

Service Manual

38EH,EN,ES,QH,QN,QS

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INTRODUCTION

This Service Manual enables a service technician to service and repair a family of similar condensing units and heat pumps. Outwardly, many models appear

similar, however, there are distinct differences. Tables 1 and 2 help to differentiate these differences.

Models and SEER Ranges

Table 1 — Condensing Units

MODEL	DIAMETERS (in.)	SEER* (Nominal)
38EH015	22	9.0
38EH018	22	9.0
38EH024	22	9.0
38EH030	30	9.0
38EH036	30	9.0
38EH042	30	9.0
38EH048	30	9.0
38EH060	30	9.0
38EN015	17	8.0
38EN018	17	8.0
38EN024	17	8.0
38EN030	22	8.0
38EN036	22	8.0
38EN042	30	8.0
38EN048	30	8.0
38EN060	30	8.0
38ES018	30	10.0
38ES024	30	10.0
38ES030	30	10.0
38ES036	30	10.0
38ES042	30	10.0
38ES048	30	10.0
38ES060	39	10.0

*SEER — Seasonal Energy Efficiency Ratio. The higher the number, the less electrical power required to reach a given capacity. SEER is derived by dividing output energy by input energy.

Table 2 — Heat Pumps

MODEL	DIAMETERS (in.)	SEER* (Nominal)	C.O.P.† (Minimum)
38QH015	22	9.0	2.85
38QH018	22	9.0	2.85
38QH024	30	9.0	2.85
38QH030	30	9.0	2.85
38QH036	30	9.0	2.85
38QH042	30	9.0	2.85
38QH048	30	9.0	2.85
38QH060	39	9.0	2.85
38QN015	17	8.0	2.55
38QN018	17	8.0	2.55
38QN024	22	8.0	2.55
38QN030	22	8.0	2.55
38QN036	30	8.0	2.55
38QN042	30	8.0	2.55
38QN048	30	8.0	2.55
38QN060	30	8.0	2.55
38QS018	30	10.0	2.85
38QS024	30	10.0	2.85
38QS030	30	10.0	2.85
38QS036	30	10.0	2.85
38QS042	30	10.0	2.85
38QS048	30	10.0	2.85
38QS060	39	10.0	2.85

†C.O.P. — Coefficient of Performance (heating), determined by dividing Btu output by power input required to produce this Btu output.

Manufacturer reserves the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.

Factory-Installed Options — Any condensing unit or heat pump listed in Tables 1 and 2 may be ordered as Basic or in one of 3 factory-option packages. Package designations are included in model number (excluding

Basic). Example: 38EN024301SM. SM designates this unit as sheet metal option package. Option package designations are shown in Table 3.

Table 3 — Option Packages

38EH,ES		38QH,QS	
Basic	Standard unit with no added options.	Basic	Standard unit with no added options.
Sheet Metal Option (SM)	Same unit as Basic except with addition of louvered inlet casing.	Sheet Metal Option (SM)	Same unit as Basic except for addition of louvered inlet casing.
Deluxe Option (DL)	Same unit as (SM) except for addition of start assist components on single-phase units, crankcase heater, high- and low-pressure switches, and accumulator.	Deluxe Option (DL)	Same unit as (SM) except for addition of start assist components on single-phase units, high-pressure switch, and Service Sentry device.
Custom Deluxe Option (CD)	Same unit as (DL) except for addition of sound shield around compressor, and Time Guard II device.	Custom Deluxe Option (CD)	Same unit as (DL) except for addition of sound shield around compressor and Time Guard II device.
38EN		38QN	
Basic	Standard unit with no added options.	Basic	Standard unit with no added options.
Sheet Metal Option (SM)	Same unit as Basic except for addition of louvered inlet casing.	Sheet Metal Option (SM)	Same unit as Basic, except for addition of louvered inlet casing.

Table 4 — Condensing Unit Specifications

OUTDOOR UNIT MODEL NO. 38-	ORIGINAL COMPRESSOR MODEL	REPLACEMENT COMPRESSOR MODEL	OIL CHARGE		REFRIG CHARGE* (R-22)
			Initial	Recharge	
EH-					
015301	REZ3-0125	50QT662300	24	20	6.2
018301	AB5515H	50SR661301	32	30	6.3
024301	MD2315GG	MD2364GE	46	44	5.6
030301	MD3215GG	MD3264GE	46	44	7.3
036301	AV5535E	50SR661336	54	50	7.4
042301	AV5542E	50SR661300	54	50	7.1
048321	AV5546H	50SR661331	54	50	8.9
060301	PC6016BD	PC6066ED	76	72	12.7
EN-					
015310	AK8515E	51DZ661300	17	15	3.2
018310	RES3-0175-PFV	38EA662301	24	20	3.7
024310	H21B243ABC	38EN663307	40	37	3.8
030300	H21A313ABCA	38EN663302	40	37	5.6
030320	MD3215GG	MD3264GE	46	44	6.7
036320	H21A363ABCA	38EN663303	50	47	5.8
042300	H21A463ABCA	38EN663304	50	47	7.2
048300	PC5316BD	PC5366HD	76	72	7.6
060300	PC6716AG	PC6766HG	76	72	9.6
060310	PC6716AG	PC6766HG	76	72	12.5
030500	H21A313DBD	38EN663501	40	37	5.6
036500	H21A373DBD	38EN663502	50	47	5.8
042500	H21A463DBD	38EN663500	50	47	7.2
048500	PY5316AD	See Note †	76	72	7.6
060500	PY6716AF	See Note ‡	76	72	9.6
060510	PY6716AF	See Note ‡	76	72	12.5
036600	H21A373DBE	38EN663600	50	47	5.8
042600	A21A463DBE	38EN663601	50	47	7.2
048600	PH5316AD	PH5366HD	76	72	7.6
060600	PH6716AF	PH6766HF	76	72	9.6
060610	PH6716AF	PH6766HF	76	72	12.5
ES-					
018	AB5515H	50SR661301	32	28	7.20
024	CRC1-0175-PFV	38VH660303	55	51	7.40
030	H23A263ABCA	50SR661333	50	46	6.50
036	CRH3-0275-PFV	51HK660304	55	51	7.50
042	CRK3-0325-PFV	48GH662302	55	51	7.80
048	AV5546H	50SR661331	54	50	12.50
060	—	—	—	—	—

*Factory refrigerant charge is adequate when indoor unit and outdoor unit are the same size and are connected with 25 ft or less of field tubing of recommended size or Carrier accessory tubing. For tubing requirements beyond 50 ft, consult Carrier distributor.

NOTE: Originally an extended voltage compressor. Select replacement compressor for voltage required: †PF5366HD (200-3-60), PG5366HD (230-3-60). ‡PF6766HF (200-3-60), PG6766HF (230-3-60).

Table 5 — Heat Pump Specifications

OUTDOOR UNIT MODEL NO. 38-	ORIGINAL COMPRESSOR MODEL	REPLACEMENT COMPRESSOR MODEL	OIL CHARGE		REFRIG CHARGE* (R-22)
			Initial	Recharge	
QH					
015	REZ3-0125-PFV	50QT662300	24	20	5.3
018	H22B173ABCA	38QF663300	40	37	5.5
024	CRC2-0175-PFV	38VH660303	55	52	7.8
030	AV5532E	50SR661333	54	50	7.8
036	AV5535H	50SR661336	54	50	7.9
042	AV5542H	50SR661330	54	50	11.0
048	AV5546H	50SR661331	54	50	12.5
060	WD6000AAA	WD6051AA	76	74	14.1
060341	H23A563ABCA	—	55	50	14.0
030	AV5532E	50SR661415	54	50	7.8
036	AV5535E	50SR661413	54	50	7.9
042	AV5542E	50SR661414	54	50	11.0
048	AV5546E	50SR661500	54	50	12.5
060	WY6000AAA	WY6051AA	76	74	14.1
036	AV5535E	50SR661623	54	50	7.9
042	AV5542E	50SR661624	54	50	11.0
048	AV5546E	50SR661622	54	50	12.5
060	WH6000AAA	WH6051AA	76	74	14.1
QN					
015	REZ3-0125-PFV	38QB662301	24	20	3.6
018	AB5519H	50SR661311	32	28	4.1
024	MD2315GG	MD2364GE	46	44	5.6
030	MD3215GG	MD3264GE	46	44	6.1
036	MD3515GG	MD3564GE	46	44	8.9
042	AV5542E	50SR661330	54	50	9.5
048	PC5316BD	PC5366HD	76	72	9.7
060	PC6016BD	PC6066ED	76	72	10.8
036	MF3513GB	MF3563GE	46	44	8.9
042	AV5542E	50SR661330	54	50	9.5
048	PY5316AD	See Note †	76	72	9.7
060	PY6016BD	PY6066EF	76	72	10.8
036	MH3513GB	MH3563GE	46	44	8.9
042	PH4616AD	PH4666HD	76	72	9.5
048	PH5316AD	PH5366HD	76	72	9.7
060	PH6016BD	PH6066EF	76	72	10.8
QS					
018	AB5515H	50SR661301	32	28	6.8
024	JD2200AA	JD2251AA	50	46	7.5
030	JD2800AA	JD2851AA	50	46	8.5
036	JD3300AA	JD3300AA	50	46	10.6
042	CRJ3-0300-PFV	38EB660301	55	51	11.5

*Factory refrigerant charge is adequate when indoor unit and outdoor unit are the same size and are connected with 25 ft or less of field tubing of recommended size or Carrier accessory tubing. For tubing requirements beyond 50 ft, consult Carrier distributor.

NOTE: Originally an extended voltage compressor. Select replacement compressor for voltage required:
 †PF5366HD (200-3-60), PG5366HD (230-3-60).

SAFETY CONSIDERATIONS

Service and repair of these units should be attempted only by trained service technicians familiar with Carrier Standard Service Instructions.

All equipment should be installed in accordance with accepted practices and in compliance with all national and local codes.

Power should be turned off when servicing or repairing electrical components. Extreme caution should be observed when troubleshooting electrical components with power on. Observe all warning notices posted on equipment.

Refrigeration system contains refrigerant under pressure. Extreme caution should be observed when handling refrigerants. Wear safety glasses and gloves to prevent personal injury. During normal system operation, some components are hot and can cause burns. Rotating fan blades can cause personal injury. Appropriate safety considerations are posted throughout this manual where potentially dangerous techniques are addressed.

SERVICE

Cabinet — Certain maintenance routines and repairs require removal of cabinet panels. All condensing units and heat pump models of this series have same basic design with only minor differences. See Fig. 1.

REMOVING LOUVERED CASING — (See Fig. 2.)

1. Turn off all power to unit.
2. Loosen screws around circumference of fan orifice.
3. Remove screws around circumference of basepan.
4. Remove screws along control box support brackets.
5. Carefully remove louvered casing.

CAUTION

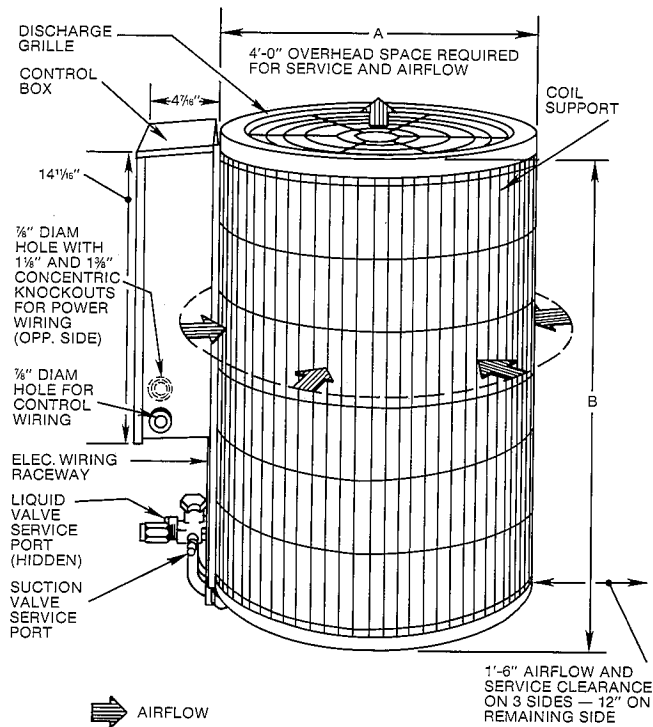
Do not attempt to remove wire grille around coil. Grille is integral part of coil structure and supports coil.

REMOVING FAN ORIFICE — (See Fig. 3.)

