

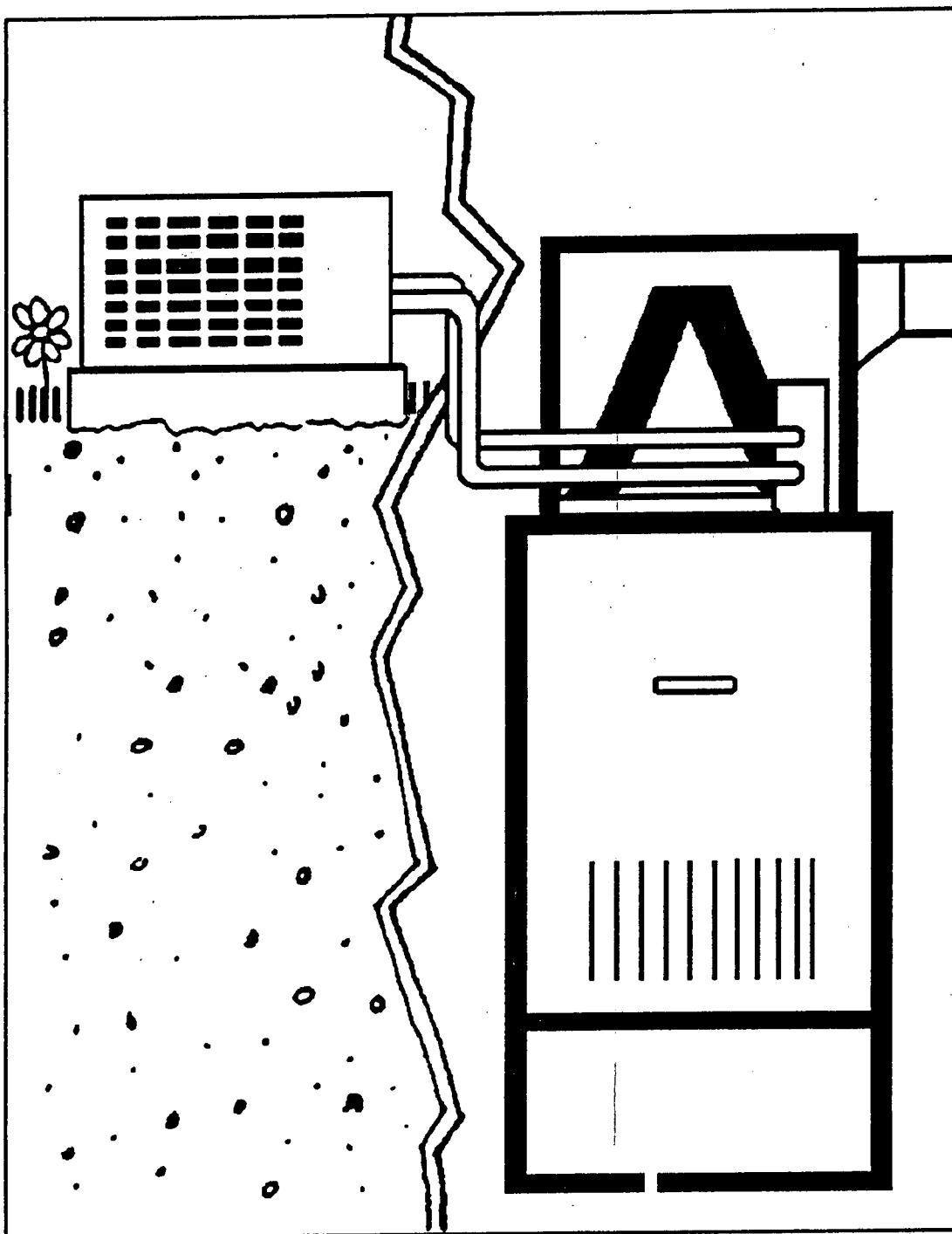
KeepRite®



Bulletin AC3-PDS8-2

Residential Split System Air Conditioner

Training Manual
Application Data
Trouble Shooting Guide



KEEPRITE RESIDENTIAL AIR CONDITIONER

"TROUBLE SHOOTING GUIDE"

SYSTEMS

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APPENDIX

Table 1 – Symptoms of Refrigerant – Problems and Insufficient Evaporator Air

Table 2 – Normal Suction Pressures and Temperatures

TROUBLE SHOOTING CHART

PROCEDURE FOR REPLACING COMPRESSORS

FORWARD

The KeepRite Trouble Shooting Chart has been prepared to provide a logical approach for the diagnosis of problems on KeepRite Residential Systems.

Basic problem areas may be in the area of:

Electrical
Environmental
Refrigeration
Evaporator Air Flow
Condenser Air Flow

By following the procedure outlined on the chart and by discussion with the homeowner, the basic problem areas can be established and reference can be made to the appropriate tables.

The accompanying article elaborates on potential problem areas and on procedures for checking out problem areas.

The various tables make reference to the text on the more complex or more technical problem areas.

TROUBLE SHOOTING RESIDENTIAL SPLIT SYSTEMS

SYSTEMS

In a residential split system there are four inter-related systems which function simultaneously, to provide cooling. These systems and their functions are as follows:

Evaporator Air Handling System

Consisting of:
Furnace Fan,
Evaporator Coil,
Ducts and Grilles.

Function

Circulates air from the conditioned space through the furnace, evaporator coil and duct system back into the conditioned space.

Refrigerant System

Consisting of:
The Evaporator Coil,
The Condenser Coil,
The Compressor,
Interconnecting Tubing,
Refrigerant.

Circulates refrigerant to and from the evaporator coil and the condenser coil and in the process transfers heat from the conditioned space to the outdoor air.

Condenser Air System (Part of Condensing unit)

Circulates outdoor air over the condenser coil to remove heat from the refrigerant.

