remove refrigerant gas from the storage tank and discharge it into the chiller. This will create a pressure differential between the storage tank and provide the specified flow rate.

The end of the liquid refrigerant transfer can be determined by observing the liquid indicator. When liquid is no longer visible, the transfer is complete. Close the bottom valve on the chiller and turn off the pump.

Refrigerant Vapor Transfer

⚠ WARNING

If the required vacuum level cannot be reached due to the presence of a large leak in the chiller, the vapor recovery process should be stopped. The constant infiltration of air into the chiller may contaminate the refrigerant.

Refrigerant vapor recovery is required after the liquid refrigerant has been removed. Most refrigerant vapor can be recovered by evacuating the chiller or storage tank and condensing the vapor. The United States EPA requires the evacuation level for low pressure chillers to be 29 in. Hg (25 mm Hg absolute). Refer to Table 5 for additional information.

Before using the pump for vapor recovery, make sure it is at the correct operating temperature of 120 F (49 C). This can be achieved by running the pump on air only for approximately 15 minutes. If the pump is operating below operating temperature with refrigerant, excessive amounts of refrigerant will be absorbed into the oil, causing dilution of the oil. This condition may cause reduced vacuum capability and may shorten the life of the pump.

NOTE: If oil dilution is affecting the pump's ability to achieve 29 in. Hg (25 mm Hg absolute), an oil change may be required. See the Maintenance section on page 15.

BEFORE TRANSFERRING REFRIGERANT VAPOR — When transferring refrigerant vapor from a chiller to a storage tank, connect the 12-ft refrigerant hose from the vapor valve on the chiller to the suction service valve on the pump. See Fig. 11. Copper tubing is factory installed from the pump to the oil separator. Connect a 6-ft refrigerant hose from the discharge connection of the oil separator to the inlet of the tube-in-tube condenser. See Fig. 4 for location. Connect another 6-ft refrigerant hose from the refrigerant outlet of the tube-in-tube condenser to the vapor valve on the storage tank. See Fig. 4. Close the bottom valve on the chiller and turn off the pump. The tube-in-tube condenser must be evacuated before starting this process.

The tube-in-tube condenser must be evacuated. Make sure all refrigerant hose valves are closed. Remove the refrigerant hose end connected to the pump suction service valve. Remove the refrigerant hose end connected to the top valve on the storage tank and connect it to the pump suction service valve. Close the pump discharge service valve and remove the 1/4-in. cap on top of the pump discharge service valve. Open all valves between the suction and discharge service valves of the pump. Turn on the pump for about 5 seconds to evacuate the tube-in-tube condenser. The air will be discharged through the 1/4 in. discharge port on the pump discharge service valve. Once the evacuation is complete, reconnect the refrigerant hoses to their original connections. Replace the 1/4-in. cap on the pump discharge service valve. Open the pump discharge service valve.

Connect a water hose to the water inlet connection (located on the bottom of the tube-in-tube condenser) and the other water hose to the water outlet connection (located on top of the tube-in-tube condenser). A water flow rate of approximately 2 gpm (.012 L/s) is required at 70 F (21 C).