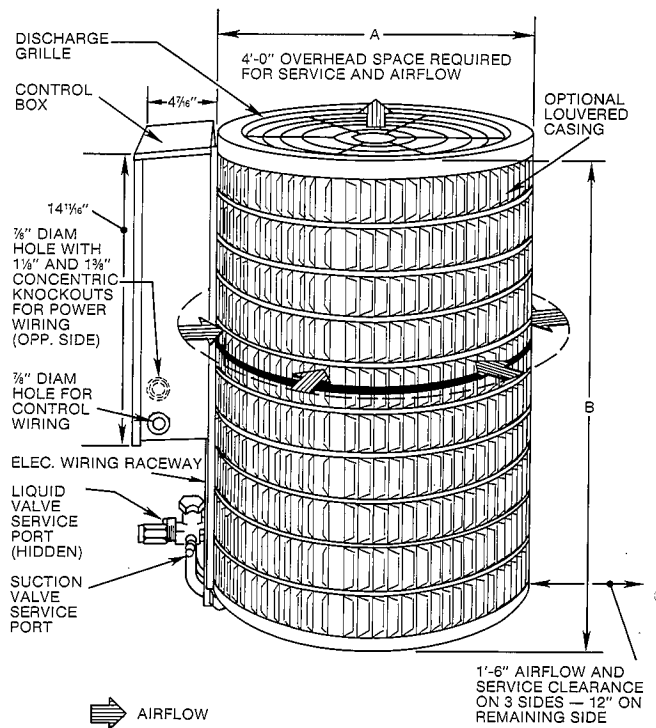
1. Turn off all power to unit.
2. Remove screws holding grille on top of fan orifice.
3. Unplug wires from fan motor. Fan blades on certain models may have to be removed. Refer to Service — Electrical.
4. Remove screws holding fan orifice to wire grille and control box.
5. Remove fan orifice.

ELECTRICAL BOX ACCESS — (See Fig. 1.)

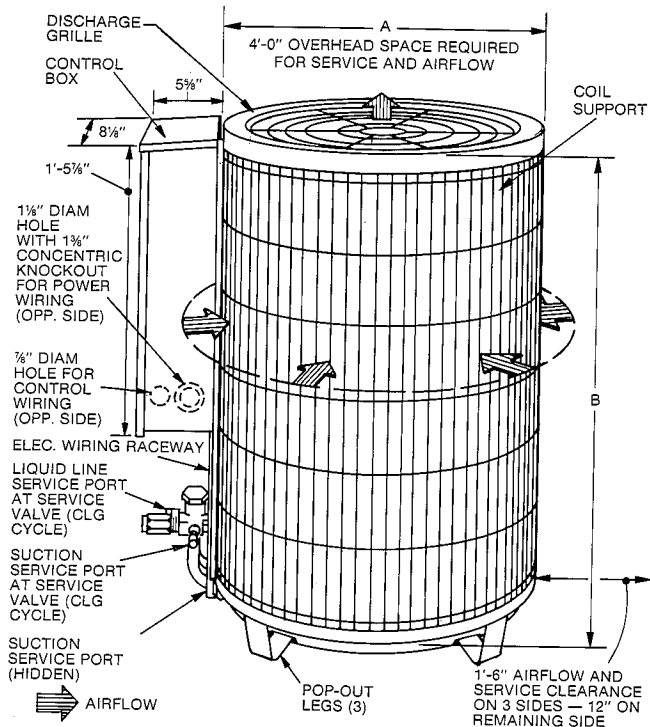
1. Turn off all power to unit.
2. Remove screws holding box cover.



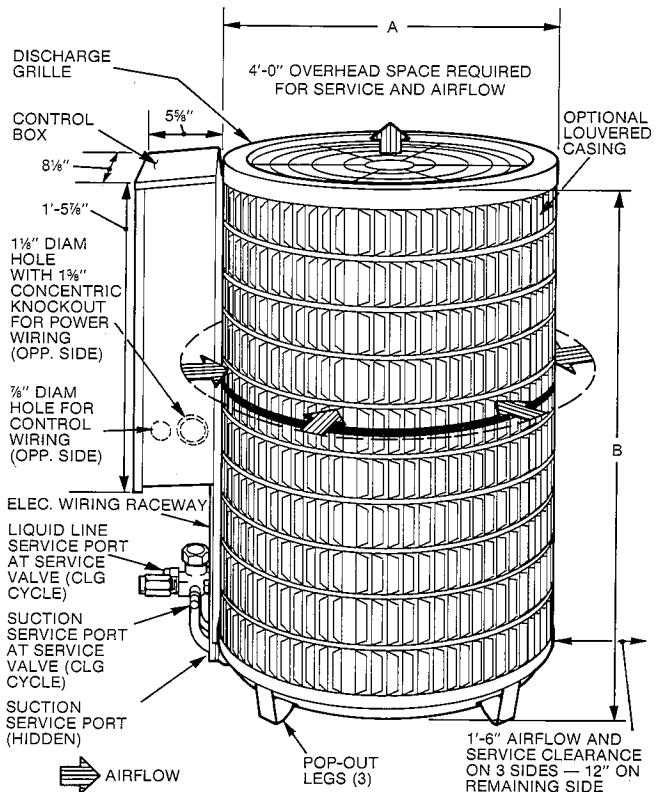
BASIC CONDENSING UNIT



LOUVERED CONDENSING UNIT

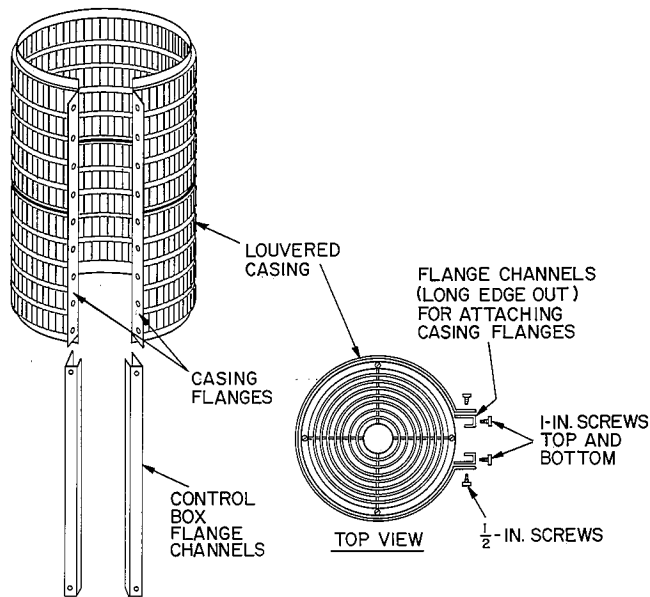


BASIC HEAT PUMP UNIT



LOUVERED HEAT PUMP UNIT

Fig. 1 — Condensing and Heat Pump Units



LOUVERED CASING COMPONENTS

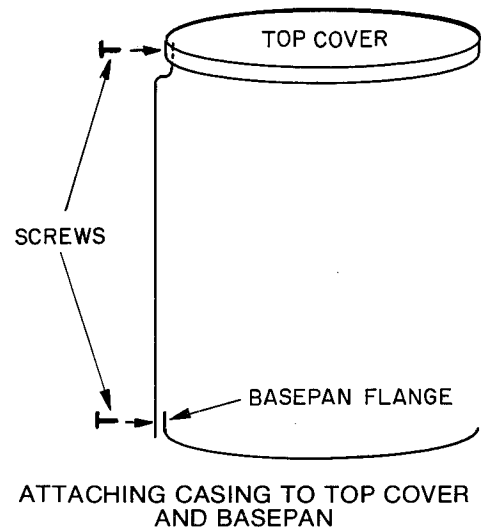


Fig. 2 — Louvered Casing Assembly

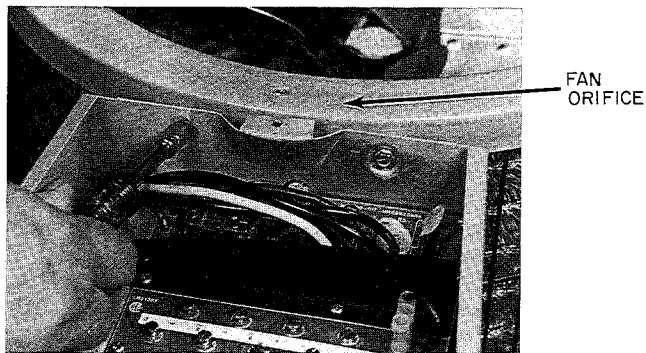


Fig. 3 — Removing Orifice Fan

Electrical — Exercise extreme caution when working on any electrical components. Shut off all power to system prior to troubleshooting. Some troubleshooting techniques require power to remain on. In these instances, exercise extreme caution to avoid danger of electrical shock. **ONLY TRAINED SERVICE PERSONNEL SHOULD PERFORM ELECTRICAL TROUBLESHOOTING.**

CONTACTORS — (See Fig. 4.) Contactor provides means of applying power to unit using lower power (24 v) from transformer in order to power the contactor coil. Depending on unit model, you may encounter single-, double- or triple-pole contactors to break power. One side of the line may be electrically hot, so extreme caution must be exercised when troubleshooting.

The contactor coil for these and most residential models of condensing units and heat pumps is powered by 24 vac. If contactor does not operate:

1. With power off, check whether contacts are free to move. Check for severe burning or arcing on contact points.

2. With power off, use ohmmeter to check for continuity of coil. Disconnect leads before checking. A low-resistance reading is normal. Do not look for a specific value as different part numbers used will have different resistance values.
3. Reconnect leads and apply low-voltage power to contactor coil. This may be done by leaving high-voltage power to outdoor unit off, and by turning thermostat to heat or cool. Check voltage at coil with voltmeter. Reading should be between 20 - 30 volts. Contactor should pull in if voltage is correct and coil is good. If contactor does not pull in, change contactor.
4. With high-voltage power off and contacts pulled in, check for continuity across contacts with ohmmeter. A very low or zero resistance should be read. Higher readings could indicate burned or pitted contacts which may cause future failures.

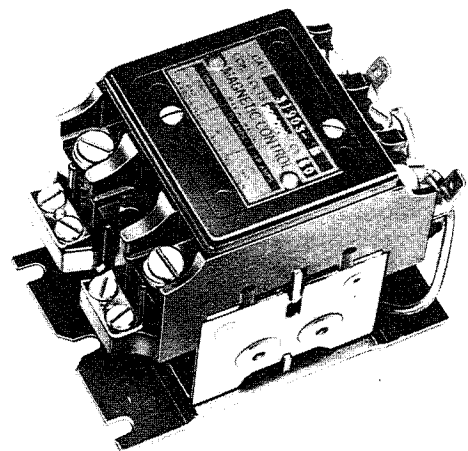


Fig. 4 — Contactor

⚠ CAUTION

Capacitors can store electrical energy when power is off. Electrical shock can result if you touch the capacitor terminals and discharge this stored energy. Exercise extreme caution when working near capacitors. With power off, discharge stored energy by shorting across the capacitor terminals with a 15,000-ohm, 2-watt resistor, or a screwdriver blade with insulated handle.

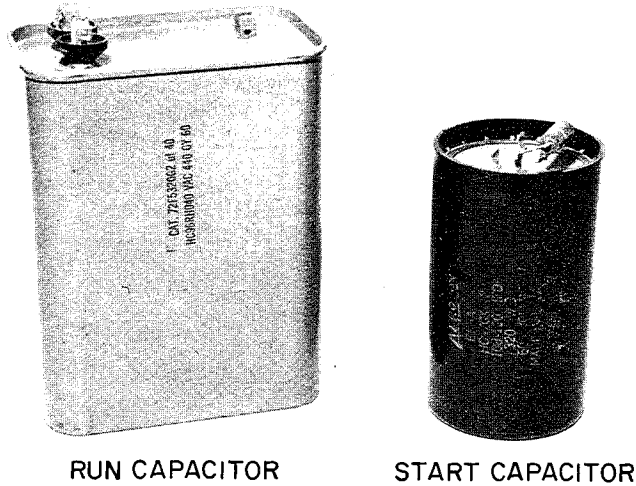


Fig. 5 — Capacitors

Capacitors are used as a phase shifting device to aid in starting certain single-phase motors. Check capacitors as follows:

1. Always check capacitors with power off. Attempting to troubleshoot a capacitor with power on can be dangerous. Defective capacitors may explode when power is applied. Insulating fluid inside is combustible and may ignite, causing burns. After power is off, discharge capacitors as outlined above. Disconnect capacitor from circuit. Use ohmmeter, check each terminal to ground (use capacitor case). Discard any capacitor that shows resistance. Place ohmmeter leads across capacitor and place on R x 10k scale. Meter should jump to a low resistance value and slowly climb to higher value. Failure of meter to do this indicates an open capacitor. If resistance stays at zero or a low value, capacitor is shorted.
2. Capacitance testers are available which will read value of capacitor. If value is not within ± 10% value stated on capacitor, it should be changed. If capacitor is not open or shorted, its capacitance value is calculated by measuring voltage across capacitor and current it draws.

⚠ WARNING

Exercise extreme caution when taking readings while power is on. Use following formula to calculate capacitance:

$$\text{Capacitance (mfd)} = \frac{2650 \times \text{amps}}{\text{volts}}$$

3. Remove any capacitor that shows signs of bulging, dents or leaking. Do not apply power to a defective capacitor as it may explode.