Electrical System

115 Volt Furnace Fan System
24 Volt Control System
230 Volt Condensing Unit System

Provides power to operate and control the furnace fan and condensing unit.

When an air conditioning system is not operating properly, there may be more than one cause. Malfunctioning in one system will affect the other systems therefore, a thorough understanding of these systems is necessary. The next chapters provide the basic information on each system.

1. EVAPORATOR AIR HANDLING SYSTEM

The major single cause of inefficient operation of a residential split system is inadequate evaporator air flow.

In an evaporator coil, liquid refrigerant picks up heat from the evaporator air and boils to form a vapour. It is important that the refrigerant is completely evaporated and that some superheating occurs. (See Fig. 2.A "Effect of Airflow ... on System Temp".) If there is inadequate air flow little heat will be absorbed and superheating will not occur. (See Fig. 2B "Effect of air flow ... on System Temp".) The system will only operate at partial capacity with the possibility of liquid refrigerant returning to the compressor and damaging the unit. The suction pressure in the system will be reduced to the point that the evaporator coil will frost over (See Fig. 1A "Pressure Gauge Analysis").

The amount of heat available at the evaporator depends upon the quantity of air circulated and the temperature of the return air available to the evaporator.

KeepRite have taken two important steps in the design of their evaporator equipment to minimize this problem. (1) The use of a larger face area than normal has resulted in a relatively low air pressure drop. (2) The use of a low nominal air quantity of 400 Cfm/ton (360 Cfm on an SSC-19) helps to ensure proper evaporator conditions.

In addition, information has been prepared to assist installers to properly match furnaces and air conditioning systems. To ensure that the furnace fan has the necessary air handling capacity see Application Bulletins.

1 (a) Problem Areas

The evaporator air handling system consists of a return air grille return ducts, furnace and fan, evaporator coil, supply ducts and outlet grilles. Major problem areas in the systems are:

- furnace fans too small to handle the necessary air flow.
- inadequate return air grilles and return air ducts.
- inadequate supply ducts to the conditioned space.
- poorly located supply and return grilles resulting in cool air from the supply short circuiting back to the return grille.
- uninsulated supply ducts in attic spaces.
- restricted space above the evaporator coil.
- open humidifier by-pass ducts.

Before attempting to analyze the refrigerant system it is important to ensure that the airflow across the evaporator is correct.

1 (b) Checking Evaporator Airflow

The simplest method of checking evaporator airflow is to compare the pressure drop across the coil against the published pressure drop, using an inclined manometer.

A 3/8" Dia. hole should be made in the duct on both the air entering and air leaving side of the coil. The difference in static pressure between these points will be the pressure drop across the coil.

Catalogued pressure drops are for a wet coil which would be the case when the air conditioning is working. For a dry coil, use the manufacturers specs. The dry coil pressure drop is the recommended method.

If the actual pressure drop is less than the rated pressure drop the airflow is low and the fan should be speeded up until the correct airflow is obtained. The evaporator fan motor amperage draw as stated on the motor nameplate, must not be exceeded. Should the existing motor be of insufficient capacity, a larger one must be installed.

SUMMARY OF LOW AIR FLOW SYMPTOMS

1. Pressure drop across evaporator lower than catalogued rating.
2. Insufficient cooling capacity.
3. Low suction pressure.
4. Possible frosting of evaporator coil and sweating or frosting of suction line.
5. Cold compressor, noisy operation, low amperage draw.
6. Discharge pressure lower than normal.

SEE ALSO COMPARATIVE LIST OF SYSTEM SYMPTOMS - TABLE 1 IN APPENDIX.

2. THE REFRIGERATION SYSTEM

The refrigeration system consists of three main components plus interconnecting tubing and refrigerant. These components are:

Evaporator Coil – which removes heat from the evaporator air and transfers it to the refrigerant.

Condenser Coil – which transfers heat from the refrigerant to the outdoor condenser air.

Compressor – which pumps refrigerant from a low to a high pressure.

Efficient operation of the complete refrigeration system depends upon –

- Adequate evaporator air flow. *
- Proper refrigerant charge.
- Unrestricted refrigerant system.
- Proper compressor operation.
- Adequate condenser air flow.

* The importance of adequate evaporator air flow has already been pointed out and must always be checked first before reaching conclusions about the

refrigerant charge or compressor operation. Failure to establish the correct air flow may result in the incorrect refrigerant charge being applied. Under such conditions compressor warranty may be voided.

2 (b) Refrigerant Charge

KeepRite Residential Systems leave the factory with a standard operating charge and will be suitable for normal operating conditions. The standard operating charge assumes that all system components are functioning correctly and the evaporator air flow is according to catalogue requirements. If system suction pressure falls below 60 PSIG at outdoor and room temperatures above 70°F, this is usually an indication of low evaporator air flow or a system restriction. For best operation, suction line temperature should fall in the shaded area in Table 2 "Suction Line Temperature" (Appendix), when system operates at the suction pressure and ambient temperatures shown. Suction temperatures shown outside the shaded area may be experienced during the pull down period when higher than normal suction pressures will occur.

2 (b) Undercharged System

If a system has operated satisfactorily for a period of time and then fails, a system leak is a prime suspect, (provided neither the evaporator or condenser airflow is restricted). A system leak will naturally result in an undercharged system.

In an undercharged system the amount of refrigerant gas discharged by the compressor will be less than normal and will require only a portion of the condenser to condense it. The compressor discharge pressure will therefore be relatively low.

As this low pressure liquid flows from the condenser to the evaporator some of it may vaporize in the liquid line or in the evaporator capillary tubes. A flow of a mixture of gas and liquid will reduce the amount of refrigerant entering the evaporator.

A slight hiss in the capillary lines indicates that a mixture of gas and liquid exists and is evidence of an undercharged system.