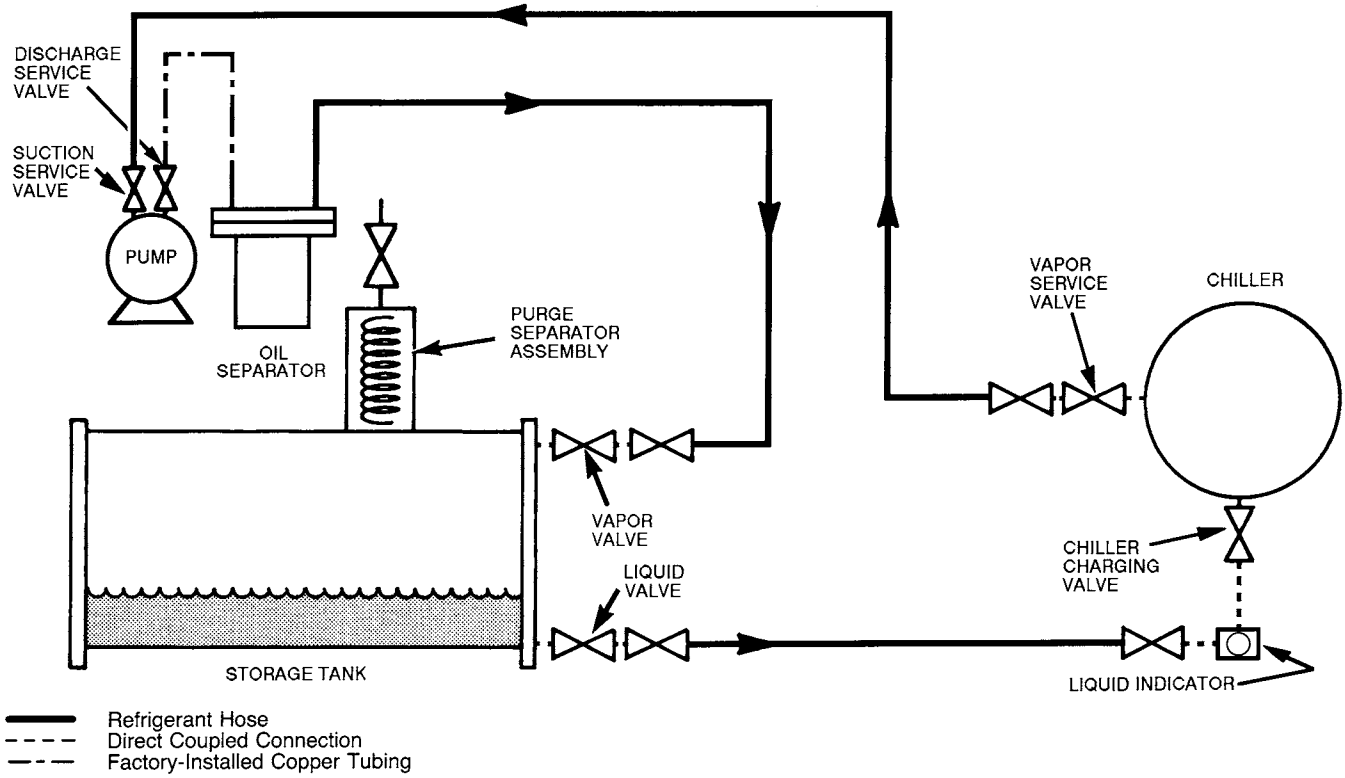


Fig. 10 — Liquid Refrigerant Transfer (From Storage Tank to Chiller)