Hard-Start Capacitors and PTC Devices — Sometimes, under adverse conditions, a standard run capacitor in a system is inadequate to start compressor. In these instances, a start-assist device is used to provide an extra starting boost to compressor motor. The first device is called a PTC (positive temperature coefficient) or thermistor (see Fig. 6). It is a resistor wired in parallel with run capacitor. As current flows through it at start-up, it heats up. As it heats up, its resistance increases greatly, until it effectively lowers current through it to an extremely low value. This, in effect, removes it from the circuit.

After system shuts down, resistor cools and resistance value returns to normal, until next time system starts. Thermistor device is adequate for most conditions, however, in systems where off cycle is short, device cannot cool fully and becomes less effective as a start device. It is an easy device to troubleshoot. Turn off all power to system.

Check thermistor with ohmmeter as described below. If indoor coil does not have a bleed-type expansion device, it may be necessary to remove start thermistor and replace with accessory start capacitor and relay.

Shut off all power to unit. Remove PTC from unit. Wait at least 10 minutes for PTC to cool to ambient temperature.

Measure resistance of PTC with ohmmeter. Resistance of 25-ohm PTC is measured between center tab and end tab with jumper across 2 end terminals.

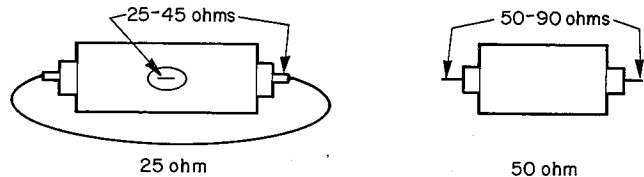


Fig. 6 — PTC Devices

The cold resistance (R_T) of any PTC device should be approximately 100 - 180% of device ohm rating.

- 50-ohm PTC = 50 - 90 ohm resistance
- 25-ohm PTC = 25 - 45 ohm resistance

If PTC resistance is appreciably lower or more than 200% higher than rating, device is defective.

If thermistor is good and compressor does not start, disconnect thermistor from starting circuit. Give compressor a temporary capacitance boost. Run compressor for 10 minutes, shut off, allow system pressure to equalize. Reconnect start thermistor. Try restarting compressor without boost capacitor. If after 2 attempts, compressor does not start, remove thermistor. Add an accessory start capacitor relay package.

Temporary Capacitance Boost — (See Fig. 7.) There are times when a temporary capacitance boost is needed to get compressor started. *Do not* under any circumstances attach temporary boost capacitor directly across compressor terminals. Serious personal injury can result. Exercise extreme caution with this procedure when high-voltage power is on. If compressor motor does not start, it may be due to low-line voltage, improper pressure equalization or weak run capacitor. Check each possibility, attempt capacitance boosting *before* adding auxiliary start capacitor and relay.

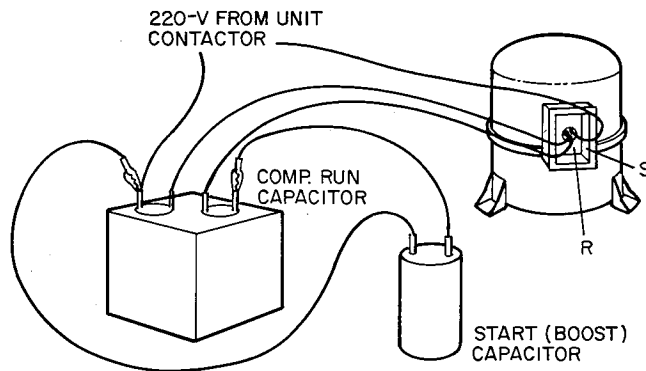


Fig. 7 — Capacitance Boosting

Turn off power. Check compressor for ground or open. If there is none, proceed. Obtain a start capacitor approved by compressor manufacturer. Connect wires with insulated probes to each terminal. Touch probes to each side of run capacitor. Energize and start compressor, pull probes away after about 3 seconds. *Discharge start capacitor.* Run compressor about 10 minutes. Stop and allow to sit idle about 5 minutes. Check system pressure equalization. Attempt to restart *without* capacitance boost. If compressor does not start after several attempts, add proper auxiliary start capacitor and relay.

If PTC thermistor device is inadequate as start device, a start capacitor and relay may be added to system to insure positive start. Capacitor is wired in parallel with run capacitor through normally closed set of contacts on a device called start relay. The relay coil is wired across start and common terminals of compressor. The added capacitance gets compressor started. As compressor comes up to speed, voltage across start and common terminals increases to a value high enough to cause start relay to energize. This opens normally closed contacts and removes start capacitor from circuit. In actual practice, this occurs in a fraction of a second.

To check start relay and capacitor, first turn off all power to unit. Discharge start and run capacitors as outlined earlier. Most start capacitors will have a 15,000-ohm, 2-watt bleed resistor. Disconnect these devices from system. Start capacitor can be inspected visually. It is designed for short duration or intermittent duty. If left in circuit for prolonged period it blows through a specially designed orifice. If it appears blown, check for stuck contacts in start relay. Start capacitor can be checked by ohmmeter method discussed earlier.

⚠ CAUTION

If bleed resistor is wired across start capacitor, it must be disconnected to avoid erroneous readings when ohmmeter is applied across capacitor.

Start relay is checked with ohmmeter. Check for continuity across coil of relay. You should encounter a high resistance. Since relay contacts are normally closed, you should read low resistance across them.

Both PTC device and capacitor relay start system are standard equipment on some of these units. They are also available as accessories and may be field installed.

TIME GUARD II — (See Fig. 8.)

Description — Solid-state Time Guard device protects unit compressor by preventing short cycling. After a

system shutdown, Time Guard provides for a 5 ± 2 -minute delay before compressor restarts. On normal start-up, 5-minute delay occurs before thermostat closes. After thermostat closes, Time Guard device provides a 3-second delay to prevent contactor chattering.

Time Guard II device is simple to troubleshoot. Only a voltmeter capable of reading 24 v is needed. Device is in control circuit, therefore, troubleshooting is safe with control power (24 v) on and high-voltage power off.

With high-voltage power off, attach voltmeter leads across T1 and T3, set thermostat so that Y terminal is energized. Make sure all protective devices in series with Y terminal are closed. Voltmeter should read 24 v across T1 and T3. With 24 v still applied, move voltmeter lead from T1 terminal to T2 terminal. After 5 ± 2 minutes, voltmeter should read 24 v, indicating control is functioning normally. If no time delay is encountered, or device never times out, change control. A schematic diagram printed on device enables you to troubleshoot this device.

CRANKCASE HEATER — Crankcase heater is a device for keeping compressor oil warm. By keeping oil warm, refrigerant does not migrate to and condense in compressor shell. This prevents flooded starts which can severely damage compressor.

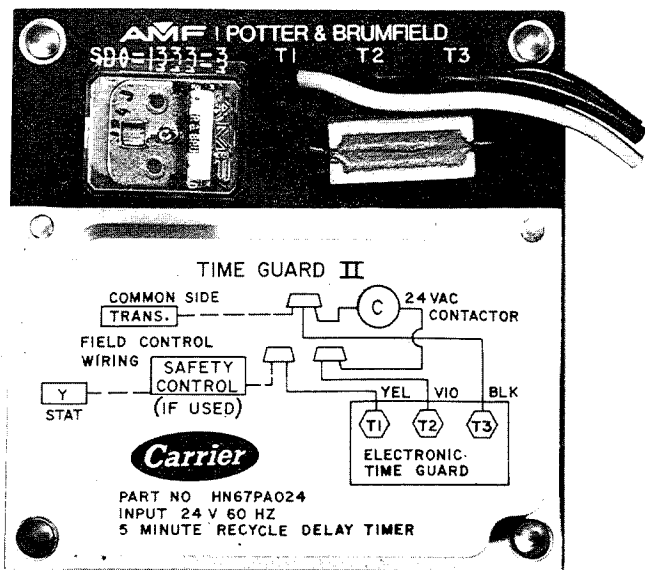
Crankcase heaters come in 2 basic types, wraparound (belly-band) type that is wrapped externally around compressor shell, and insertion type that is inserted into compressor oil well in shell of compressor. Both types are in this family of units.

Crankcase heater is powered by *high-voltage* power of unit. Use extreme caution troubleshooting this device with power on. Easiest method of troubleshooting is to apply voltmeter across crankcase heater leads to see if heater voltage is on. Carefully feel area around crankcase heater. If warm, crankcase heater is probably functioning. Do not rely on this method as absolute evidence heater is functioning. If compressor has been running, area will still be warm.

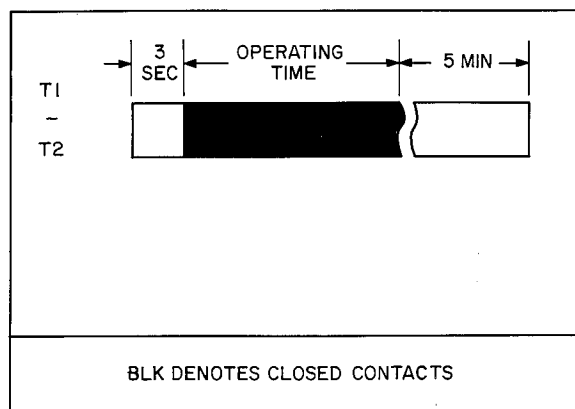
With power off, and heater leads disconnected, check across leads with ohmmeter. Do not look for a specific resistance reading. Check for resistance or an open circuit. Change heater if an open circuit is detected. Some crankcase heaters in this series of units are equipped with crankcase heater switch installed in series with heater. This energy-saving device shuts off power to heater when temperatures are high enough that heater is not needed. Be sure this switch is functioning normally before condemning crankcase heater.

PRESSURE SWITCHES — Pressure switches are protective devices wired into control circuit (low voltage). They shut compressor off if abnormally high or low pressures are present in refrigeration circuit. Depending on unit model, you may find a low- or high-pressure switch, or both, in system.

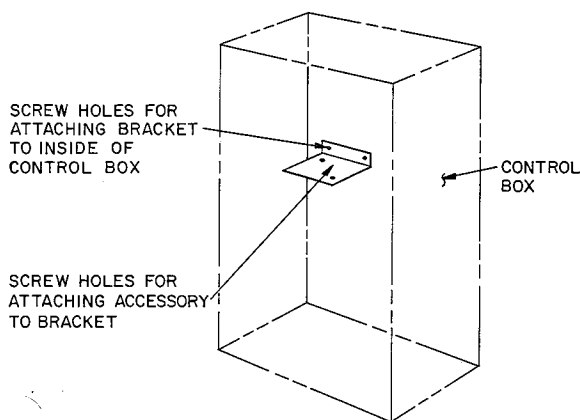
Low-Pressure Switch — Located on suction line, protects against low suction pressures caused by such events as loss of charge, low airflow across indoor coil, dirty filters, etc. It opens on a pressure drop at about 30 psi. If system pressure is above this, switch should be closed. To check switch, turn off all power to unit, disconnect leads on switch, apply ohmmeter leads across switch. You should have continuity on a good switch. Because these switches are attached to refrigeration system under pressure, it is not advisable to remove this device for troubleshooting unless you are reasonably certain that a problem exists. If switch must be removed, bleed all system charge so that pressure gage reads 0 psi.



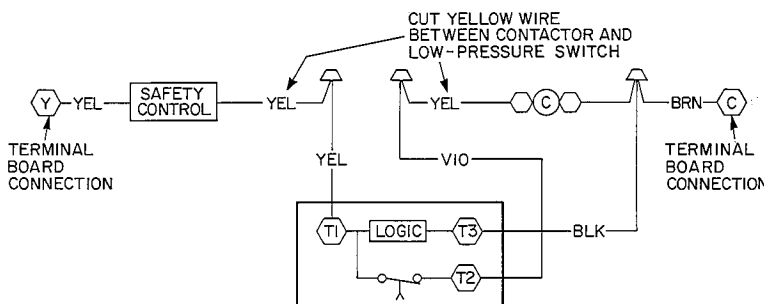
ACCESSORY TIME GUARD II DEVICE



TIME GUARD II SEQUENCE CHART



MOUNTING ACCESSORY TIME GUARD II ON MODEL 38QH, QS, QN



NOTE: When accessory Time Guard II is used with accessory Service Sentry control on 38QH, QN, QS units, refer to wiring instructions packed with Service Sentry control.

TIME GUARD II CONTROL WIRING CONNECTIONS FOR 38QH, QN, QS UNITS

Fig. 8 — Solid-State Time Guard II Description

CAUTION

Wear safety glasses and gloves when working with refrigerants. Apply heat with a torch to solder joint and remove switch. Wear safety glasses when using torch. Have quenching cloth available. Oil vapor in line may ignite when switch is removed.

Braze in 1/4-in. flare fitting and screw on replacement pressure switch. Wear safety glasses, observe all safety precautions.