A reduced flow of refrigerant will require only a portion of the evaporator to evaporate it. That portion of the evaporator, near the capillary feed lines will therefore be low in temperature and a portion of the evaporator near the suction lines will be warm. (See Fig. 2C Effect of Air Flow ... on System Temp.) The suction line back to the compressor will be warmer than normal and suction pressure lower than normal. (See Fig. 1B "Pressure Gauge Analysis".)

Since the compressor depends upon the refrigerant vapour for most of its cooling, the compressor will run hot and may cut out on thermal overloads. The compressor will work at reduced capacity, will run quietly, and will draw less than normal amperage.

In some instances in an undercharged system, refrigerant flow will be sporadic and the evaporator will alternatively frost and thaw. In other instances the evaporator will start to frost near the refrigerant inlet and as the air flow is reduced, the frosting will be progressive until all of the evaporator is frosted. Eventually the suction line will also frost. In this instance,

although the first cause is lack of refrigerant, the problem is compounded by lack of air flow caused by the initial frosting.

The net result of an undercharged system is one of reduced capacity and a system which operates longer than normal. The first step to correct the problem is to check the system for a refrigerant leak.

SUMMARY OF UNDERCHARGE SYMPTOMS

1. Low discharge pressure.
2. Low suction pressure.
3. Hissing in capillary lines at evaporator.
4. Evaporator colder than normal at top, warm at bottom.
5. Suction line warmer than normal.
6. Hot running compressor. Quiet operating and low amperage draw.
7. Frosting may occur, at top of evaporator in severe undercharge conditions.
8. Lack of capacity.

SEE ALSO COMPARATIVE LIST OF SYSTEM SYMPTOMS, TABLE I

2 (c) Overcharged System

In an overcharged system, complete evaporation of the liquid in the evaporator will not take place and some liquid refrigerant will flow back to the compressor.

The suction line will be colder than normal due to the presence of liquid and lack of superheat. (See Fig. 2B "Effect of Air Flow ... on System Temp."). The fact that the suction line is now acting as an evaporator will result in considerable sweating or frosting back to the compressor shell. The compressor shell under normal conditions should not be cold enough for sweating to occur.

There is also a distinct possibility that liquid in the suction line will slug the compressor thus causing damage. A higher than normal noise level will be evident during compressor operation and current draw will be above normal.

In an overcharged system, condensing pressure and temperature will be higher than normal and lack of cooling capacity will be evident. (See Fig. 1 F, "Pressure Gauge Analysis").

It is important to note that in both an overcharged system and one with insufficient evaporator airflow, the suction line is susceptible to sweating and/or frosting. Checking for proper evaporator airflow is necessary to avoid an incorrect conclusion that an overcharge exists when frost appears on the suction line and compressor.

SUMMARY OF SYMPTOMS OF OVERCHARGE

1. Higher than normal discharge pressure.
2. Slightly higher than normal suction pressure.
3. Suction line cold, excessive sweating and possible frosting.

4. Compressor is noisy, runs cold and is sweating. Higher than normal amperage draw.
5. Unit operates longer than normal.

2 (d) Checking Refrigerant Charge

Before checking the refrigerant charge, reference should be made to Table II, "Suction line temperatures", (Appendix). A correctly charged system under normal load conditions should result in suction line temperatures as shown in the shaded area of the chart. High suction line temperatures may occur during the pull down period.

The following procedure should be carried out to determine the correctness of the refrigerant charge. It should be noted that this procedure assumes that the air side of the system is performing in a satisfactory manner. **Improper air flow conditions due to a restricted filter, faulty ductwork or inadequate fan performance, will result in incorrect refrigerant charge. Always check air side performance, before adjusting refrigerant charge.** If suction pressure is less than 60 PSIG. at ambient and room temperatures above 70°F., this is usually an indication of **low evaporator airflow** or a system restriction. Refrigerant adjustments should only be made after all the above system conditions have been checked.

REFRIGERANT CHECK PROCEDURE

1. Attach a suitable thermometer or sensor bulb of a temperature tester to the suction line at the condensing unit. Both should be wrapped with insulating tape to insure an accurate reading.
2. Attach a manifold gauge to the suction and liquid line service connections at condensing unit. Lines should be purged before use.
3. Allow unit to operate for some time to insure stable load conditions.
4. Determine the outdoor ambient temperature (Ambient must be 70°F. or above for the correct charging of system).
5. Read and note the suction pressure as indicated on the gauge.
6. Compare the suction line temperature to that indicated on Table II, for the ambient temperature, and suction line pressure as indicated on the gauge.
7. If suction line temperature is lower than that indicated in Table II gas should be removed from the system until the correct temperature reading as shown, is obtained. If suction line temperature is higher than shown on Table II, additional refrigerant charge should be added. Allow 15 minutes running time between charge adjustments.
8. When correct system charge has been established, disconnect manifold gauge and thermometer sensing bulb.
9. If a system is undercharged, refer to the next page for the procedure for leak testing.

2 (e) Procedure for Leak Testing and Correction

Leak testing should begin with a close visual inspection. A small deposit of oil can be a tell-tale sign of a leak.

If the system has lost its charge, it must have refrigerant vapour added to it. The preferred technique is to add R22 in its vapour form to the system until the gauge reads a pressure of 50 psig. Remove the refrigerant cylinder, and use a regulated dry nitrogen cylinder to bring the system to 150 psig.