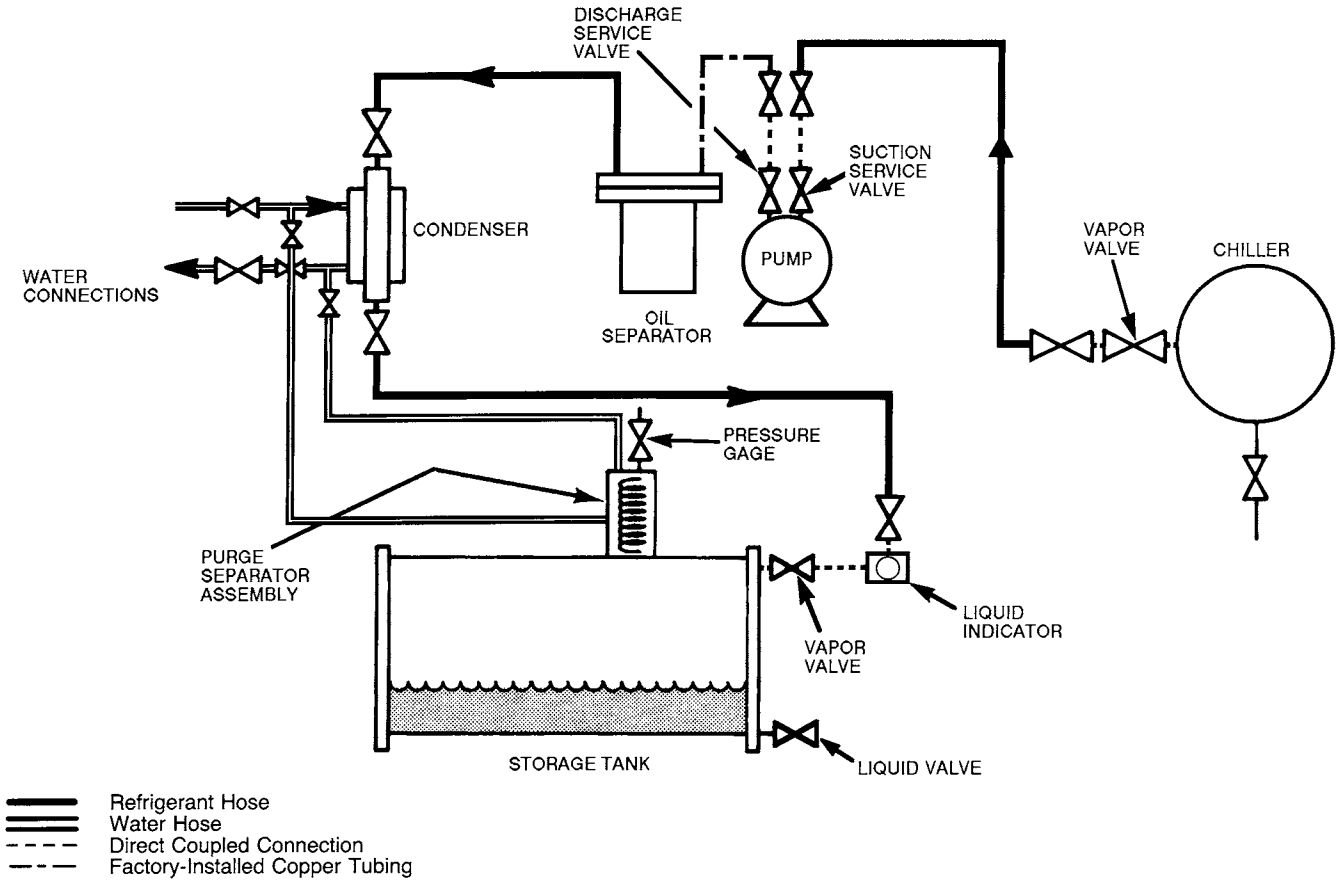


Fig. 11 – Refrigerant Vapor Transfer/Evacuation Connections

TO TRANSFER REFRIGERANT — Open all valves between the chiller and storage tank. Turn on the water to the tube-in-tube condenser. Turn on the pump. After a few minutes, the condensed vapor will be seen in its liquid form flowing through the liquid indicator to the storage tank. The end of the vapor transfer can be determined by observing the liquid indicator. When liquid is no longer visible, the transfer is complete.

⚠ CAUTION

Be sure to run the chiller water pumps when removing refrigerant vapor. Trapped liquid may boil and can cause tube freeze-up.

The vapor recovery process is complete when the vacuum in the chiller has reached 29 in. Hg (25 mm Hg). Before turning off the pump, shut off the water to the tube-in-tube condenser and then drain the water from the condenser. As the condenser warms up, it will help drain any liquid remaining in the condenser and refrigerant hose into the storage tank. Turn off the pump. Close the valves to the storage tank and chiller. Disconnect the refrigerant hoses. Any refrigerant vapor remaining in the refrigerant hoses and the tube-in-tube condenser are considered to be de minimis. See Fig. 12.

Use the same process when transferring vapor refrigerant from the storage tank to the chiller.

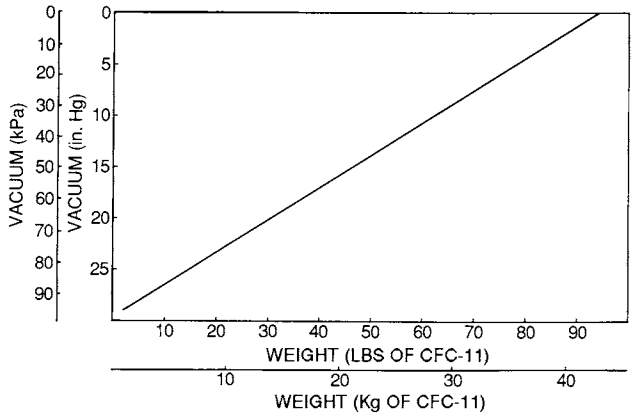


Fig. 12 – Refrigerant Vapor Remaining in Chiller After Removal of Liquid Refrigerant (400 Ton Unit)

Purge Separator Assembly — A purge separator assembly is used to remove noncondensable gases that may be mixed with the refrigerant being recovered. See Fig. 4. If vapor is being recovered from a leaking chiller, air will enter the machine. The air will mix with the refrigerant gas and collect in the storage tank. The air will raise the pressure of the storage tank until the pressure reaches 10 psig (69 kPa). At this point, the high pressure cutout switch will turn off the pump. To avoid this situation, a purge separator assembly is factory installed. See Fig. 8.