High-Pressure Switch — Located on discharge line, protects against high discharge pressures caused by such events as overcharge, condenser fan motor failure, system restriction, etc. It opens on pressure rise at about 425 psi. If system pressures go above this setting during abnormal condition, switch opens. *Do not* attempt to simulate these system abnormalities, as high pressures pose a serious safety hazard. High-pressure switch is also checked with an ohmmeter similar to checking low-pressure switch. If system pressure is below 425 psi, switch shows continuity. It is replaced in same manner as low-pressure switch. Observe all safety precautions.

Liquid Line Pressure Switch — Located on liquid line, used in heat pump only. Function is similar to conventional low-pressure switch. Because heat pumps experience very low suction pressures during normal system operation, a conventional low-pressure switch cannot be installed on suction line. Switch is installed in liquid line instead and acts as loss-of-charge protector. It operates identically to low-pressure switch except it opens at 5 psi. Troubleshooting and removing this switch is identical to procedures used on other switches. Observe same safety precautions.

DEFROST THERMOSTATS — Defrost thermostat signals heat pump that conditions are right for defrost or that conditions have changed to terminate defrost. It is a thermally actuated switch clamped to liquid line to sense its temperature. Normal temperature range is: closed at 27 ± 5 F, open at 80 ± 5 F.

Since defrost thermostat is the heart of the defrost system, its troubleshooting procedure is described below.

PRINTED-CIRCUIT CONTROL BOARD — Solid-state defrost control used on 38QH, QN, QS heat pumps replaces electro-mechanical timer and defrost relay found on previous Carrier Chronotemp™ defrost systems. Defrost control board can be set to check need for defrost

every 30, 50 or 90 minutes of operating time. Control board has additional feature that allows unit to restart in defrost cycle if room thermostat is satisfied during defrost.

Troubleshooting defrost control involves a series of simple steps that indicate whether board is defective.

NOTE: Procedure allows mechanic to check control board and defrost thermostat for defects. First, troubleshoot to make sure unit operates properly in heating and cooling modes. This ensures problems are not attributed to the defrost control board. Additional steps follow:

1. Turn thermostat to OFF. Disconnect all power to outdoor unit.
2. Remove control box cover for access to electrical components and defrost control board.
3. Disconnect defrost thermostat leads from control board, connect to ohmmeter. Thermostat leads are the heavy-gage black insulated wires connected to DFT and C terminals on control board. Resistance reading may be 0 (indicating closed defrost thermostat) or infinity (∞ for open thermostat) depending on outdoor temperature.
4. Jumper between DFT and C terminals on control board as shown in Fig. 9.

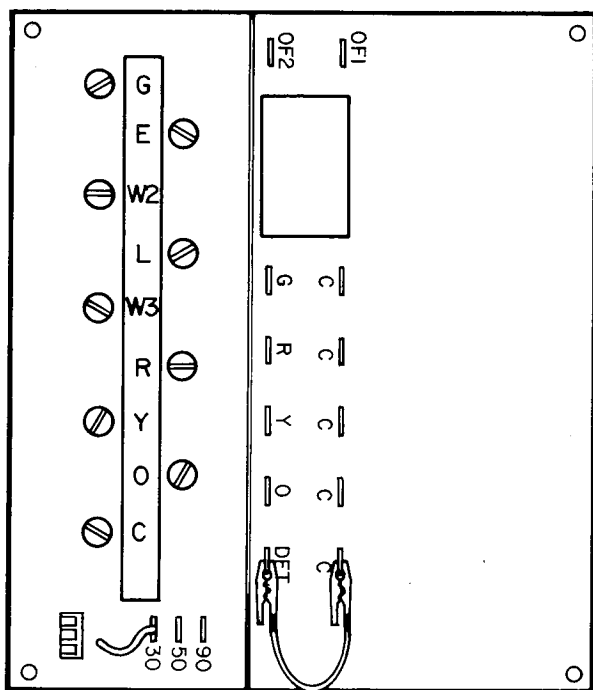


Fig. 9 — Jumper DFT and C Terminals

5. Disconnect outdoor fan motor lead. Tape lead to prevent grounding.
6. Restart unit in heating, allowing frost to accumulate on outdoor coil.
7. After a few minutes in heating, liquid line temperature should drop below closing set point of defrost thermostat. Using ohmmeter, check resistance across defrost thermostat leads. Resistance of 0 indicates defrost thermostat is closed and operating properly.
8. Remove protective cover from TP1 and TP2 speed-up terminals. Insert jumper wire into protective cover, reinsert protective cover on speed-up terminals. This reduces by 1/4 timing sequence of original time (see Fig. 10). Since Fig. 10 shows timing cycle set at 30 minutes, unit initiates defrost within approximately 30 seconds; if setting is at 50 minutes, within

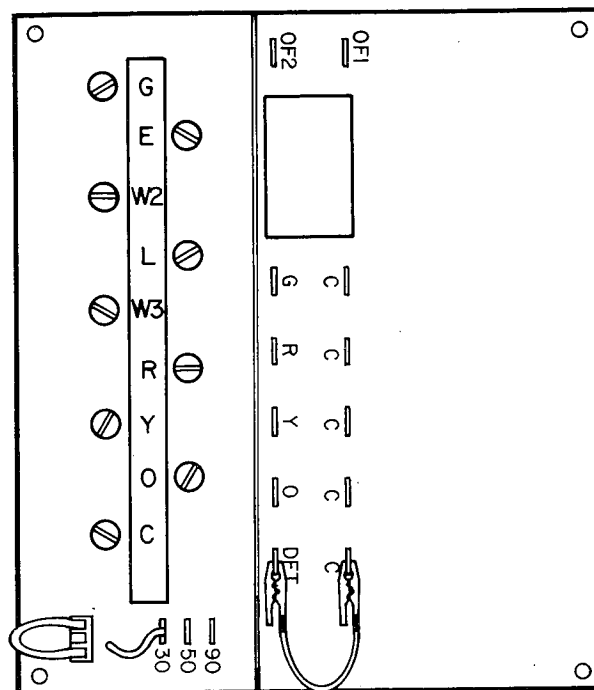


Fig. 10 — Inserting Jumper Wire into Protective Cover

50 seconds; 90 minutes, within 90 seconds. When you hear reversing valve change position, remove protective cover/jumper, otherwise control will terminate normal 10-minute defrost cycle in approximately 10 seconds.

▲ CAUTION

Do not use screwdriver or other means to short speed-up pins. If pins are accidentally grounded, control board is destroyed.

9. Unit is now operating in defrost mode. Using voltmeter, check between R and W2 as shown in Fig. 11.

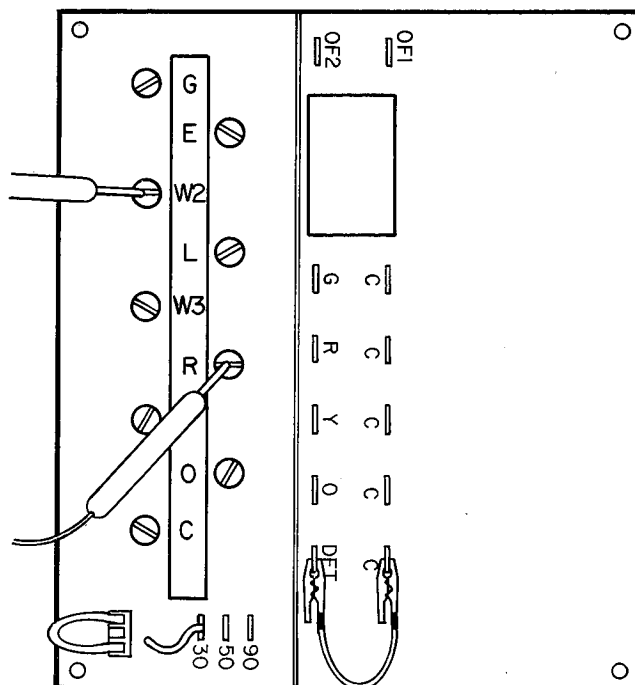


Fig. 11 — Checking Between R and W2

Reading on voltmeter should indicate zero volts. This step ensures defrost relay contacts have closed, energizing supplemental heat and reversing valve solenoid.

10. Unit should remain in defrost no longer than 10 minutes. Actual time in defrost depends on how quickly speed-up jumper is removed. If it takes 3 seconds to remove speed-up jumper after unit has switched to defrost, only 7 minutes of defrost cycle remains.
11. After a few minutes in defrost (cooling) operation, liquid line should be warm enough to have caused defrost thermostat contacts to open. Check resistance across defrost thermostat. Ohmmeter should read infinite resistance, indicating defrost thermostat has opened.
12. Shut off unit power and reconnect fan lead.
13. Remove jumper wire from speed-up terminal protective cover and reinsert cover on speed-up terminals. *Failure to remove jumper causes unit to speed up operating cycles continuously.*
14. Remove jumper between DFT and C terminals. Reconnect defrost thermostat leads.
15. Replace control box cover. Restore power to unit.

If defrost thermostat does not check out following above steps or incorrect calibration is suspected, check for a defective thermostat as follows:

1. Follow steps 1 - 5 above.
2. Using thermocouple temperature measuring device, route sensor or probe underneath coil (or other convenient location). Attach to liquid line near defrost thermostat. Insulate for more accurate reading.
3. Restart unit in heating.
4. Within a few minutes, liquid line temperature drops within a range causing defrost thermostat contacts to close. Temperature range is from 32 F to 22 F. Notice temperature at which ohmmeter reading goes from ∞ to 0 ohms. Thermostat contacts close at this point.
5. Remove protective cover from TP1 and TP2 speed-up terminals, insert jumper wire into protective cover, reinsert protective cover on the speed-up terminals.
6. Unit changes over to defrost within 90 seconds (depending on timing cycle setting). Liquid line temperature rises to range where defrost thermostat contacts open. Temperature range is from 75 F to 85 F. Resistance goes from 0 to ∞ when contacts open.
7. If either opening or closing temperature does not fall within above ranges, or thermostat sticks in one position, replace thermostat to ensure proper defrost operation.

FAN MOTORS (See Fig. 12.) Fan motor powers fan that draws air through outdoor coil to perform heat exchange. Motors are totally enclosed to increase reliability. This also eliminates need for rain shield. Motors are provided with color-coded terminal block to facilitate removal. Oilers are provided on motor bearings. Adhere to following schedule for fan motor lubrication.

▲ CAUTION

Turn off all power to unit before servicing or replacing fan motor.

Fan Motor Bearings — Oiling holes are provided at each end of condenser fan motor. Remove fan motor, lubricate

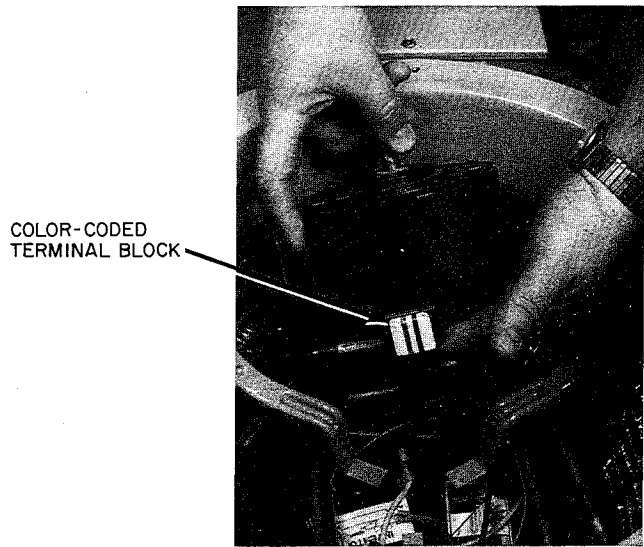


Fig. 12 — Removing Outdoor Fan Motor

motor with 32 drops (16 drops per hole) of SAE 10 non-detergent oil at intervals described below:

- a. *Annually*, when environment is very dirty, ambient temperature is higher than 105 F (40 C), and average unit operating time exceeds 15 hours a day.
- b. *Every 3 years*, when environment is reasonably clean, ambient temperature is less than 105 F (40 C) and unit operating time averages 8 to 15 hours a day.
- c. *Every 5 years*, when environment is clean, ambient temperature is less than 105 F (40 C) and unit operating time averages less than 8 hours a day.

After motor is lubricated, be sure fan prop is positioned correctly on motor shaft. See Fig. 13.

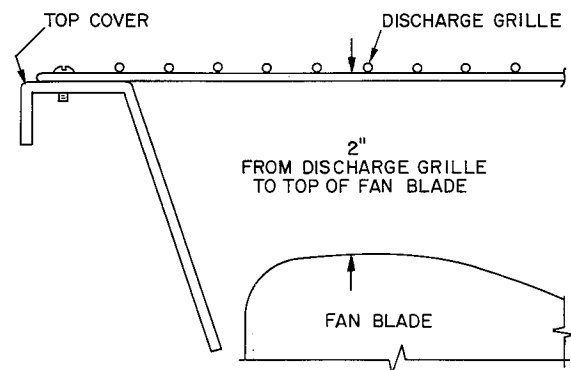


Fig. 13 — Condenser Fan Position

Fan motors should present no problem in troubleshooting. A motor with seized or tight bearings can sometimes be saved or have its life extended by adding oil to the bearings.