The following recommendations should be considered when leak testing:

- Always start at the highest point and work down because refrigerant is heavier than air and tends to collect in low spots.
- Cupping the hands around a joint or using a plastic envelope can aid in pinpointing a leak.
- After a leak has been found, discharge the system and prepare for a sealed-system repair.
- Six simple steps, if followed, will always lead to strong leak tight joints. These steps are: proper fit, cleanliness, sufficient flux, proper heat and final cleaning.
- Flux assists in the flow of alloy but, even more important, it serves as a temperature indicator.
- The flux, as heat is applied to it, will bubble, dry and turn white and then turn clear and water-like when the proper temperature has been reached.
- Overheating can cause scale on the inside of the tubing.
- Oxy-acetylene brazing requires a certain amount of skill in its use. The hotter temperatures can melt or burn through the tubing.
- **Whenever a system has been entered, a liquid line filter drier must be added to the system.**
- During the evacuation process the system must be evacuated to 29.90" mercury (500 microns) and held for 30 minutes.
- Always cap the Schrader valves when repairs have been completed.
- **When replacing a burnt-out compressor a suction line drier as well as a liquid line drier must be installed.**
- When computing the system charge, the capacity of the drier(s) must be included.
- If, while charging a system, all the refrigerant does not flow into the high-side, it must be drawn in by the system compressor, (through the suction side). This must be done carefully so as not to slug the compressor with liquid refrigerant or cause an oil pump out.

2 (f) System Restrictions

In a refrigerant system which is working properly, the refrigerant flows without undue restriction. If a system has an unusual restriction, the flow will be reduced or completely cut off and system capacity will be reduced.

Restrictions can be caused by:

- (1) Kinked tubing between the evaporator and condenser.

- (2) Improperly connected aeroquip fittings or diaphragms that have not pierced.
- (3) Damaged tubing in the evaporator or condensor.
- (4) Foreign material or solder restrictions at tubing joints.
- (5) Ice in the capillary tubes, resulting from water vapour in the system.
- (6) A manufacturing error in the circuiting of the evaporator or condenser.

2 (g) Checking for System Restriction

The symptoms of a restriction will vary with the degree and the following are typical effects:

	PARTIAL RESTRICTION RESULT	FULL RESTRICTION RESULT
Suction line temperature from evaporator (See Table II in Appendix)	Above normal	Near room temp.
Suction Pressure *	Near or below normal	A deep vacuum
Compressor	Warm to hot	Noisy & hot
Compressor amperage	Near normal	Above average Unit cut out on overload.
Discharge Pressure *	Near normal	Lower than normal
Condenser coil	Relatively cool especially near bottom.	Relatively cool
Liquid Line to Evaporator	Cooler than normal & might have frost, particularly at point of restriction.	Cooler than normal
Capillary lines	Emit gurgling sounds.	No sound emitted.
Evaporator	Cool to frosted on top, warm at bottom.	Warm.

* See also Figs. 1C and 1D, "Pressure Gauge Analysis".

When the preceding checks, other than actual refrigerant pressures indicate a restriction, pressure gauges should be put on the Schrader valves on the pre-charged tubing lines near the condenser. Pressure readings will help indicate a restriction.

After the unit has run to the point where the gauges are steady the unit should be shut off. If a partial restriction exists, they will equalize very

slowly. If a complete restriction exists, they will not equalize. (See Fig. 1C and 1D Pressure Gauge Analysis.)

Often, a partial restriction can be found by feel as there is a decided temperature difference from one side of the obstruction to the other, with possible condensation or frost occurring at the restriction.

Once a restriction is found, the refrigerant must be discharged and the fault corrected.

2 (h) Compressor Problems

Compressor failures fall into two general categories:

1. Electrical – where the compressor will not run.
2. Capacity – where the compressor runs but is not pumping efficiently.

The replacement of a compressor is costly and every possibility must be checked out before concluding that it is at fault.

2 (j) Checking Compressor Problems

If the compressor does not run the problem can be

- defective wiring
- incorrect wiring size
- blown fuses
- open circuit breakers
- open thermal protection
- open contactor
- defective capacitor
- incorrect capacitor
- low line voltage
- incorrect thermostat setting
- defective transformer

If the compressor is hot, it may be necessary to wait up to 5 hours until it has cooled down to ensure that the overload has a chance to close. The compressor windings should then be checked as outlined on Page 15. If the windings have failed, the compressor has to be replaced.

If the compressor hums, it is trying to start but does not have the necessary power. The unit should be shut off immediately and the windings checked. If the windings are satisfactory, low voltage could be the problem. Alternatively a defective compressor capacitor could be the problem and should be checked. Should the above points check out satisfactorily the problem may be resolved by using an approved start assist kit of the correct size.

If the compressor capacity is low, usually other problems are involved such as

- inadequate evaporator air flow.
- improper refrigerant charge.
- inadequate condenser airflow.
- an undersized unit.

After checking these other possibilities, manifold gauges should be used to check the system. In a unit with a defective compressor, the discharge pressure will be lower than normal and the suction pressure will be higher than normal. i.e. 100 psig. or more. (See Fig. 1G "Pressure Gauge Analysis"). Furthermore the compressor motor will draw less than normal current. A compressor operating under capacity is extremely rare.

When the diagnosis confirms that the compressor is not pumping satisfactorily it has to be replaced.

3. CONDENSER AIR HANDLING SYSTEM

In the condensing unit, efficient heat transfer from the high pressure high temperature refrigerant vapour to the condenser air depends upon proper airflow.

Condenser air is drawn over the two condenser coils by a fan discharged vertically upward.

3 (a) Problem Areas

If the condenser is placed too close to a wall or if it is allowed to plug up with leaves, grass etc. the airflow will be restricted. This will result in higher refrigerant temperatures and pressures than normal on the discharge side of the compressor. (See Fig. 1H, "Pressure Gauge Analysis"). If this condition is not corrected it could lead to compressor failure.

3 (b) Checking Condenser Air Flow

Check the condenser coil for fouling by leaves, grass clippings etc.

Check that the distance from the condenser to the nearest fence or wall is a minimum of 8".

Check for any overhang which might deflect discharge air back to the unit.

Check that the fan and motor turn freely.

If any of the above conditions exist, correct as necessary. After any problems have been corrected recheck system pressures.