During the vapor recovery process, the pressure in the storage tank should not be higher than the corresponding pressure/temperature relationship for a given refrigerant, based on ambient conditions. If the room temperature is approximately 75 F (24 C) and CFC-11 is being recovered, the pressure in the storage tank should be approximately 0 psig (0 kPag). If the pressure is higher than 0 psig (0 kPag), a noncondensable gas is present in the storage tank. See Table 5.

A pressure gage is mounted on top of the purge separator assembly. When the pressure reaches 8 psig (55 kPag) and the pressure/temperature relationship shows this as excessive, the purge valve on top of the purge separator assembly should be opened to remove the noncondensable gas. See Fig. 4. Based on the ambient temperature, the purge separator assembly should be operated until the saturated pressure is achieved. If the ambient temperature is 75 F (24 C), the purge valve should be opened until the storage tank pressure reaches 0 psig (0 kPa).

Oil Separation — The refrigerant management system separates oil from refrigerant through distillation. The refrigerant can be transferred from the chiller to the storage tank and then distilled back to the chiller or another storage tank.

Connect the 3-ft refrigerant hose from the storage tank vapor valve to the pump suction service valve. See Fig. 13. Copper tubing is factory installed from the pump to the oil separator. Connect the 6-ft refrigerant hose from the oil separator discharge connection to the top connection on the tube-in-tube condenser. Connect the 12-ft refrigerant hose with the liquid indicator to the refrigerant outlet connection on the condenser and to the chiller charging valve or another storage tank. Provide water at approximately 2 gpm (.012 L/s) and a maximum temperature of 70 F (21 C) to the tube-in-tube condenser using suitable water hoses. Turn on the pump and heater using the toggle switches provided. If the distilled refrigerant is being returned to the chiller, run cool water through the evaporator heat exchanger. Approximately 1.2 lb per minute (.54 kg per minute) of CFC-11 can be distilled per hour. When liquid refrigerant is no longer seen in the liquid indicator, the distillation process is complete.

After the distillation process is complete, the oil remaining in the bottom of the storage tank should be drained using the liquid valve on the storage tank. After the oil is drained, the tank can be wiped clean by opening the access cover located on the opposite end of the level gage.