▲ CAUTION

Be sure unit main power switch is turned off. Failure to do so may result in electric shock, or injury from rotating fan blade.

For suspected electrical failures, check for loose or faulty electrical connections, or defective fan motor

capacitor. Fan motor is equipped with thermal overload device in motor windings which may open under adverse operating conditions. Allow time for motor to cool so device can reset. Further checking of motor can be done with an ohmmeter. Set scale on R x 1 position, check for continuity between 3 leads. Replace motors that show an open circuit in any of the windings. Place one lead of ohmmeter on each motor lead. At same time, place other ohmmeter lead on motor case (ground). Replace any motor that shows resistance to ground. Obviously any motor that shows signs of arcing, burning or overheating should be suspect and replaced.

SERVICE SENTRY CONTROL BOARD — Service Sentry control provides immediate warning when outdoor heat pump requires servicing. It turns on indoor thermostat light if compressor doesn't operate for either heating or cooling. This enables owner to obtain speedy heat pump service during heating season, reducing supplementary electric heat costs, and during cooling season, reducing period of heat discomfort, Fig. 14.

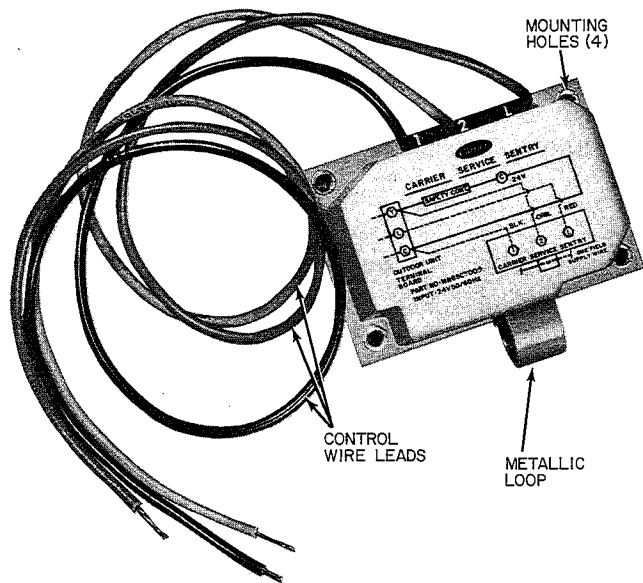


Fig. 14 — Service Sentry Control

Use Service Sentry control with single-phase Carrier heat pumps equipped with 24-v control circuit.

Connect black, orange and red pigtails (24 v) on Service Sentry to outdoor unit control circuit terminal board. See Fig. 15 and wiring diagram on unit. An extra control wire is required between L terminals on outdoor unit, indoor unit and thermostat subbase (the L terminal is currently being added to outdoor and indoor unit terminal blocks). If units do not already have L terminal, splice control wire between L terminals on Service Sentry and thermostat subbase. Terminal L is labeled terminal X on some thermostat subbases (all future subbases will read terminal L).

Connect all field line power wires to unit in usual manner. However, route *one field line power supply wire* through metallic loop on bottom of Service Sentry, then to normal unit connection. On 015 (230-1-60) and 018 (230-1-60) units, pass supply wire through metallic loop twice, as shown in Fig. 14 and 15. On all other units, pass supply wire through loop only once.

Refer to Fig. 15 for wiring connections when Service Sentry and solid-state Time Guard II accessories are used.

The Service Sentry is an accessory device. On heat pump DL and CD option packages, a slightly different version of Service Sentry is installed as standard equipment. It functions almost identically to accessory Service Sentry except that it locks out compressor under certain adverse operating conditions. System is manually reset by shutting it off at thermostat subbase, then turning it back on. If adverse condition is corrected, system restarts.

One example of an adverse condition would be if system is located in a desert climate where high operating temperatures may cause system to shut down on the high-pressure switch, or on the compressor internal overload.

Service Sentry Requires 2 Inputs:

1. It must sense a 24-v input from thermostat. As thermostat calls for heating or cooling, it supplies 24 v to Service Sentry device.
2. A current transformer (or induction loop) similar to a clamp-on ammeter senses current draw in the compressor lead. Induction loop must sense a minimum current draw when thermostat is calling for heating or cooling.

NOTES:

1. On a single-phase compressor, induction loop senses current in common leg.
2. On a 3-phase compressor, induction loop senses current in one of the phases.

Troubleshooting Service Sentry device is easy. With thermostat calling for heating or cooling and compressor running, indoor thermostat light should be off. If on, check for wiring errors or replace the Service Sentry.

To check for correct operation, shut off circuit breaker or disconnect switch to outdoor unit *while it is running*. Signal light on thermostat should light. If this does not occur, check for wiring errors or replace the Service Sentry.

⚠ CAUTION

If Service Sentry needs replacing, shut off all power to unit before attempting repairs.

OUTDOOR THERMOSTATS — (See Fig. 16.) Outdoor thermostat brings on stages of electric heat as outdoor temperature and heat pump output drops. Setting at which thermostat closes is variable, depending on design of system. It is set at time of installation and should not be changed without good reason. Up to 2 outdoor thermostats may be installed. Some systems may not have any thermostat.

Although these devices are installed in control circuit (24 v), turn off all power to unit before attempting to troubleshoot thermostat.

Use a standard ohmmeter to check for continuity through thermostat. If you suspect thermostat is out of calibration, use calibrated electronic thermometer to determine correct outdoor temperature. Insert a screwdriver blade in adjustment slot and turn thermostat switch until it closes. Observe this using ohmmeter across switch. Read temperature setting when switch closes. It should be close to reading observed using electronic thermometer. Any setting within ± 5 degrees is acceptable.

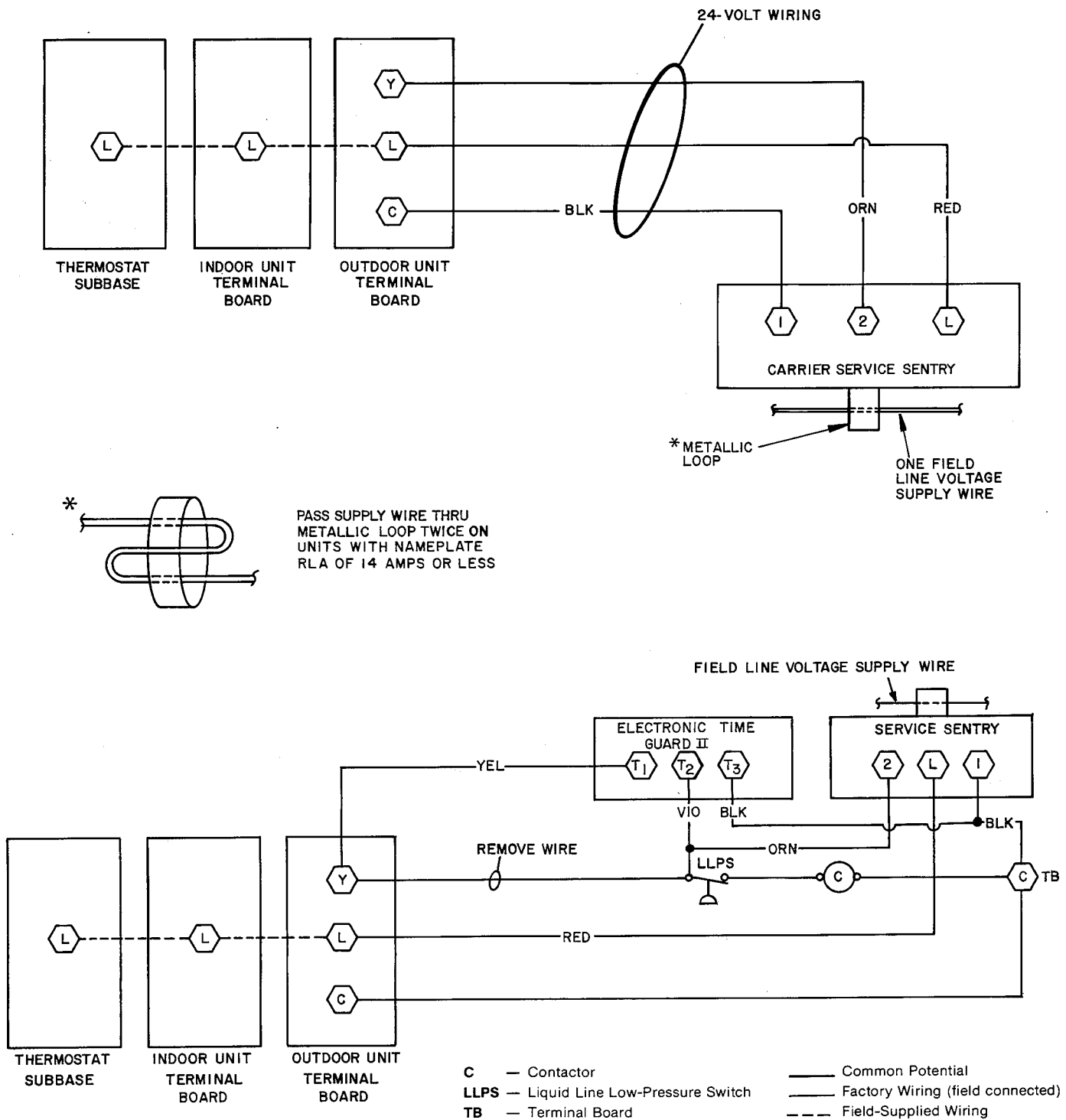


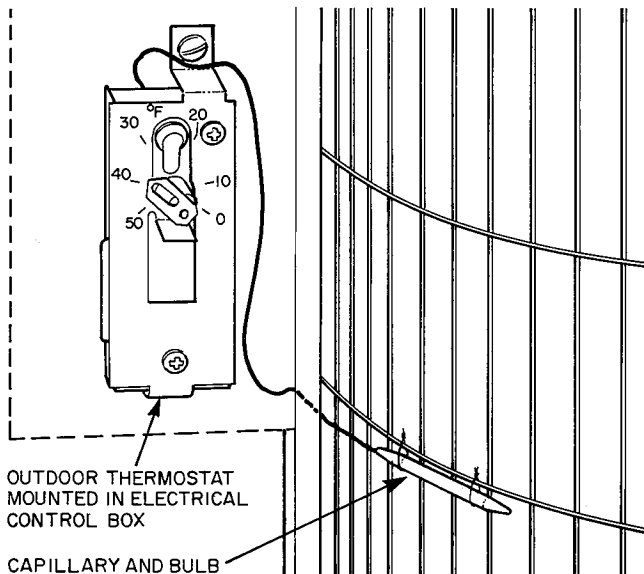
Fig. 15 — Wiring Connections for Service Sentry and Solid-State Time Guard II

Compressor — The compressor is the heart of the refrigeration system. It pumps refrigerant through the system. If it malfunctions, the whole system suffers.

The compressor is an electrical (as well as mechanical) device. Extreme caution should be exercised when working near compressors. Power should be shut off, if possible, for most troubleshooting techniques. Refrigerants in system present other safety hazards. *Always* wear safety glasses and gloves when handling refrigerants.

Compressor failures are classified in 2 broad failure categories, mechanical and electrical. Both types are discussed below and on page 13.

MECHANICAL FAILURES — Compressor is a mechanical pump driven by an electric motor contained in a welded or hermetic shell. In a mechanical failure, motor or electrical circuit appears normal, but compressor does not function normally.



NOTES:

1. Affix capillary and bulb on outside of grille wire nearest control box.
2. Secure bulb to grille with wire ties or suitable fastener.
3. If necessary, shield bulb from direct sunlight using appropriate material.

Fig. 16 — Outdoor Thermostat Installation

⚠ CAUTION

Exercise extreme caution when reading compressor currents, as high-voltage power is on. Correct any of the problems described below before installing and running a replacement compressor. Wear safety glasses and gloves when handling refrigerants.

Locked Rotor — In this type of failure, compressor motor and all starting components are normal. When compressor attempts to start, it draws locked rotor current and cycles off on the internal protection. Locked rotor current is measured by applying a clamp-on ammeter around common lead of the compressor on a single-phase compressor, or any one of the leads on a 3-phase compressor. Then measure current it draws when it attempts to start. LRA (locked rotor amp value) is stamped on compressor nameplate.

If compressor draws locked rotor amps, and all other external sources of problems have been eliminated, compressor must be changed. Because compressor is a sealed unit, it is impossible to determine exact mechanical failure. However, complete system should be checked for abnormalities such as incorrect refrigerant charge, restrictions, insufficient airflow across indoor or outdoor coil, etc., which could be contributing to the failure.