4. ELECTRICAL SYSTEM

The electrical system of a typical residential split system consists of three sub-systems which are interlocked through the fan transformer relay, and by the contactor in the condensing unit.

A 115 volt circuit provides power for the furnace fan and energizes the transformer portion of the fan transformer-relay.

The 24 volt control circuit power is provided by this transformer, and

through the room thermostat controls both the furnace fan and the outdoor condensing unit.

A 230 volt power supply is required for the condensing unit. When the thermostat calls for cooling, the 24 volt relay in the contactor of the condensing unit, closes the contactor and energizes the condensing unit.

It is apparent that if the 115 volt circuit is not operative, 24 volt power will not be available to pull in the furnace fan relay or the contactor of the condensing unit. The logical sequence to trouble shoot the electrical system is therefore to confirm the 115 volt, 24 volt and 230 volt systems in that sequence.

In the electrical system there are numerous problem areas. Many of these are simple, such as loose wires, open disconnect switches and blown fuses. Other problems involve defective contactors, capacitors or fan motors.

**4 (a) Compressor
Motor
Winding
Check**

The following procedure is used to determine the condition of the compressor motor windings and will enable the service technician to identify the common, start and run terminals on a single phase compressor motor. **First disconnect power to the condenser and remove the leads to the compressor.**

Using a Simpson 260 multimeter (or equivalent), set the meter to the highest ohm scale, short the test leads together and adjust the needle to read zero ohms. Attach one lead of the meter to one of the copper tubing connections at the compressor. Make sure that it is making good electrical contact. With the other lead, probe each compressor motor terminal. The needle should remain stationary at an infinite resistance reading. If the needle deflects toward zero it indicates a grounded or partially grounded compressor motor and it must be replaced.

If no shorts exist, disconnect the lead from the copper tubing; if the compressor identification is unknown make a sketch of the terminal locations similar to Fig. 3. Attach one meter lead to the top compressor terminal and one to the lower right terminal. Read the resistance in ohms and record the results on the sketch. Leave the lead connected to the top terminal and move the other lead to the lower left terminal. Read the resistance and record the results. Leave the lower left lead attached and connect the other lead to the right hand terminal. Read the resistance and record it on the sketch. The sketch, with typical readings record, appears in Fig. 3.

In a single phase PSC compressor motor such as found on most central air conditioners, the highest resistance value will be from the start to the run windings (S to R). The next highest resistance is from the start to the common connection (S to C) and the lowest resistance from the run winding to the common connection (R to C). By using this method the terminals can be identified. Normally these connections are identified at the compressor terminals.

Should any of the foregoing checks indicate that the compressor windings have failed, discharge the system and replace the compressor.

4 (b) Locked Rotor Voltage (LRV) Test

Locked rotor voltage (LRV) is the actual voltage available at the compressor under a stalled condition. This voltage should be 230 volts plus or minus 20% because the compressor motor is not designed to operate at voltages below 207V (LRV) or above 253V. The procedure, using the voltmeter portion of an Amprobe meter, is as follows:

1. Set up the meter to read the proper voltage scale.
2. Attach one lead of the meter to the T1 terminal on the contactor.
3. Attach the other lead of the meter to the T2 terminal on the contactor.
4. Start the unit with the voltmeter attached; then stop the unit. Attempt to restart the unit within a couple of seconds and immediately read the voltage on the meter. The unit under these conditions will not start and will usually kick out on overload within just a few seconds since the pressures in the system will not have had time to equalize.
5. If the locked rotor voltage is below the 207V minimum, check for the cause. This can be accomplished by rechecking the wiring between the unit and the main electrical panels. Low LRV at the unit and normal LRV at the main panel indicates the electric wire size is too small. Low LRV at the main panel indicates insufficient power supplied from the utility source. If the running voltage is within the specifications and the LRV cannot be corrected, a start kit may be utilized to overcome starting problems. Be sure to use only an approved start kit.

4 (c) Running and Locked Rotor Amperage (LRA) Test

The LRV and LRA of a compressor motor are closely associated. Should it be determined that the correct voltage is available at the main electrical terminal box, and the locked rotor amperage is greater than the specifications for that compressor, the electrical wiring to the compressor is not of sufficient size. The running amperage of the compressor is probably the most important of these readings. A running amperage higher than that indicated in the performance data or specifications immediately signals that the compressor is overloaded (doing too much work). One that is lower than specifications indicates that the compressor motor is not fully loaded. This can be due to load conditions on equipment.

The procedure for obtaining both running amperage and LRA is as follows:

1. Consult the unit specifications for performance data to obtain the running amperage (full-load amperage). This rating can be found on the unit serial plate and refers to equipment running under full load conditions.
2. Refer to the wiring diagram to determine the location and wire colour of the common lead to the C (Common) terminal of the compressor.
3. Unlock the meter needle and select the proper amperage scale.
4. Clamp the meter probe around the wire to the C terminal of the compressor.

5. Turn on the condensing unit and read the running amperage on the meter. If the compressor does not start, the reading will indicate the locked rotor amperage (LRA).

Compare these readings to those in the unit specifications, performance data, and/or compressor data plate.

CAUTION: ONLY DO THESE TESTS WITH THE COMPRESSOR TERMINAL COVER IN PLACE. NEVER OPERATE A COMPRESSOR WITH THIS COVER REMOVED.

4 (d) Checking Capacitors

CAUTION: A capacitor can hold a charge for long periods of time. A service technician who touches these terminals can get a startling shock. Never discharge the capacitor by shorting across the terminals with a screwdriver. Many air conditioner motor capacitors are internally fused. Shorting the terminals on these units will blow the fuse, ruining the capacitor. A simple 20,000 ohm 2 watt resistor installed to a jumper wire can be applied across the terminals to discharge capacitors safely.