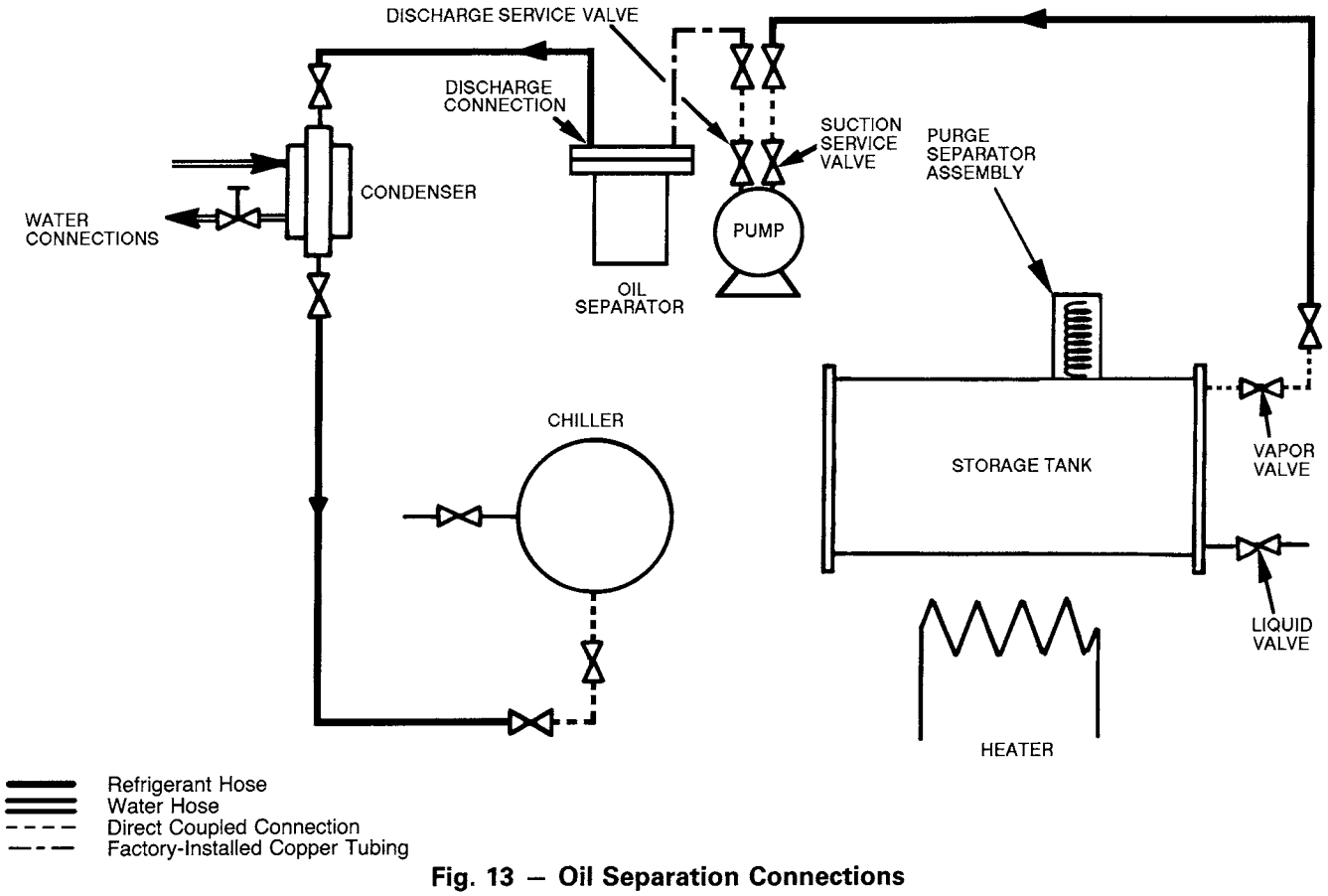


Fig. 13 — Oil Separation Connections

Water Separation — Water is only slightly soluble in refrigerant. See Table 4. If additional water is present, it will float on top of the refrigerant and can be easily removed by the RMS unit.

Transfer the water contaminated refrigerant to the storage tank using the procedures described in the Liquid Refrigerant Transfer section. If the refrigerant contamination was caused by a chiller failure, the chiller must be repaired, dehydrated, and vacuum broken with refrigerant. Use 24 in. Hg (−81 kPa) for CFC-113, 18 in. Hg (−61 kPa) for HCFC-123, and 15 in. Hg (−51 kPa) for CFC-11 to avoid freezing the tubes in chiller before the cleaned liquid refrigerant can be returned to the chiller. If the chiller is not repaired, the clean refrigerant should be transferred to another clean tank.

Connect the 12-ft refrigerant hose from the chiller or clean storage tank vapor valve to the suction service valve on the pump. See Fig. 14. Copper tubing is factory installed from the pump to the oil separator. Connect a 6-ft refrigerant hose from the discharge connection of the oil separator to the vapor valve on the storage tank. Connect the 3-ft refrigerant hose and liquid level indicator from the liquid valve of the storage tank to the filter drier canister. See Fig. 5. Connect the remaining 6-ft refrigerant hose from the filter drier canister to the chiller charging valve or the liquid valve, if using a storage tank. Open all valves between the storage tank and the chiller. Turn on the pump.

While the liquid refrigerant is being transferred into the chiller or another storage tank, use the water separation glass at the bottom of the tank to determine when the water/refrigerant level is close to the liquid valve. See Fig. 4. Reduce the liquid flow rate as the water level approaches the liquid valve. Close the liquid valve when the water/refrigerant level is at the bottom of the water separation glass to prevent water from entering the other storage tank.

To prevent the loss of remaining refrigerant, transfer the water/refrigerant mixture into an open container. Skim the water off the top of the refrigerant. Transfer the remaining refrigerant into the storage tank.

