The Semi Hermetic Compressor Book

Instructional Teaching Guide & Manual

Air Conditioning & Refrigeration

Technical Start Up & Maintenance Manual

By

Anthony Reynolds

American Compressor Engineering
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Why Did The Original Compressor Fail?

Most technicians fail to ask a simple question on a compressor replacement. Why did the original compressor die? A technician must always ask himself why did this compressor fail? If you do not find out why then more than likely you will be changing the same compressor again and again. Measure twice cut once is a standard rule of thumb in the carpenter trade so why would it not be wise to find the cause and correct the problem before starting the new compressor. STOP!!! Are you certain that you know the reason “Why” the old compressor failed. Do you want to explain to your boss why it failed again?

Now it’s time to open the old compressor and make certain the reasons it failed.

Opening The Failed Compressor

Opening the failed compressor could be thought of as time wasted but in reality let’s look at the amount of time it takes to open the old compressor verses replacing it again and again. A typical carrier compressor can have the oil drained, heads off, valve plates off and the motor end bell off in less than thirty minutes yet, replacing the whole compressor again can take as much as six hours along with a crane and other miscellaneous expensive items.

What to Look For?

“Cause and Effect”

Caution: Release all pressure lock out all electrical incoming from the compressor before starting these procedures!!!!

<table>
<thead>
<tr>
<th>1.</th>
<th>Effect</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taking Off The Heads</td>
<td>a. Broken Discharge and Suction Valves</td>
<td>a. Flooding refrigerant &amp; or Slugging Oil</td>
<td>a. Check superheat 15 degrees and oil levels (no higher than ¼ in.) in sightglass</td>
</tr>
<tr>
<td></td>
<td>b. Blued or Tarnished valve plates &amp; valves</td>
<td>b. Too much superheat and or high discharge temperatures</td>
<td>b. Lower the superheat. Check condenser and clean if necessary. Check head fans for operation.</td>
</tr>
</tbody>
</table>
### 2. IDENTIFYING COMPRESSOR FAILURE MODES

<table>
<thead>
<tr>
<th>Effect</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Draining Oil</td>
<td>a. Gray Worn rods and/or bearings</td>
<td>a. liquid freon washing off the lubricating surfaces causing aluminum material to mesh with steel materials creating the graying of the oil. Lack of oil pressure to lubricated surfaces.</td>
</tr>
<tr>
<td></td>
<td>b. Dark or Black</td>
<td>b. motor burn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. Recheck superheat to ensure 15 degrees at the suction service valves. Check oil pressure for proper operating parameters.</td>
</tr>
</tbody>
</table>

### 3. IDENTIFYING COMPRESSOR FAILURE MODES

<table>
<thead>
<tr>
<th>Effect</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Removing Endbell checking rotation</td>
<td>a. compressor locked</td>
<td>a. liquid freon and or slugging of oil</td>
</tr>
<tr>
<td></td>
<td>b. check page # for identifying</td>
<td>b. check page # to identify cause of</td>
</tr>
<tr>
<td>motor appearance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. superheat wrong, to much oil returning to compressor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. refer to page #</td>
</tr>
</tbody>
</table>

Replacement compressor new or remanufactured fail at a rate of four times the rate of original compressors. This indicates most compressors fail due to system malfunctions which must be corrected to prevent repeat failures. Field
examinations of the failed compressor often will reveal symptoms of system problems.

**Refrigerant Floodback**

This is the result of liquid refrigerant returning to the compressor during the running cycle. The oil is diluted with refrigerant to the point that it cannot properly lubricate the load bearing surfaces.