The capacitor analyzer is a money-saving tool. So much so, that the saving of one large air conditioner capacitor, will pay for the cost of the instrument. This instrument will show whether the capacitor is "open" or "shorted". It will tell you whether the capacitor is within its microfarad rating and it will show whether the capacitor is operating at the proper power-factor percentage. Further, the instrument will automatically discharge the capacitor when the test switch is released.

To use the analyzer, set the line-voltage switch to the proper setting. Set the range switch to the correct range in microfarads to match the capacitor value. Attach the leads to the capacitor and push the test switch to TEST and hold "on" (this switch is spring loaded and will return to OFF when it is released). Now turn the microfarad dial until the "eye" is as sharp as you can obtain. You may find it necessary to use the power-factor dial to make the eye very sharp. This test will tell you two things.

- whether the capacitor is within its microfarad rating
- whether it has an acceptable power rating

If the "eye" will not sharpen, the capacitor is either "open" or "shorted". By observing the eye you can determine which by turning the microfarad dial all the way left for "open" or all the way right for "shorted".

The use of the analyzer eliminates the problems caused by shorting with screwdrivers, a practice which has cost an untold amount of dollars. Shorting with a screwdriver will ruin an internally fused capacitor in one try. Discharge a fused capacitor by placing a 2 watt 22,000 ohm resistor across the terminals.

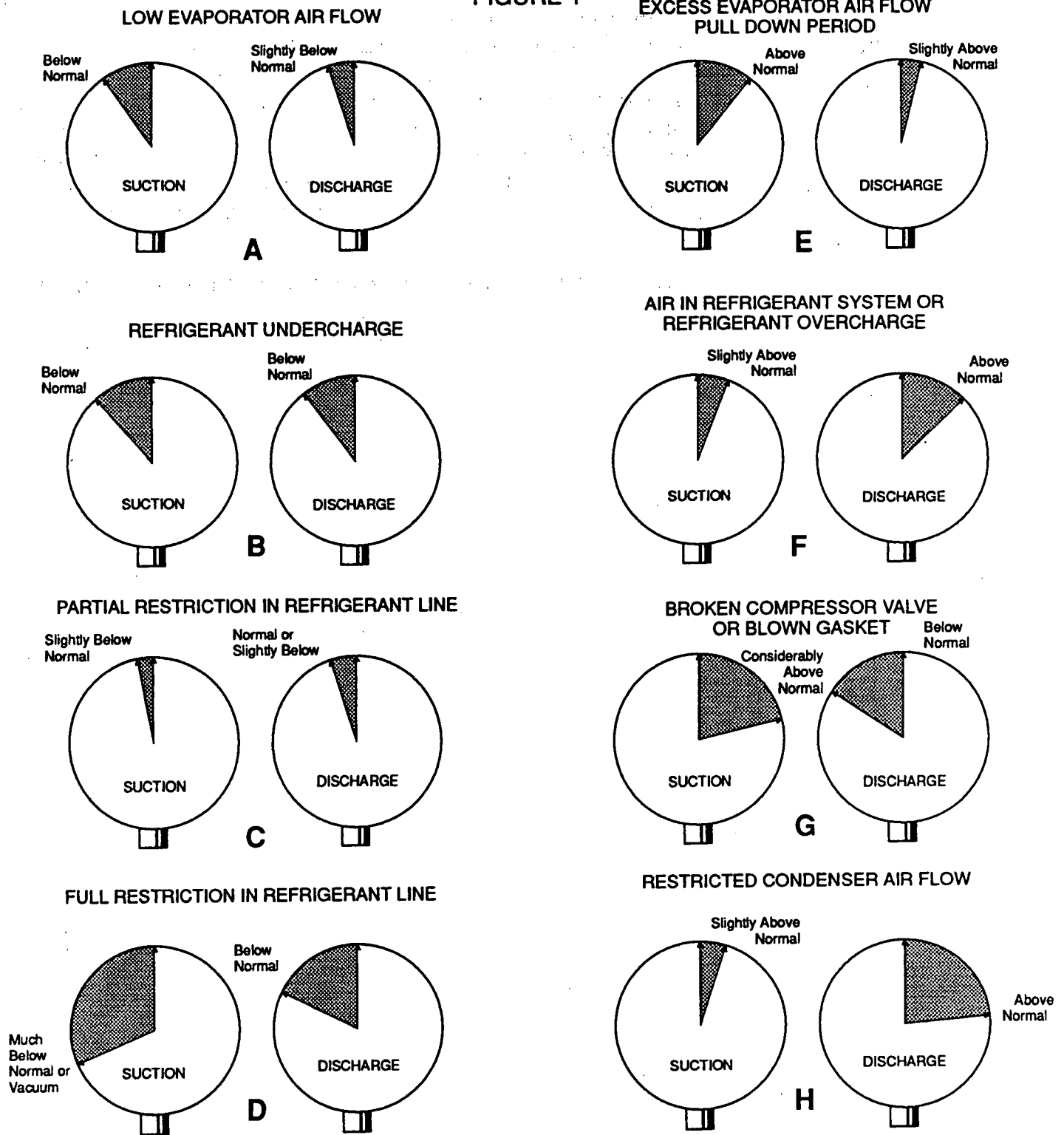
**4 (e) Ohmeter
Capacitor
Check**

Since capacitors used in central air conditioning are generally quite large, always discharge them (with a resistor) before attempting any checks. The ohmeter test is not recommended and at the very best gives only an indication that the capacitor could be good. Set the ohmeter scale at RX100 and connect the test probes to the terminals of the capacitor. A shorted capacitor registers instantly at zero ohms or extremely low resistance. A good capacitor will cause the pointer to move toward zero at the instant the leads are connected; then the pointer will slowly return toward the high resistance end of the scale. An open capacitor will register infinity on the meter scale.

Again, this test should only be used as a last resort and is not recommended.