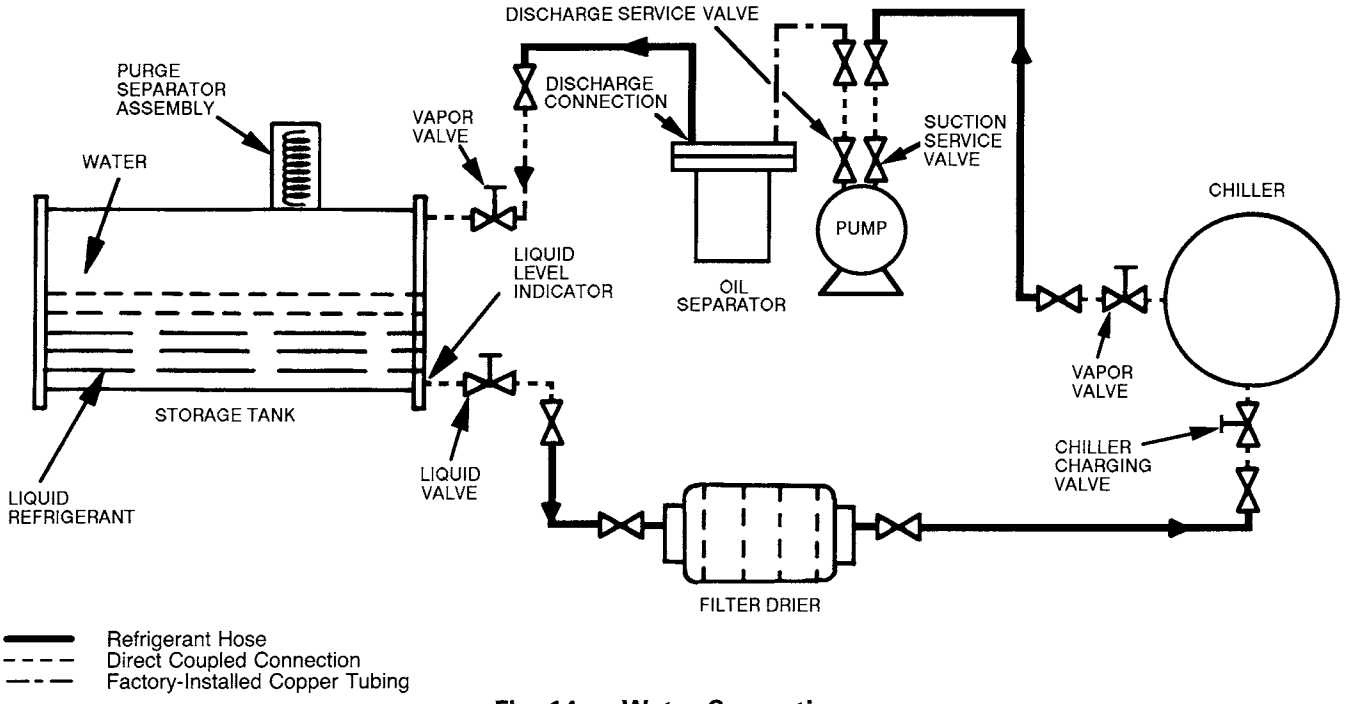


Fig. 14 — Water Separation

Table 5 – Vapor Pressure

TEMPERATURE		CFC-11				CFC-113				HCFC-123			
°F	°C	Psi Gage	Psi Absolute	kPa Gage	kPa Absolute	Psi Gage	Psi Absolute	kPa Gage	kPa Absolute	Psi Gage	Psi Absolute	kPa Gage	kPa Absolute
–20	**–28.9**	*26.9*	1.4	–91.1	9.7	*29.0*	0.4	–98.2	2.8	*27.6*	1.1	–93.5	7.6
–15	**–26.1**	*26.5*	1.7	–89.7	11.7	*28.8*	0.5	–97.5	3.4	*27.3*	1.3	–92.4	9.0
–10	**–23.3**	*25.9*	1.9	–87.7	13.1	*28.6*	0.6	–96.8	4.1	*26.8*	1.5	–90.7	10.3
–5	**–20.6**	*25.3*	2.2	–85.7	15.2	*28.4*	0 7	–96.2	4.8	*26.3*	1.8	–89.1	12.4
0	**–17.8**	*24.6*	2.6	–83.3	17.9	*28.1*	0 8	–95.1	5.5	*25.8*	2.0	–87.4	13.8
5	**–15.0**	*23.9*	2.9	–80.9	19.9	*27.9*	0.9	–94.5	6.2	*25.1*	2.3	–84.9	15.9
10	**–12.2**	*23.0*	3.4	–77.9	23.4	*27.5*	1.1	–93.1	7.6	*24.4*	2.6	–82.6	17.9
15	**–9.4**	*22.1*	3.8	–74.8	26.2	*27.1*	1.3	–91.8	8.9	*23.3*	3.1	–80.0	21.4
20	**–6.7**	*21.0*	4.3	–71.1	29.6	*26.7*	1.5	–90.4	10.3	*22.7*	3.5	–76.8	24.1
25	**–3.9**	*19.8*	4.9	–67.0	33.8	*26.3*	1.8	–89.1	12.4	*21.7*	4.0	–73.4	27.6
30	**–1.1**	*18.5*	5.6	–62.6	38.6	*25.7*	2.0	–87.0	13.8	*20.6*	4.5	–69.8	31.0
35	**–1.7**	*17.1*	6.3	–57.9	43.4	*25.1*	2.4	–85.0	16.5	*19.4*	5.2	–65.7	35.9
40	**4.4**	*15.6*	7.0	–52.8	48.3	*24.4*	2.7	–82.6	18.6	*18.0*	5.8	–60.9	39.9
45	**7.2**	*13.8*	7.9	–46.7	54.5	*23.7*	3.1	–80.2	21.4	*16.5*	6.6	–55.9	45.5
50	**10.0**	*12.0*	8.8	–40.6	60.7	*22.9*	3.4	–77.6	23.4	*14.9*	7.3	–50.5	50.3
55	**12.8**	*9.9*	9.8	–33.5	67.6	*21.9*	3.9	–74.2	26.9	*13.0*	8.3	–44.0	57.2
60	**15.6**	*7.7*	10.9	–26.1	75.2	*20.9*	4.4	–70.8	30.3	*11.0*	9.2	–37.2	63.4
65	**18.3**	*5.3*	12.0	–17.9	82.7	*19.8*	5.0	–67.0	34.5	*8.9*	10.3	–30.1	71.0
70	**21.1**	*2.7*	13.4	–9.1	92.4	*18.6*	5.5	–62.9	37.9	*6.6*	11.4	–22.3	78.6
75	**23.9**	0.1	14.7	.6	101.4	*17.2*	6.2	–58.2	42.7	*4.0*	12.8	–13.5	88.3
80	**26.7**	1.6	16.2	11.0	111.7	*15.8*	6.9	–53.5	47.6	*1.2*	14.1	–4.1	97.2
85	**29.4**	3.2	17.9	22.1	123.4	*14.2*	7.7	–48.1	53.1	0.9	15.7	6.2	108.3
