Common Air Conditioning Electro-Mechanical failures and the tools used to diagnose them

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Where to start

Circuit breakers:

Protect the unit's fan motor and compressor against short-circuit condition.

When the circuit breaker trips, the fan motor and compressor motor are the first components the technician needs to check.

Using your NCV and/or DMM check for voltage to make sure mains power is OFF

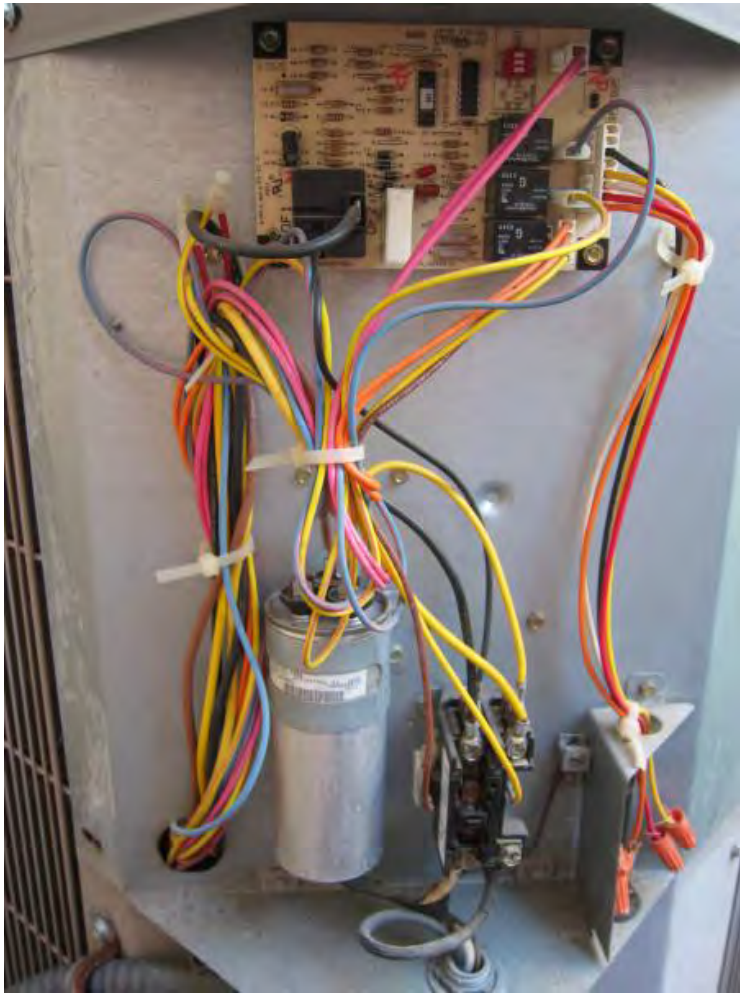
Compressor and fan controls failures:

We measure it. testo

Compressor and fan controls:

Can wear out, especially when the A/C system short cycles, as is common when a system is oversized.

Corrosion of wire and terminals is also a problem in many systems, electrical connections and contacts should be checked during a professional service call.



Compressors and Fan motor failures

Compressor bearing failure or lockup may be caused by poor piping practices, which lead to oil clogging the system and result in insufficient oil return to the compressor and locking up the bearings.

If the bearings don't lock up and continue to wear during these conditions, the rotor will lower into the stator housing, shorting out the windings and trip the breaker.

Compressors and Fan motor failures

Disconnect both the fan and compressor, then reconnect them one at a time and switch the breaker on.

The faulty component may trip the breaker there by identifying the failed component.

Compressors and Fan motor and failures

- A more challenging condition which is difficult to diagnose is when the compressor motor is overheating, over time, and ultimately trips the circuit breaker
- Clamp meters designed to accurately measure both AC voltage and AC current are especially useful. They let you measure current without breaking the electrical circuit.
- Using your clamp meter check the voltage and current draw of the compressor, if it exceeds the manufacturer's normal operating specification you need to consider whether mechanical conditions may have resulted in this type of failure

Compressors failure cause by improper installation or service

System failure is often blamed on a defective compressor, but this failure may be attributable to mechanical system failure cause by poor installation or service attributable to:

- Oversized system resulting in short cycle operation
- Under sized system resulting extended run time
- Poor piping practices resulting in oil not adequately returning to the compressor during the run cycle.
- High discharge temperatures creating acids in the oil.
- Insufficient airflow across the evaporator and condenser coils.
- Extremely low suction pressures.
- Liquid refrigerant flooding back into the compressor.