<table>
<thead>
<tr>
<th>Symptoms of System Problems</th>
<th>Solution or Corrections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearings worn or seized</td>
<td>Maintain proper evaporator and compressor superheat</td>
</tr>
<tr>
<td>Dragging rotor, shorted stator</td>
<td>Correct abnormally low load conditions</td>
</tr>
<tr>
<td>Worn crankshaft</td>
<td>Install suction accumulator to stop uncontrolled liquid return</td>
</tr>
<tr>
<td>Worn rods or broken rods</td>
<td></td>
</tr>
<tr>
<td>Worn piston rings</td>
<td></td>
</tr>
<tr>
<td>Lubricated surfaces dry and shiny</td>
<td></td>
</tr>
<tr>
<td>The liquid dilutes the oil in the crankcase and the refrigerant rich oil will be pumped to the rods and bearings through the crankshaft. As the refrigerant boils off there will not be enough oil for proper lubrication at the bearings farthest from the oil pump. The center and rear bearings may seize or may wear enough to allow the rotor to drop and drag on the stator causing it to short or spot burn.</td>
<td></td>
</tr>
</tbody>
</table>

**Flooded Starts**

The result of refrigerant migration to the crankcase oil during the off cycle. When the compressor starts, the diluted oil cannot properly lubricate the crankshaft load bearing surfaces causing an erratic wear or seizure pattern.

<table>
<thead>
<tr>
<th>Symptoms of System Problems</th>
<th>Solution or Corrections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worn or scored rods or bearings</td>
<td>Keep compressor warm---put compressor on pumpdown system---install a</td>
</tr>
<tr>
<td>Rods broken or seized</td>
<td></td>
</tr>
<tr>
<td>Erratic wear patterns on crank</td>
<td></td>
</tr>
<tr>
<td>During the off cycle liquid refrigerant migrates to the evaporator or the oil sump where it is not needed.</td>
<td></td>
</tr>
</tbody>
</table>
**Liquid Slugging**

Slugging is usually caused by a combination of oil and liquid refrigerant coming back to the compressor in a fast moving large lump of material.

<table>
<thead>
<tr>
<th>Broken reeds, rods or crankshaft</th>
<th>This is the result of trying to compress liquid in the cylinders. This liquid can be either refrigerant or oil or a combination of both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blown gaskets</td>
<td></td>
</tr>
<tr>
<td>Backer bolts sheared off</td>
<td></td>
</tr>
</tbody>
</table>

**Solutions or Corrections**

- Maintain proper evap and compressor superheat
- Correct abnormally low load conditions
- Locate the compressor in a warm ambient
- Install a continuous pumpdown system
- Proper oil management
- Piping sized properly

**High Discharge Temperatures**

This is the result of temperatures in the compressor head and cylinders becoming so hot that the oil loses its ability to lubricate properly.

<table>
<thead>
<tr>
<th>Discolored valve plates</th>
<th>With the inability to lubricate properly the oil is broken down and this causes pistons, rings and cylinder walls to wear resulting in blow by, leaking valves also the oil can start to carbonize and become hard carbon that will travel through the system and clog up strainers etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burned reed valves</td>
<td></td>
</tr>
<tr>
<td>Worn pistons, rings and cylinders</td>
<td></td>
</tr>
<tr>
<td>Stator spot burn from metal fragments</td>
<td></td>
</tr>
</tbody>
</table>

**Solutions and Corrections**

- Correct high compression ratios from low load conditions
- Check low pressure switch settings
- Insulate suction line
- Provide proper compressor cooling/motor cooling
- Check condenser fans for proper cycling
- Check condenser vanes for obstructions
- Check cooling tower for restrictions
## Loss of Oil

Insufficient lubrication of critical wear components

<table>
<thead>
<tr>
<th>Rods and bearings worn or scored</th>
<th>When the flow of refrigerant is too low to return oil as fast as it is being pumped out of the sump, a uniform wear pattern results on wear components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crankshaft scored</td>
<td></td>
</tr>
<tr>
<td>Rods broken from seizure</td>
<td></td>
</tr>
<tr>
<td>Little or no oil in crankcase</td>
<td></td>
</tr>
</tbody>
</table>

### Solutions and Corrections
- Check oil failure control operation
- Check system refrigerant charge
- Correct abnormally low load situations or short cycling
- Check for improper line sizing and improper traps
- Check for inadequate defrost cycles

### Important Note

It is important to note that adding oil to the sump is not a sufficient way to correct low oil levels in the sump. The oil has left the sump and is located somewhere in the system. If the evaporator is running cold the oil more than likely will lie there until either the evaporator warms up or until the oil creates a blockage and then will be brought back to the compressor in volumes resulting in slugging.