90	**32.2**	4.9	19.6	33.8	135.1	*12.2*	8.5	–41.9	58.6	2.5	17.2	17.2	118.6
95	**35.0**	6.8	21.5	46.9	148.2	*10.5*	9.5	–35.6	65.5	4.2	19.0	28.9	131.0
100	**37.8**	8.8	23.5	60.7	162.0	*8.5*	10.5	–28.8	72.4	6.1	20.8	42.1	143.4
105	**40.6**	10.9	25.6	75.2	176.5	*6.3*	12.2	–21.3	84.1	8.1	23.0	55.8	158.6
110	**43.3**	13.2	27.9	91.0	192.4	*3.8*	13.8	–12.9	95.2	10.3	25.0	71.0	172.4
115	**46.1**	15.7	30.3	108.3	208.9	*1.2*	14.6	–4.1	100.7	12.6	27.4	86.9	188.9
120	**48.9**	18.3	32.9	126.2	226.8	0.8	15.4	5.5	106.2	15.1	29.8	104.1	205.5
125	**51.7**	21.1	35.7	145.5	246.2	2.2	16.6	15.2	114.5	17.7	32.6	122.2	224.8
130	**54.4**	24.0	38.7	165.5	266.8	3.8	18.5	26.2	127.6	20.6	35.3	142.0	243.4
135	**57.2**	27.1	41.8	186.9	288.2	5.5	20.2	37.9	139.3	23.4	38.4	161.3	264.8
140	**60.0**	30.5	45.1	210.3	310.9	7.3	21.9	50.3	151.0	26.8	41.5	184.8	286.2
145	**62.8**	34.0	48.6	234.4	335.1	9.2	23.9	63.4	164.8	30.2	45.0	208.2	310.3
150	**65.6**	37.7	52.7	259.9	363.4	11.2	25.9	77.2	178.6	33.8	48.5	233.1	334.4

NOTE: *Italics* indicates in. Hg vacuum.

MAINTENANCE

Periodic maintenance is necessary to keep all components functioning as designed. A maintenance log is recommended to ensure a proper maintenance schedule is followed.

Maintaining the Pump — Clean lubricating oil is essential to maintaining the required vacuum capabilities. If the oil is diluted with refrigerant, it will not be able to obtain a 29 in. Hg (25 mm Hg absolute) rating. Refer to Table 5 for additional information.

Change the oil in the pump and separator before each use. Both the pump and the oil separator use 16 oz. of 300 SSU oil at 100 F (38 C). The pump and oil separator have drain ports for oil removal. The drain port for the oil separator is located on top of the separator. The drain port for the pump is located on the bottom of the pump. Drain the oil from the separator by using the pump to pressurize the oil separator with air.