Troubleshooting check list (mechanical)

Using the manufacturer's mechanical specs:

- Inspect the oil level in the compressor
- Check for incorrect piping installation resulting in oil not adequately returning to the compressor during the run cycle
- Check for proper airflow across the evaporator and condenser coils.
- Check superheat and sub cooling
- Make sure refrigerant is not flooding back into the compressor
- Check for correct amount of refrigerant
- Test for refrigerant leaks using a leak detector

Troubleshooting check list (mechanical)

- Measure airflow through the evaporator coil
- Verify the correct electric control sequence and make sure that the heating system and cooling system cannot operate simultaneously
- Inspect electric terminals, clean and tighten connections, and apply a non-conductive coating if necessary
- Oil motors and check belts for tightness and wear
- Check the accuracy of the thermostat

Assuming that all the above are ok and your superheat and subcooling are within the manufacture's specs, excessive current may be due to shorted or grounded windings, bearing fatigue, a bad capacitor, or a faulty start relay.

Troubleshooting check list (electrical)

Compressor: To check the compressor for electrical problems, remove the electrical terminal cover and check the following external connections.

1. **Check line voltage at the junction box** with the compressor off. Low line voltage causes the motor to draw more current than normal and may result in overheating and premature failure. Line voltage that is too high will cause excessive inrush current at motor start, again leading to premature failure.
2. **Check line voltage at the motor terminals** with the compressor running. The voltage should be within 10 percent of the motor rating.

Troubleshooting check list (electrical)

1. **Check running current.** The readings should not exceed the manufacturers' full-load rated amps during heavy load periods. Low amps are normal during light-load conditions. Excessive high current may be due to shorted or grounded windings, a bad capacitor, a faulty start relay, or an indication of excessive bearing fatigue

2. **Disconnect the compressor**, using your clamp meter's resistance input, measure and **verify the compressor's motor winding resistance**, if the reading are not within the manufacturer specs, the compressor needs to be replaced

3. **Check the capacitance of the starter capacitor,** the coil resistance and contacts of the start relay. Based on these measurements a determination can be made as to which of these components has failed.

Troubleshooting check list (electrical)

Worn Contactor:

- There are three contactors in a unit: one for the compressor, which is noted above, one for the condenser fan motor, and one for the blower motor. The contactors engage when there is a need for cooling or heating, making an electrical connection. This starts the compressor and motors. Arcing and pitting can form on the contactor making it hard for the electrical current to pass and start the particular motor

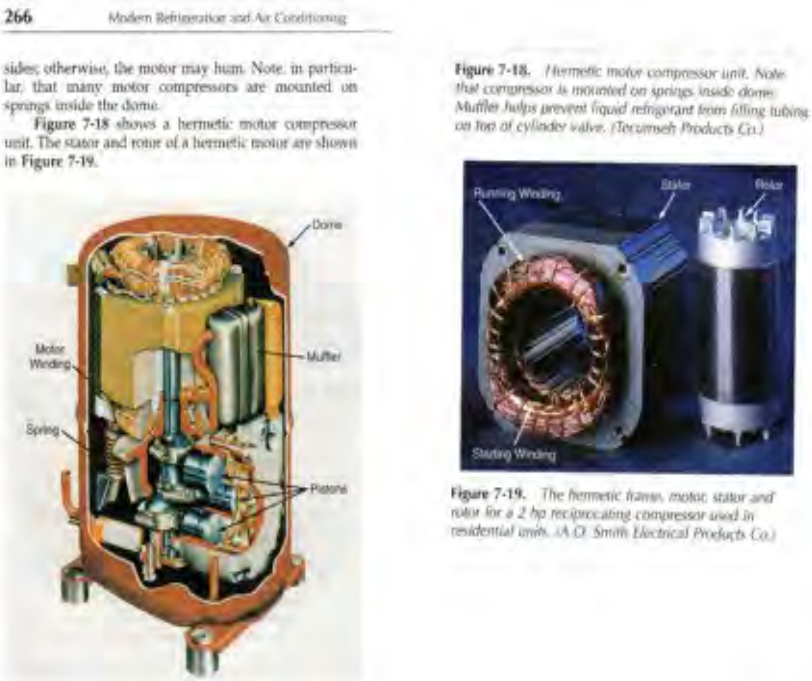
Thermostat:

- This device that tells the system when to start cooling and when to stop. Before calling an HVAC service company, make sure the thermostat is on. Many times, the thermostat is accidentally turned off or set to heat mode.