PRESSURE GAUGE ANALYSIS OF SYSTEM PROBLEMS

FIGURE 1



Normal Acceptable Pressure Range

AMBIENT TEMP ° F	GAUGE PRESSURE, P.S.I.	
	SUCTION	DISCHARGE
95	73-78	230-270°
90	72-75	225-245°
85	67-71	220-240°
80	63-68	200-230°
75	60-66	190-210°

NOTE:

Pressure reading variations from the normal acceptable range can result from a single problem or a combination of problems. It is always essential that the evaporator air flow be checked before correcting any other problem on the refrigeration system.

TABLE 1 — COMPARATIVE LIST OF SYMPTOM PROBLEMS DUE TO REFRIGERANT AND AIR DEFICIENCY

	COMPONENT	UNDERCHARGED SYSTEM	OVERCHARGED SYSTEM	INSUFFICIENT EVAPORATOR AIR
1	Suction line from evaporator	Warm	Cold, sweating possible frost	Cold, sweating, possible frost
2	Suction Pressure	Below normal	Above normal	Below normal
3	Compressor	Warm, may cut out on overloads	Cold, sweating	Cold, sweating
		Runs quiet	Noisy	Noisy
4	Compressor amperage (Refer to nameplate for full load amps.)	Below normal	Above normal May cut out on overloads	Below normal
5	Discharge Pressure	Below normal	Above normal	Below normal
6	Condenser Coil	Cooler than normal	Warmer than normal	Cooler than normal
7	Liquid Line to Evaporator	Cooler than normal	Warmer than normal	Cooler than normal
8	Capillary Lines	Cold — emits gurgling or hissing sounds	Warm	Cool to normal
9	Evaporator Coil	Cold near Cap. lines, may frost and thaw	Cold throughout	Cold throughout and tendency to frost
10	Unit Operation	Longer than normal	Longer than normal	Longer than normal
		Cooling effect may be insufficient or nil depending on amount of charge	Below normal cooling effect	Below normal cooling effect. Reduction can be excessive

TABLE 2 —

SUCTION LINE TEMPERATURES

OUTDOOR AMBIENT TEMP.		SUCTION PRESSURE AT CONDENSING UNIT PSIG																								
		60		62		64		66		68		70		72		74		76		78		80		82		
		SUCTION LINE TEMPERATURE																								
°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	°F	°C	
70	21	47	8	58	14	69	20	78	25																	
72	22	43	6	54	12	64	17	74	23																	
74	23	39	4	50	10	60	15	70	21	79	26															
76	24			46	8	56	13	65	18	75	23															
78	25			41	5	52	11	62	16	71	21	80	26													
80	26					48	9	58	14	67	19	76	24													
82	27					43	6	53	11	62	16	71	21	79	26											
84	28							48	9	57	13	66	18	74	23	81	27									
86	30									51	10	60	15	68	20	75	23	81	27							
88	31									45	7	55	12	63	17	70	21	76	24							
90	32											49	9	58	14	66	18	72	22	78	25					
92	33													52	11	61	16	68	20	74	23	79	26			
94	34															55	12	62	16	69	20	75	23	81	27	

NOTE:
for most efficient operation, desirable suction line temperature should be in shaded area. Temperature outside shaded area may occur during pull-down period

EFFECT OF AIR FLOW AND REFRIGERANT CHARGE ON SYSTEM TEMPERATURE (80° F Ambient Conditions)