Runs, Doesn't Pump — In this type of failure, compressor motor runs and turns compressor, but compressor does not pump the refrigerant. A clamp-on ammeter on common leg of a single-phase compressor, or any one lead of a 3-phase compressor, shows a very low current draw, much lower than RLA (rated load amps) value stamped on compressor nameplate. Because no refrigerant is being pumped, there is no return gas to cool compressor motor. It eventually overheats and shuts off on its internal protection.

Runs — Doesn't Pump, High-To-Low Side Leak — This failure is similar to previous one except compressor is

pumping. Usually, an internal problem such as blown head gasket or broken internal discharge line causes compressor to pump hot discharge gas back into its own shell rather than through system.

Using pressure gages on service valves shows high suction and low discharge pressure readings. Motor currents are lower than normal. Because hot gas is being discharged into shell, the shell becomes hot. The hot gas causes compressor motor to cycle off on its internal protection.

Runs and Pumps, Low Capacity — This failure type is difficult to pinpoint because extent of damage varies. Compressor is a pump with internal valves that enable compressor to pump properly. On multicylinder compressors, each cylinder has a complete set of suction and discharge valves. Any of these parts may become damaged or broken causing loss in pumping capacity. Severity of damage determines amount of capacity loss. Use pressure gages to find any abnormal system pressures if system charge and other conditions are normal.

An owner may complain that a unit is not handling the building's heating or cooling load. The compressor current draw may be abnormally low or high. Although this type of failure does occur, all other possible causes of capacity loss must be eliminated before condemning compressor.

Noisy Compressor — May be caused by variety of internal problems such as loosened hardware, broken mounting springs, etc. May also be caused by system problems. Overcharging a compressor causes operating noise, particularly at start-up. Certain single-cylinder compressors are noisy at start-up and may operate noisily. Too much oil in compressor may cause noise. Normally this problem is encountered only after a replacement compressor has been added, without purging oil from previous compressor. As new compressor pumps, excess oil in system returns and adds to volume already present, causing noise.

Compressor Leaks — Sometimes a leak is detected at weld seam around girth of compressor, or a fitting that joins compressor shell. Many of these leaks can be repaired and the compressor saved if correct procedure is followed. Turn off all power to unit. Remove all refrigerant from system so that gage pressure is 0 psi. Use safety glasses and gloves when handling refrigerants. Clean area around leak to bare metal. Apply flux and repair joint with silver solder. *Do not* use low-temperature solder such as 50-50. Clean off excess flux, check for leaks, and apply paint over repaired area to prevent corrosion. *Do not* use this method to repair a compressor leak due to severe corrosion. Never attempt to repair a compressor leaking at electric terminals. This type of failure requires compressor replacement.

ELECTRICAL FAILURES — The compressor mechanical pump is driven by an electric motor within hermetic shell. In electrical failures, compressor does not run although external electrical and mechanical systems appear normal. Compressor must be checked electrically for abnormalities.

Before troubleshooting compressor motor, review this description of compressor motor terminal identification.

Single-Phase Motors — See Fig. 17. To determine terminals C, S, and R: Turn off all unit power. Short the run (and start) capacitor to prevent shock. Remove all wires from motor terminals. Using an ohmmeter on 0-10 ohm scale, read resistance between all pairs of terminals. Determine 2 terminals that provide greatest resistance reading. Through elimination, remaining

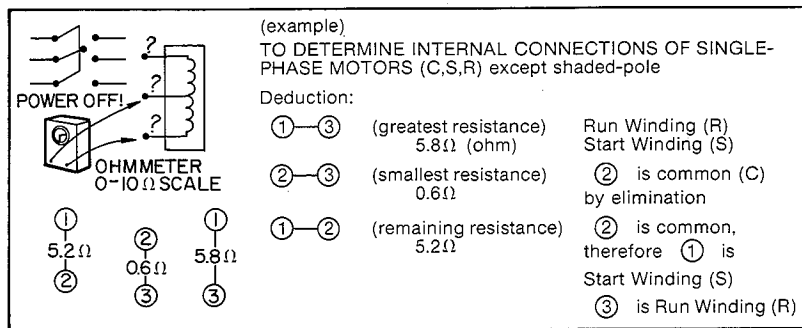


Fig. 17 — Determining Internal Connections

terminal must be common (C). Greatest resistance between common (C) and another terminal indicates start winding because it has more turns. This terminal is start (S). Remaining terminal will be run winding (R).

NOTE: If there is an internal line break protector, it must be closed.

Three-Phase Motors — See Fig. 18. Resistance readings between all 3 sets of windings should be the same.

All compressors are equipped with internal motor protection. If motor becomes hot for any reason, protector opens. Compressor should always be allowed to cool and protector to close before troubleshooting. Always turn off all power to unit and disconnect leads at compressor terminals before taking readings.

Most common motor failures are due to either an open, grounded or short circuit. Directions below are specifically for single-phase units, however, they also apply to 3-phase compressors. When a single-phase compressor fails to start or run, 3 tests can help determine the problem. First, all possible external causes should be eliminated, such as overloads, improper voltage, pressure equalization, defective capacitor(s), relays, wiring, etc. If compressor has internal line break overload, be sure it is closed.

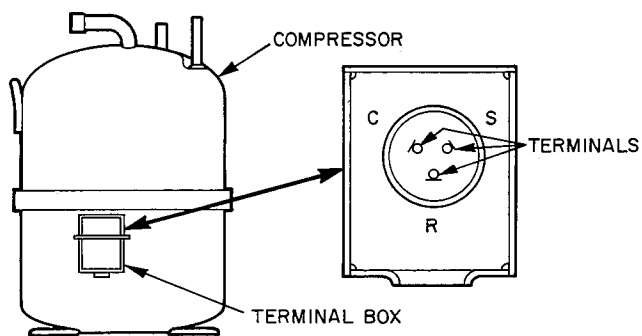


Fig. 18 — Compressor Terminals

Open Circuit — To determine if any winding has a break in the internal wires and current is unable to pass through: Be sure all power is off. Discharge all capacitors. Remove wires from terminals C, S and R. Use an ohmmeter on 0-1000 ohm scale to check resistance from C-R, C-S and R-S. Because winding resistances are usually less than 10 ohms, each reading appears to be approximately zero ohm. If resistance remains at 1000 ohms, an open or break exists and compressor should be replaced.

⚠ CAUTION

Be sure internal line break overload is not temporarily open.

Ground Circuit — To determine if a wire has broken or come in direct contact with shell, causing a direct short to ground: Be sure all power is off. Discharge all capacitors. Remove wires from terminals C, S and R. On hermetic compressors, allow crankcase heaters to remain on for several hours before checking motor to ensure windings are not saturated with refrigerant. Use an ohmmeter on R x 10,000 ohm scale. A megohmmeter may be used in place of ohmmeter (follow manufacturer's instructions). Place one meter probe on ground or on compressor shell. Make a good metal-to-metal contact. Place other probe on terminals C, S and R in sequence. Note meter scale. If reading of zero or low resistance is obtained, motor is grounded. Replace compressor.

A compressor of one-ton capacity or less is probably grounded if resistance is below one million ohms. On larger size single-phase compressors, resistance to ground should not be less than 1000 ohms per volt of operating voltage.

Example:

$$230-1-60 \dots 230 \times 1000 = 230,000 \text{ ohms minimum.}$$

Short Circuit — To determine if any wires within windings have broken through their insulation and made contact with other wires, thereby shorting all or part of the winding(s): First, be sure the following conditions are met:

1. Correct motor winding resistances must be known before testing, either from previous readings or from manufacturer's specifications.
2. Temperature of windings must be as specified, usually about 70 F.
3. Resistance measuring instrument must have an accuracy within $\pm 5\%$ - 10% . This requires accurate ohmmeter (such as a Wheatstone bridge or null balance-type instrument).
4. Motor must be dry or free from direct contact with liquid refrigerant.

Make This Critical Test — (Not advisable unless above conditions are met.) Be sure all power is off. Discharge all capacitors. Remove wires from terminals C, S and R. Place instrument probes together, determine probe and lead wire resistance. Check resistance readings from C-R, C-S and R-S. Subtract instrument probe and lead

resistance from each reading. If any reading is within $\pm 20\%$ of known resistance, motor is probably normal. Usually a considerable difference in reading is noted if a turn-to-turn short is present.

SYSTEM CLEAN-UP AFTER BURN-OUT

⚠ CAUTION

Turn off all power to unit before proceeding. Wear safety glasses and gloves when handling refrigerants. Acids formed as a result of motor burn-out can cause burns.

Some compressor electrical failures can cause motor to burn. When this occurs, byproducts of burn, which include sludge, carbon and acids contaminate system. If burn-out is severe enough, system must be cleaned before replacement compressor is installed. The 2 types of motor burn-out can be classified as mild or severe.

In *mild* burn-out, there is little or no odor detectable. Compressor oil is clear or slightly discolored. An acid test of compressor oil will be negative. This type of failure is treated the same as mechanical failure. Liquid line strainer should be removed and liquid line filter drier installed.

In a *severe* burn-out, there is a strong, pungent, rotten egg odor. Compressor oil is very dark. Evidence of burning may be present in tubing connected to compressor. An acid test of compressor oil will be positive. Complete system must be reverse-flushed with refrigerant. Accurater™ or TXV *must* be cleaned or replaced. In a heat pump, accumulator and reversing valve are replaced. These components are also removed and bypassed during reverse-flushing procedure. Remove and discard liquid line strainer. After system is reassembled, install liquid and suction line filter driers, run system for 2 hours. Discard both driers, install new liquid line drier only.

COMPRESSOR REMOVAL AND REPLACEMENT

— Once it is determined that compressor has failed and the reason established, compressor must be changed.

Shut off all power to unit. Remove all refrigerant from system until pressure gage reads 0 psi.

⚠ CAUTION

Wear safety glasses and gloves when handling refrigerants. Disconnect electrical leads from compressor. Disconnect or remove crankcase heater. Remove compressor holddown bolts.

Cut compressor from system with tubing cutters. Do not use brazing torch for compressor removal. Oil vapor may ignite when compressor is disconnected. Scratch matching marks on stubs in old compressor. Make corresponding marks on replacement compressor. Use torch to remove stubs from old compressor and to re-install them in replacement compressor. Use copper couplings to tie compressor back into system. Wear safety glasses when using brazing torch. Evacuate system, recharge, check for normal system operation.

Refrigeration System

REFRIGERATION CYCLE — In a refrigerant system, refrigerant moves heat from one place to another. It is useful to understand flow of refrigerant in a system. In a *straight cooling* system, compressed hot gas leaves compressor and enters condensing coil. As gas passes through condenser coil it rejects heat and condenses into liquid. The liquid leaves condensing unit through liquid

line and enters metering device at indoor coil. As it passes through metering device, it becomes a gas-liquid mixture. As it passes through indoor coil, it absorbs heat and refrigerant is again changed to gas. The gas is returned to compressor, where it is compressed to a hot gas, and cycle repeats.

In a *heat pump* (see Fig. 19), the basic cycle is the same. Reversing valve in system decides which coil, indoor or outdoor, becomes evaporator or condenser. In heating mode, indoor coil is condenser. It rejects heat into the home after heat is absorbed by outdoor evaporator coil. Thus, home is heated.

In *cooling cycle*, indoor coil becomes evaporator. It absorbs heat from home and rejects it out-of-doors through outdoor condenser coil. Thus, home is cooled.

A unique feature of the heat pump is that metering devices are designed to meter refrigerant in one direction of flow, and allow refrigerant to pass unhindered in other direction. If indoor metering device is metering refrigerant, outdoor device bypasses refrigerant and vice versa. This allows both coils to serve a dual function.

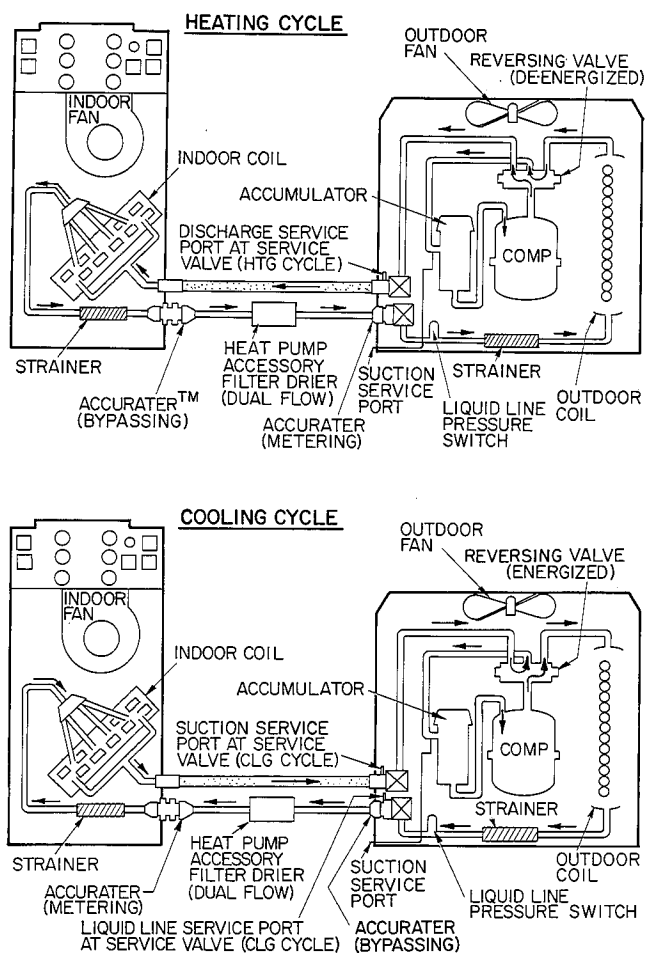


Fig. 19 — 38QN Heat Pump Refrigerant Flow Diagrams

LEAK DETECTING — (See Fig. 20.) New installations should be checked for leaks prior to complete charging.