Install a 3-ft refrigerant hose on the discharge connection of the oil separator and close the refrigerant hose valves. Open the pump's suction and discharge service valves. Turn the pump on and let it run until it shuts down due to the high pressure cutout at 10 psig (69 kPa). Use this pressure to drain the oil from the separator. When this is complete, drain the oil from the pump. Use the oil drain fittings and a hand pump to add new oil to the pump and separator.

Check pump's vacuum capability once per year. Place a test gage capable of reading 29 in. Hg (25 mm Hg) on the suction service valve. Open the pump suction and discharge service valves. Start the pump and measure the vacuum. If the pump does not achieve the proper vacuum, a new valve plate assembly should be installed. Installation instructions are provided with the new valve plate assembly from the manufacturer.

Pump Coupling — The aluminum, self-aligning coupling should be inspected for wear at least once a year or as required based on usage. The pump half of the coupling is secured on a tapered shaft with a key and lock nut. The motor half of the coupling is secured on a straight shaft with a key and set screw. The rubber insert, found between each coupling half, should be inspected for damage and replaced as needed. Remove the coupling guard and pump to access the pump coupling. Leave the base brackets in place.

High-Pressure Cutout Switches — Check the pressure cutout setting for the pump and heater pressure switches once per year. Each switch should shut the pump off at 10 psig (69 kPa). To check the pump and heater switches, disconnect the capillary tube and use a regulated pressure source. Verify with an ohmmeter that the switch opened at 10 psig (69 kPa).

Refrigerant Storage Tank — The refrigerant storage tank contains a cleanout cover. Remove the cover to clean the tank when required. Use a clean cloth to wipe the inside of the tank. Reinstall cleanout cover.

Refrigerant Hoses — Each refrigerant hose has a factory supplied, field installed ball valve and coupler assembly at each end. These couplers contain a rubber seat that must be replaced periodically. Inspect the rubber seats before each use. Replace the seats if they appear to be damaged. See Fig. 15.

Periodically check refrigerant hoses for cuts or abrasions that may allow refrigerant to leak into the atmosphere.

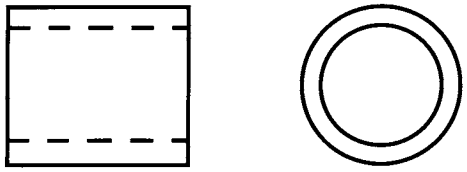


Fig. 15 — Refrigerant Hose Seats

TROUBLESHOOTING

SYMPTOM	PROBABLE CAUSE	REMEDY
Unit hums and vibrates excessively.	Motor/pump assembly out of alignment.	Check alignment and adjust if necessary.
	Motor/pump assembly holddown bolts are loose.	Check holddown bolts and tighten as necessary.
Pump does not pull a 29 in. Hg vacuum (25 mm Hg absolute).	Pump and oil separator oil is diluted with refrigerant.	Change oil in pump and oil separator as specified in maintenance section on page 15.
	Valves and valve plates are worn.	Replace valves and valve plates in pump.
Unit is plugged into electrical outlet but does not start.	The ON/OFF switch, high-pressure switch, motor thermal overload and/or motor winding are faulty.	Test all components for proper operation and replace as needed.
	Unit is plugged into a nonoperational outlet.	Try another outlet and test for presence of voltage.
Unit shuts off on the high pressure switch.	All valves on the discharge side of the pump are not open.	Open all valves on the discharge side of the pump.
	Cutout setting on the switches is incorrect.	Adjust switch as necessary.
	Inadequate water flow through the condenser.	Increase water flow or use a colder water source.
	Noncondensable gas has accumulated in the storage tank.	Purge noncondensable gases from storage tank.
Motor draws high amps at start-up.	Pump oil is very cold.	Warm up pump by running it with the suction and discharge service valves open to the atmosphere.
Compressor is damaged at start-up.	Liquid refrigerant entered the suction valve.	Check pump for internal damage.
Storage tank relief valve is relieving refrigerant gas.	Storage tank contains excessive noncondensable gas.	Bleed noncondensable gases from storage tank.
	Storage tank is placed in a hot room (above 115 F [46 C]).	Move storage tank to a cooler room.
Liquid and vapor recovery rates are slower than specified.	Vapor valve connection on the chiller is smaller than ½ inches in diameter.	Install a ½ in. vapor valve on the chiller.
	There is a restriction in the refrigerant hose system.	Check all refrigerant hose valves and verify that they are open.
Purge unit is constantly open to remove noncondensable gas from the storage tank.	Chiller probably has a severe leak.	Stop the recovery process.