AC/R COMPONENTS

A compressor has many internals parts. Below is a cut away of the reciprocating and a scroll. The compressor oil is located in the bottom. The oil and cool suction gas keeps the stator (motor windings) from overheating.

- Piston or Scroll
- Bearings
- Rotor
- Stator
- Hermetic Seal
- Overload
- Oil



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sides; otherwise, the motor may hum. Note, in particular, that many motor compressors are mounted on springs inside the dome.

Figure 7-18 shows a hermetic motor compressor unit. The stator and rotor of a hermetic motor are shown in **Figure 7-19.**

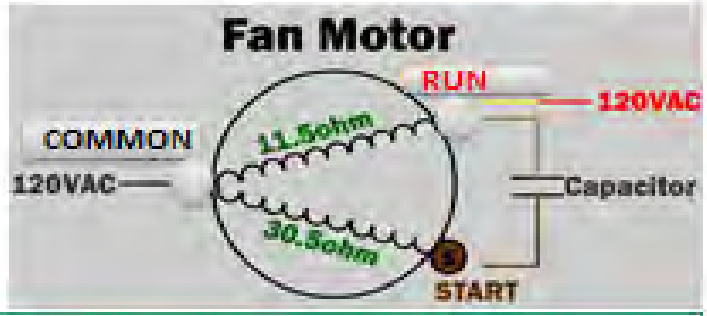
Figure 7-18. *Hermetic motor compressor unit. Note that compressor is mounted on springs inside dome. Muffler helps prevent liquid refrigerant from filling tubing on top of cylinder valve. (Tecumseh Products Co.)*

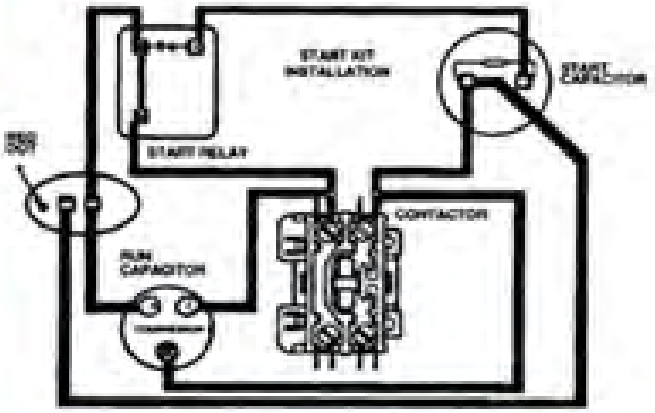
Figure 7-19. *The hermetic frame, motor, stator and rotor for a 2 hp reciprocating compressor used in residential units. (A.O. Smith Electrical Products Co.)*

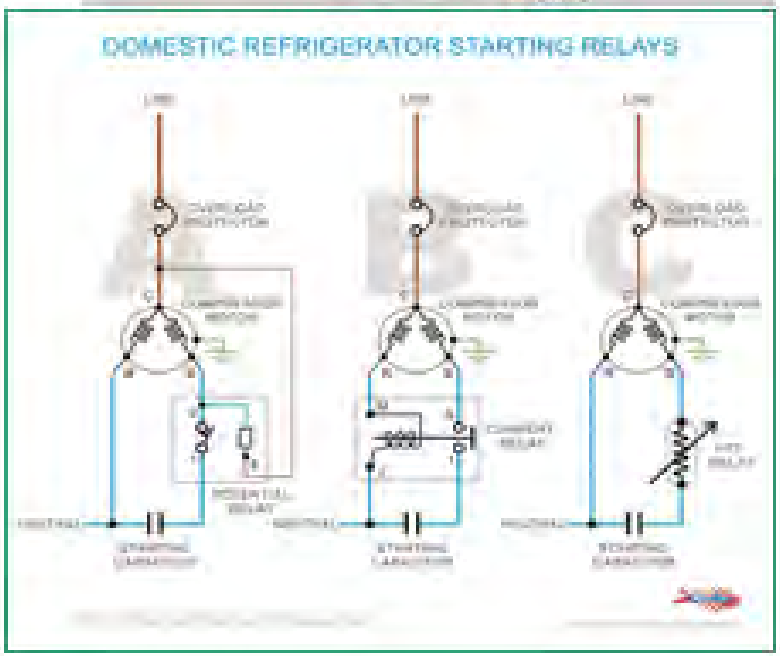
Figure 23–8 A scroll compressor. *Courtesy Copeland Corporation*