⚠ CAUTION

Always wear safety glasses and gloves when handling refrigerants.

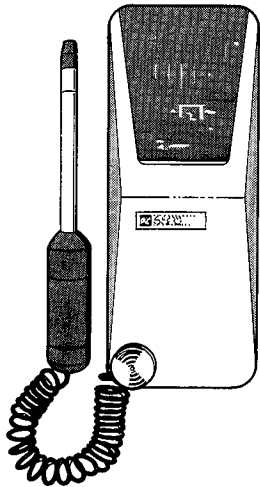


Fig. 20 — Leak Detector

If a system has lost all or most of its charge, system must be pressurized again, up to approximately 150 lb minimum. This can be done by adding refrigerant, using normal charging procedures. Or, it may be pressurized with nitrogen (less expensive than refrigerant). Nitrogen also leaks faster than R-22 and is not absorbed by refrigeration oil. Nitrogen cannot, however, be detected by leak detector.

CAUTION

Due to explosive pressures of nitrogen, it should never be used without a pressure regulator on the tank.

On the other hand, leaks in a system pressurized with refrigerant can be spotted with a leak detector which detects extremely small refrigerant leaks. This discussion assumes that system is pressurized with either all refrigerant or a mixture of nitrogen and refrigerant.

If system has been operating for some time, make first check for a leak visually. Since refrigerant carries a small quantity of oil, traces of oil at any joint or connection is an indication the refrigerant is leaking at that point.

A simple and inexpensive method of testing for leaks is to use soap bubbles. Any solution of water and soap may be used.

Soap solution is applied to all joints and connections in system. A small pinhole leak is located by tracing bubbles in soap solution around leak.

Electronic leak detectors are now available for checking for leaks. These unquestionably represent the most efficient and easiest method for checking for leaks. There are various types of electronic leak detectors. Generally speaking, they are all portable, most are lightweight, and consist of a box with several switches and a probe or sniffer. Detector is turned on and probe is passed around all fittings and connections in system. Leak is detected by either a movement of a pointer on detector dial, by a buzzing sound or a light.

In all instances, when a leak is found, system charge must be *bled down* and leak repaired before final charging and operation. After leak is repaired, evacuate system, and correct refrigerant charge.

SERVICE VALVES (See Fig. 21.) Service valves provide means for holding original factory charge in outdoor unit prior to hookup to indoor coil. They also contain

gauge ports for measuring system pressures, and provide shutoff convenience for certain types of repairs.

Vapor line on all units and liquid line on condensing units are connected to service valves by means of Compatible Fitting. This mechanical-type fitting is also used as a sweat fitting. Connections are made as follows:

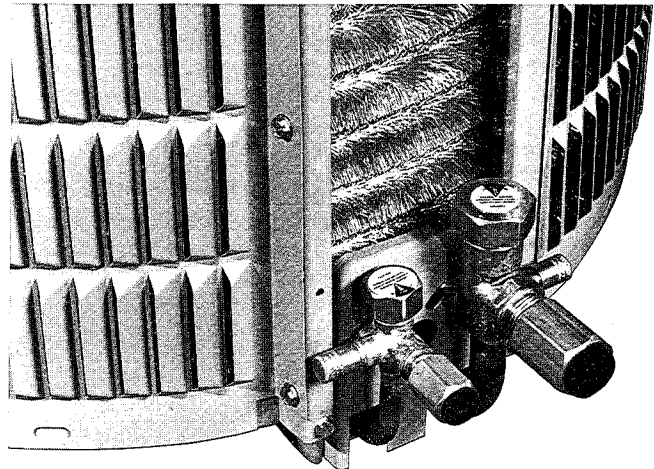


Fig. 21 — Service Valves

COMPATIBLE FITTING
CUT HERE

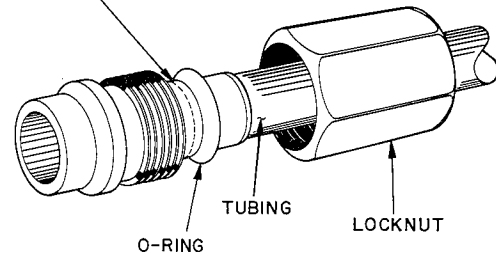


Fig. 22 — Carrier Compatible Fitting

CARRIER COMPATIBLE FITTING — (See Fig. 22.) Mechanical Connection to Compatible Fitting — (Mate one set of connections at a time.)

1. Loosen nut on Compatible Fitting one turn. Do not remove.
2. Remove plug, be sure O-ring is in groove inside Compatible Fitting.
3. Cut tubing to correct length. Deburr and size properly.
4. Insert tube into Compatible Fitting until it bottoms.
5. Tighten nut until it bottoms on shoulder of fitting. Keep tube bottomed in Compatible Fitting while tightening nut.

Sweat Connection to Compatible Fitting — (Use refrigerant grade tubing.)

1. Remove locking nut, rubber O-ring and Schrader core from valve.
2. Cut tubing to correct length. Deburr and size properly.
3. Insert tube into Compatible Fitting.
NOTE: Wrap top and bottom of service valves in wet cloth to prevent damage by heat. Solder with low-temperature 430 F (221 C) silver alloy solder.
4. Replace Schrader core.
5. Evacuate or purge system with field-supplied refrigerant.

This type of fitting is easily repaired if leaks develop.

▲ CAUTION

Wear safety glasses and gloves when handling refrigerants.

Frontseat outdoor section service valves after relieving refrigerant pressure in system. Back locknut off Carrier Compatible Fitting onto tube. Cut fitting between threads and O-ring. Remove tubing section remaining in threaded portion of fitting. Discard locknut.

Clean, flux and insert new tube end into remaining portion of Carrier Compatible Fitting. Wrap valve in wet cloth to prevent damaging valve. Heat and apply low-temperature solder (430 F [221 C]).

Leaking Sweat Connection — Frontseat service valves and relieve refrigerant pressure in tubing. Clean and flux area around leak and apply low-temperature solder (430 F [221 C]).

Liquid line service valves on all heat pump models differ from condensing unit valves in that heat pump connection has 3/8-in. male flare. When making connection, remove flare nut, install it on liquid line prior to flaring. Flare liquid line using standard flaring techniques. Valve also contains piston and retainer. Service as follows:

ACCURATER™ (Bypass Type) COMPONENTS — (See Fig. 23.) AccuRater piston has a refrigerant metering hole through it. Retainer forms a stop for piston in refrigerant bypass mode, and a sealing surface for liquid line flare connection. To check, clean or replace piston:

1. Shut off power to unit.
2. Pump unit down using Pumpdown Procedure described in this Service Manual.
3. Remove liquid line flare connection from AccuRater.
4. Pull retainer out of body, being careful not to scratch flare sealing surface. If retainer does not pull out easily, carefully use locking pliers to remove it.
5. Slide piston out by inserting a small soft wire, with small kinks, through metering hole. Do not damage metering hole, sealing surface around piston cones or fluted portion of piston.
6. Clean piston refrigerant metering hole.
7. Replace retainer O-ring (Part No. 99CC501052) before reassembling bypass-type AccuRater.

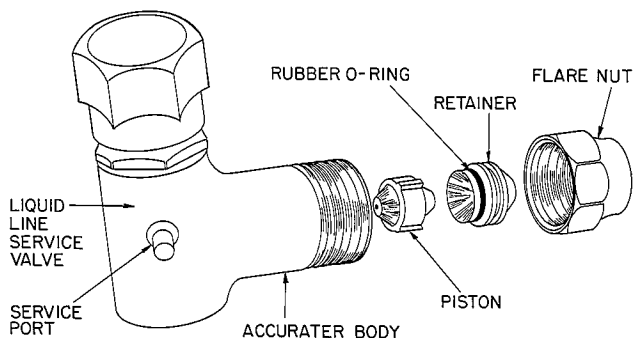


Fig. 23 — AccuRater™ (Bypass Type) Components

Service valves provide a convenient shutoff valve useful for certain refrigeration system repairs. System may be pumped down to make repairs on low side without losing complete refrigerant charge.

1. Attach pressure gage to suction service valve gage port.

2. Frontseat liquid line valve.
3. Start unit in cooling mode. Run until suction pressure reaches 5 psig (35 kPa).
4. Shut unit off. Frontseat suction valve.
5. Vent remaining pressure to atmosphere.

▲ CAUTION

All outdoor unit coils will hold only factory-supplied amount of refrigerant. Excess refrigerant may cause unit to relieve pressure through internal pressure relief valve (indicated by sudden rise of suction pressure) before suction pressure reaches 5 psig (35 kPa). If this occurs, shut off unit immediately, frontseat suction valve, and vent remaining pressure to atmosphere.

REVERSING VALVE — (See Fig. 24.) In heat pumps, changeover between heating and cooling modes is accomplished with a valve that reverses flow of refrigerant in system. This reversing valve device is easy to troubleshoot and replace. The reversing valve solenoid can be checked with power off with an ohmmeter. Check for continuity and shorting to ground. With control circuit (24v) power on, check for correct voltage at solenoid coil. Check for burned or overheated solenoid.

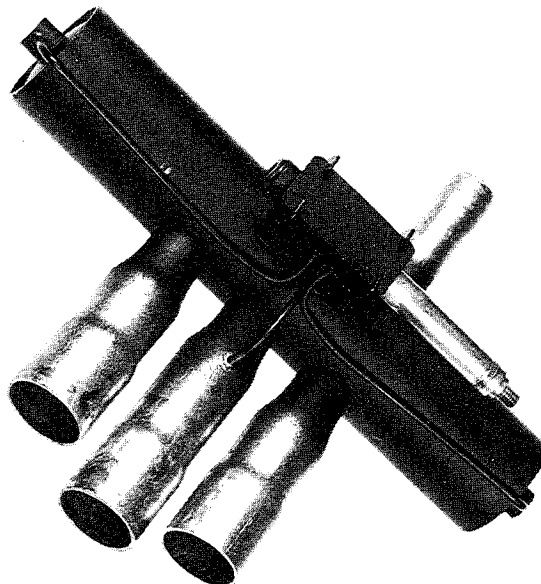
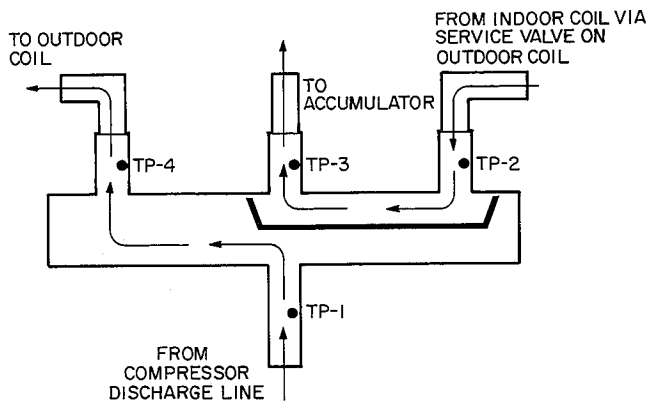


Fig. 24 — Reversing Valve

With unit operating, other items can be checked, such as frost or condensate water on refrigerant lines.

The sound made by a reversing valve, as it begins or ends defrost, is a loud whooshing noise, as reversing valve reverses, and pressures in system equalize. An experienced service person detects this sound and uses it as a valuable troubleshooting tool.

Using a remote measuring device, check inlet and outlet line temperatures. *Do not* touch lines. If reversing valve is operating normally, inlet and outlet temperatures on appropriate lines should be close. Any difference would be due to heat loss or gain across valve body. Temperatures are best checked with a remote reading electronic-type thermometer with multiple probes. Route thermocouple leads to inside of coil area through service valve mounting plate area underneath coil. Figures 25 and 26 show test points on reversing valve for recording temperatures. Insulate points for more accurate reading.