FIGURE 2A

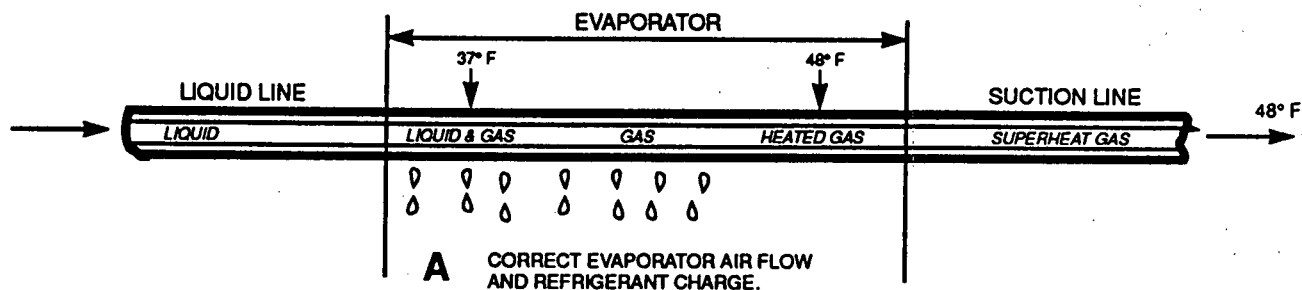
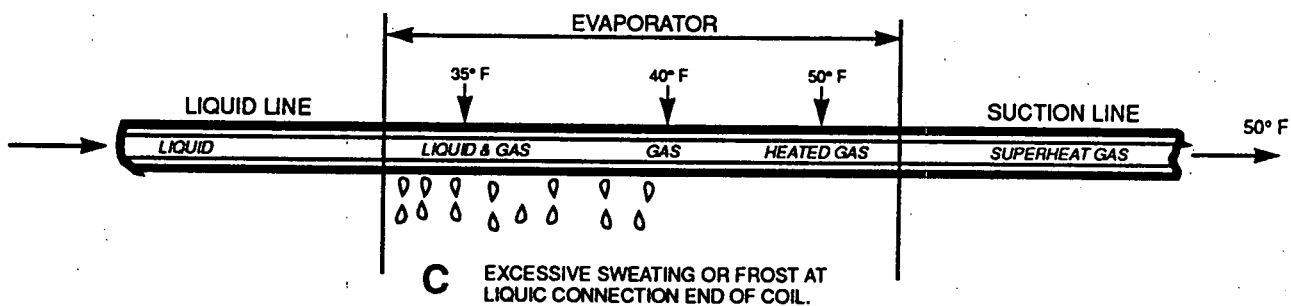
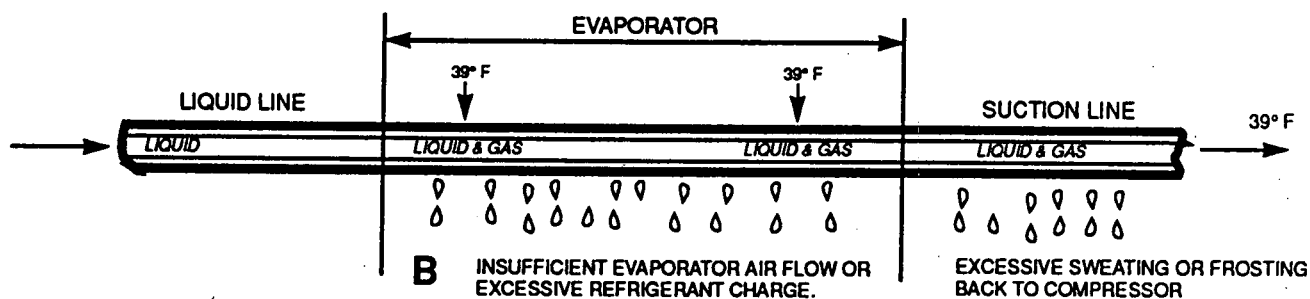
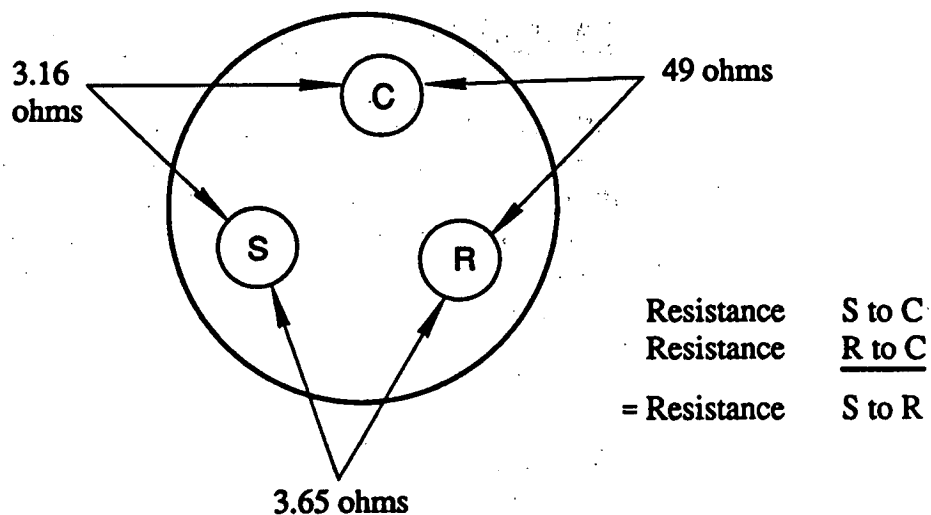


FIGURE 2B





- 9) Install the replacement compressor, tightening the mounting bolts. Solder the suction and discharge lines, being careful not to overheat the compressor body.
- 10) Reconnect the wiring to the proper terminals.
- 11) Install a new suction line and liquid line drier in the system as recommended below.

B.T.U. UNIT CAPACITY	<u>REQUIRED DRIER</u>		Extra Refrig. Charge to be Added
	Suction Line	Liquid Line	
20,000	C305 S-T-11 Sporlan 5/8"	↑ Sporlan C0 8 3-3 ↓	↑ 7 1/2 oz. ↓
24,000 28,000 28,500 32,000 32,500 36,000	C306 S-T-HH Sporlan 3/4"		
42,000 48,000	C307 S-T-HH Sporlan 7/8"		

PROCEDURE FOR REPLACING COMPRESSORS ON KEEPRIE RESIDENTIAL SPLIT SYSTEMS

After determining that the compressor has failed either electrically or mechanically, the following steps should be used as a guideline to remove the defective compressor and installing a replacement. This work should only be done by someone qualified. Before starting to repair equipment make sure the replacement part is correct both physically and electrically for this equipment.

- 1) Shut off all electrical power to the unit. (Control voltage and line voltage.)
- 2) Remove the access panel to the compressor compartment. Disconnect the electrical leads from the compressor, taking note which leads are connected to the common, start and run terminals.
- 3) Discharge all refrigerant from the liquid line gauge part of the system. Do not use gauge manifold for this purpose. If there has been a burnout you will contaminate your manifold and hoses. Use a Schrader valve adaptor and copper tubing. Do not allow the refrigerant to come in contact with people, grass, shrubs, etc., as it may have a high acid contact.
- 4) Remove the compressor holdown bolts.
- 5) Disconnect the suction and discharge refrigerant lines from the compressor.
- 6) The inoperative compressor may now be removed from the compressor compartment.
- 6A) Remove any existing suction or liquid line filter driers from the system.
- 7) Remove the rubber plugs covering the suction and discharge stubs on the replacement compressor and double-check to make sure that it has been charged with oil by tipping the compressor in the direction of the suction stub until oil may be seen.

NOTE: All replacement compressors for Residential Split Systems are oil-charged before they are shipped from KeepRite; however, it is always good practice to check this.

- 8) Before installing the replacement compressor, the motor terminals should be identified. They are usually marked – C for common; S for start; and R for run. If they are not marked, they can be identified by taking an Ohmmeter, set to the lowest scale and measuring and recording the resistance in ohms from terminal to terminal. The highest resistance in a single phase PSC compressor will be from R to S. The next highest will be from S to C, and the lowest will be from R to C.

See example on next page.