AC/R COMPONENTS

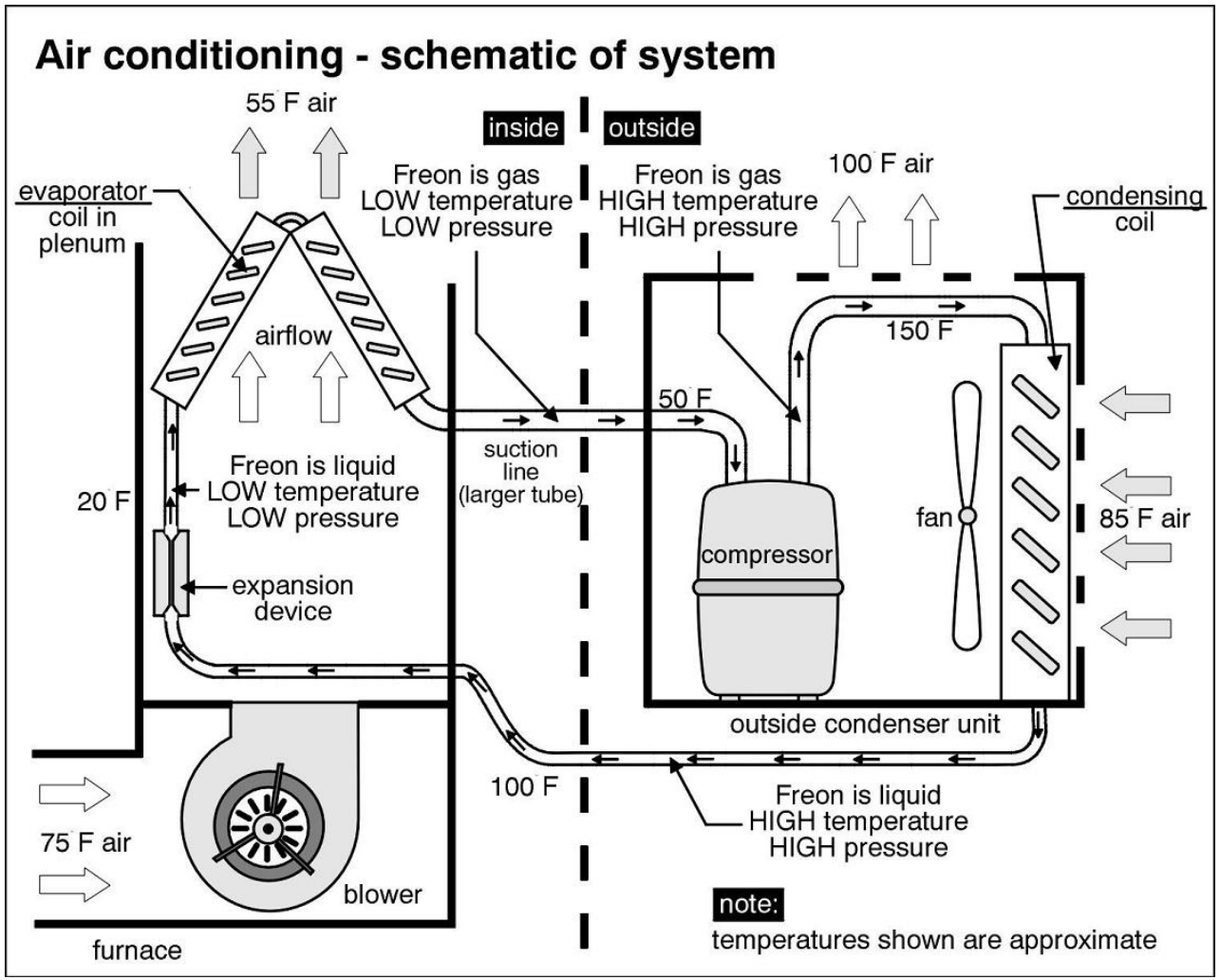
Motor/Capacitor testing







TYPICAL RESIDENTIAL AIR CONDITIONING SYSTEM DIAGRAM



When it come to HVAC test & measurement TESTO has you covered

We measure it.

testo SMART

Electrical test & measurement

AC/R System Analysis

Combustion Analysis

Air Flow Matrix

Test & Balance

THANK YOU