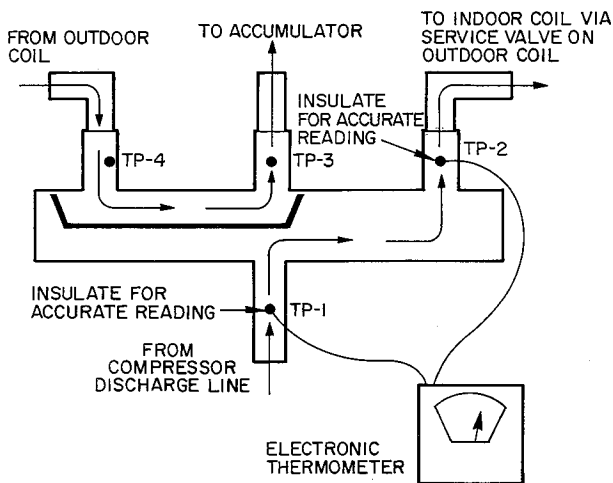


TP = Test Point

TP-2 and TP-3 Cool or cold, may have condensation or frost on both lines entering valve body, 5F to 10F maximum temperature difference across normally operating valve.

TP-1 and TP-4 Hot, 5F to 10F maximum temperature difference across normally operating valve.

Fig. 25 — Reversing Valve (Cooling Mode or Defrost Mode, Solenoid Energized)



TP = Test Point

TP-1 and TP-2 Hot, 5F to 10F maximum temperature difference across normally operating valve.

TP-3 and TP-4 Cool or cold, may have condensation or frost on both lines into valve body, 5F to 10F maximum temperature difference across normally operating valve.

Fig. 26 — Reversing Valve (Heating Mode Solenoid De-Energized)

If valve is defective: Shut off all power to unit. Some smaller sizes may require coil to be removed to gain access to reversing valve. See appropriate coil removal section. Remove all charge from system.

Remove solenoid coil from valve body. Remove valve by cutting it from system with tubing cutter. Repair person should cut in such a way that stubs can be easily rebrazed back into system. Do not use hacksaw. This introduces chips into system that cause failure. After defective valve is removed, wrap it in wet rag and carefully unbrazed stubs. Save stubs for future use. Because defective valve is not overheated, it can be analyzed for cause of failure when it is returned.

Braze new valve onto used stubs. Keep stubs oriented correctly. Scratch corresponding matching marks on old valve and stubs, and new valve body, to aid in lining up new valve properly. When brazing stubs into valve, protect valve body with wet rag to prevent overheating.

Use slip couplings to install new valve with stubs back into system. Even if stubs are long, wrap valve with a wet rag to prevent overheating.

After valve is brazed in, check for leaks. Evacuate and charge system. Operate system in both modes several times to be sure valve functions properly.

COIL REMOVAL — (See Fig. 27.) Coils on this family of units are easy to remove if required for compressor removal, or to replace coil. Shut off all power to unit. Remove refrigerant from system through service valves.

CAUTION

Wear safety glasses and gloves when handling refrigerants. If unit is equipped with a louvered casing, refer to Cabinet Servicing for casing removal procedure.

1. Remove discharge grille by removing 3 (015-030) or 6 (036-060) screws.
2. Remove control box cover (3 screws).
3. Remove fan/motor/orifice assembly by removing 4 screws (2 in top of control box). Prior to lifting out assembly, unplug motor wires from base of motor.

WARNING

Avoid possibility of fire and personal injury by cutting tubing.

4. Use midget tubing cutter to cut liquid and vapor lines at both sides of coil. Cut in convenient location for easy reassembly with copper slip couplings.

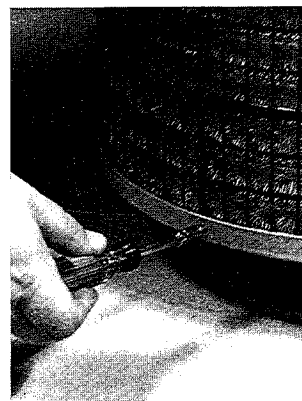
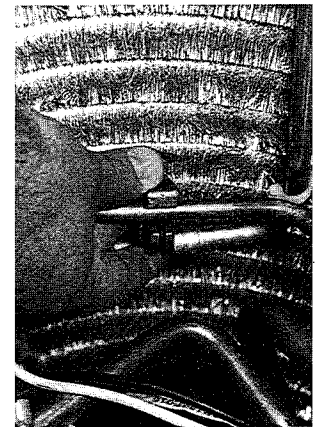


Fig. 27 — Removing Outdoor Coil

5. Remove 2 (015,018) or 4 (024,060) screws at base of coil (located at end of large vertical wires in coil support).
6. Lift coil vertically from basepan, place aside carefully.
NOTE: When coil is removed, use opportunity to also remove liquid line strainer. Strainer location is identified by label on liquid line.
7. Reverse procedure to reinstall coil.

COIL CLEANING — (See Fig. 28, 29.) For best unit efficiency, clean outdoor coil prior to start of each heating or cooling season. Shut off all power to unit if coil is equipped with louvered casing. Refer to Cabinet Servicing for casing removal procedure. To clean coil:

▲ CAUTION

Coil fin damage can result in higher operating costs or compressor damage. Do not use flame, high-pressure water, steam, volatile or corrosive cleaners on fins or tubing.

Clean coil using vacuum cleaner and its crevice tool. Move crevice tool *vertically*, close to area being cleaned, making sure tool touches only the dirt on the fins and not the fins. To prevent fin damage, do not scrub fins with tool or move tool horizontally against fins.

If oil deposits are present, spray coil with ordinary household detergent. Wait 10 minutes, proceed to next step.

Using garden hose, spray coil vertically downward with constant stream of water at moderate pressure. Keep nozzle at a 15 to 20 degree angle, about 3 in. (76 mm) from coil face and 18 in. (457 mm) from tube. Spray so debris is washed out of coil. Reinstall louvered casing if necessary.

Restore power to unit.

LIQUID LINE STRAINER — Heating and cooling models are equipped with a strainer in liquid line. It is marked with identifying sticker. Strainer picks up harmful debris that may be in system. If it becomes plugged, system does not perform properly. System pressures become abnormal and compressor may become very hot and cycle off on its protection device. If strainer is plugged, it can be easily removed.

Shut off all power to unit. Bleed off all refrigerant from system.

▲ CAUTION

Wear safety glasses and gloves when handling refrigerants. Remove fan blades and fan motor to gain access to liquid line. Cut tubing with midget tubing cutter near belled connection close to strainer. Peel off identifying sticker. Unbraid stub.

▲ CAUTION

Wear safety glasses when brazing. Protect any aluminum tubing in vicinity of joint with wet rag to prevent overheating. After stub is removed, pull strainer from line with needle nose pliers. Discard strainer. Do not install another strainer. Braze liquid line together using copper coupling. Cut liquid line between indoor and outdoor units. Install liquid line filter drier (biflow drier for heat pump). Evacuate and charge system. Add charge to compensate for volume needed by drier. Check for normal system operation.

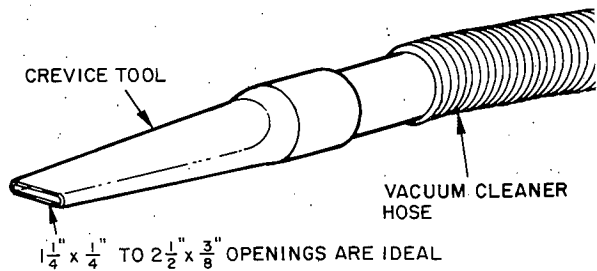


Fig. 28 — Crevice Cleaning Tool

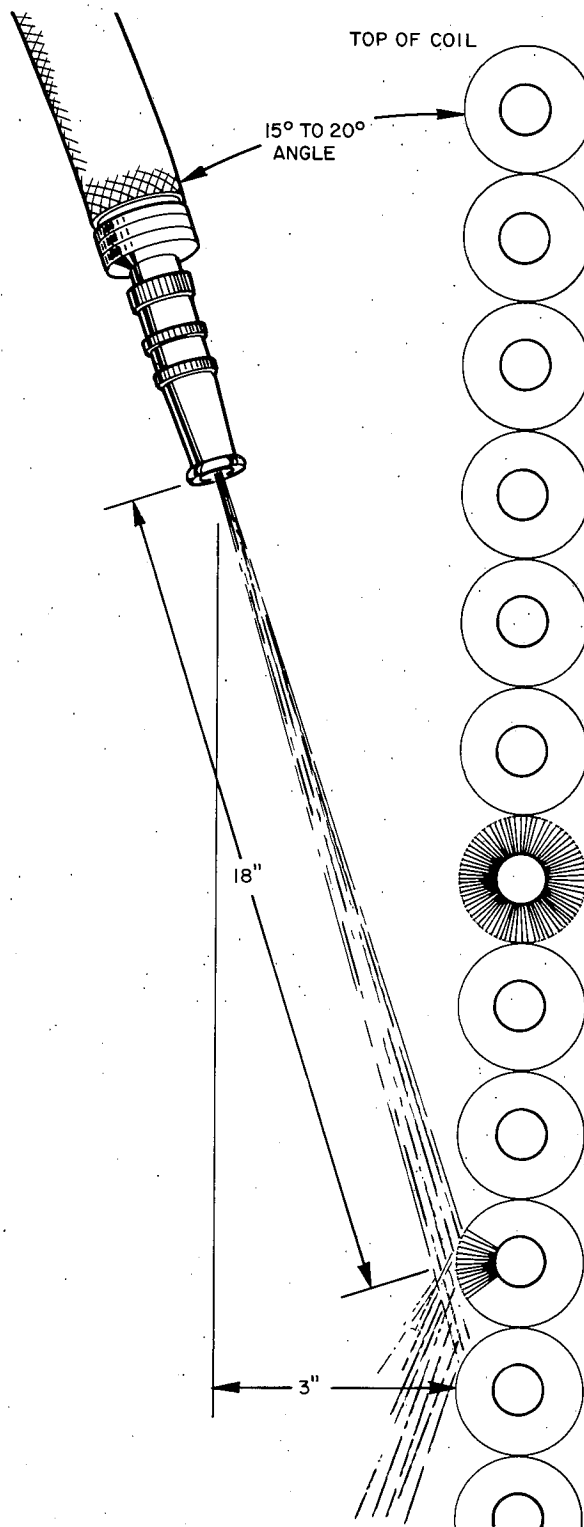


Fig. 29 — Positioning Hose to Spray Coil

New drier takes over function of strainer. *If refrigeration system in outdoor unit is opened for any reason, remove strainer and install a filter drier in liquid line between indoor and outdoor sections.*

ACCUMULATOR — Accumulator is a device always found in heat pumps and in some condensing unit models. Under some light-load conditions on indoor coils (on outdoor coil with heat pump in heating mode), some liquid refrigerant is present in suction gas returning to compressor. Accumulator stores liquid, allows it to boil off into a vapor so it can be safely returned to compressor. Since compressor is designed to pump refrigerant in its gaseous state, introduction of liquid into it could cause severe damage or total failure of compressor.

Accumulator is a passive device which seldom needs replacing. Occasionally its internal oil return orifice or bleed hole may become plugged. Some oil is contained in refrigerant returning to compressor. It cannot boil off in accumulator with liquid refrigerant. Bleed hole allows a small amount of oil and refrigerant to enter return line where velocity of refrigerant returns it to compressor. If bleed hole plugs, oil is trapped in accumulator, and compressor will eventually fail from lack of lubrication. If bleed hole is plugged, accumulator must be changed. Bleed hole is so tiny, cleaning efforts usually are not successful. The only other reason for changing accumulator is if it leaks and is not repairable.

To Change Accumulator: Shut off all power to unit. Remove all refrigerant from system.

▲ CAUTION

Wear safety glasses and gloves when working on refrigerants. Remove discharge grille and remove fan orifice. Refer to Cabinet Servicing section. Some models may require louvered casing and coil to be removed for access to accumulator. Refer to appropriate sections of Service Manual for instructions.

When accumulator is exposed, remove it from system with tubing cutters. Scratch matching marks on tubing

stubs and old accumulator. Scratch matching marks on new accumulator. Unbrazed stubs from old accumulator and braze into new accumulator. Thoroughly rinse any flux residue from joints and paint with corrosion-resistant coating such as zinc-rich paint. Reinstall accumulator into system with copper slip couplings. Evacuate and charge system.

Pour and measure oil quantity (if any) from old accumulator. If more than 20% of oil charge is trapped in accumulator, add oil to compressor to make up for this loss.

SYSTEM CHARGING (for all approved combinations) — System must be charged correctly for normal system operation and reliable operation of components.

▲ CAUTION

Always wear safety glasses and gloves when handling refrigerants. If system has lost all charge, weigh in charge. Use dial-a-charge or digital scale.

If system has some charge, charts are available to check and add small amounts of refrigerant with system running. Refer to individual unit installation instructions for charge charts.

▲ CAUTION

Heat pump charts are for checking charge and performance and for adding a *small* amount of charge. During heating mode, correct method of charging is the weight method. In heating mode, check should be made approximately 15 minutes after a defrost, with unit running with a clean coil. In cooling cycle, system should run at least 10 minutes for temperatures and pressures to stabilize. All charts assume there are no system abnormalities and indoor coil airflows are correct. If system abnormalities exist, correct them before checking system charge.