**DO NOT JUST ADD OIL IF THE SUMP IS LOW!!!**

### Notes:

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### Compressor Temperature Parameter Chart
**Parameters of Operation**

Follow all of the temperatures listed above for all Air Conditioning compressors in service

No foaming of the oil in the sight glass

If the crankcase becomes hotter than 135 degree f. oil pressure is lost

Proper super heat at suction and discharge service valves 12 in away from valves

Do not over fill the compressor with oil-oil level should be ¼ in in the sight glass

Do not allow the hot gas line to exceed 275 degrees f.

High oil levels in the sight glass result in blown head gaskets

Discharge superheat measured 12 in. from the service valve should be 60 to 70 degrees.

Following the proper parameters detailed above will ensure longevity in the life of your compressors

**Electrical Failures**

Motors are generally damaged as a result of mechanical or electrical underlying problems that result in destruction of the electrical windings.
General Burn

Entire Stator is smoked or burnt in uniform consistence

<table>
<thead>
<tr>
<th>Solution or Corrections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check for high or low voltages</td>
</tr>
<tr>
<td>Check for unbalanced voltages</td>
</tr>
<tr>
<td>Check for Superheat or High head pressures and temperatures</td>
</tr>
<tr>
<td>Check for short cycling of compressor</td>
</tr>
<tr>
<td>Check temperature of motor running should be 80-110 degrees F.</td>
</tr>
</tbody>
</table>

Single Phase Burn

Motor has a separate burn appearance as if two of the three windings are burnt

<table>
<thead>
<tr>
<th>A result of two sets of windings burnt</th>
<th>Result of not having enough current through the unburned winding forcing the other two sets of windings to overcome the amount of torque needed to keep the compressor turning</th>
</tr>
</thead>
</table>

Solutions and Corrections

Check for proper motor protection
Check contactor contacts and mechanical condition
Check terminal and wiring conditions
Check for unbalanced voltage
Check for blown fuses
Check for incoming voltage dropout of one phase from transformer
Check for one leg of breaker not connecting

Half winding single phase burn

This occurs when one half of a part winding start motor has a single phase condition
Two contactors are used in the part winding start and a problem exists with one.
Solutions and Corrections

Check both contactors one will be defective
Check sequence timer for one second or less total time to engage

Spot Burn

A localized burn within the winding, between windings or from winding to ground. Can be electrical failure or possible mechanical failure resulting from foreign materials in motor windings.

Solutions or Corrections

Check Compressor for Broken Reeds or Parts
Check system for contaminates or moisture

Motors

Phase to Phase winding short.

Turn to Turn winding short
Compressor Motor Failures

Compressor motor failure can be caused by a variety of electrical or mechanical conditions. Here is a review of the common causes of motor failure, how you can diagnose them, and prevent costly replacements.

Voltage Unbalance

The most probable cause of current unbalance on any induction motor is voltage unbalance. Current unbalance rises sharply with a small voltage unbalance. Therefore, in any current unbalance problem, suspect source voltage unbalance. The max allowable voltage unbalance from winding to winding is 2%. The effect of voltage unbalance on current unbalance for any type of three-phase induction motor is shown below. The band indicates the spread that is likely to be encountered. For a given voltage unbalance, the current unbalance will increase as load decreases.
To check voltage unbalance, take the voltage readings between phases at the disconnect or the compressor contactor load side while the compressor is operating. The most accurate way to measure what is occurring at the compressor is to read the voltage at the compressor terminals. For example, if: L1 to L2 is 220V, L2 to L3 = 231 V., and L3 to L1 = 235 V. the average is \( \frac{220 + 231 + 235}{3} \) divided by 3 or 229V. Average

Next, figure the unbalance for each phase by getting the difference between the voltage reading and the average: L1 to L2 = 229 – 221 = 8V. L2 to L3 = 231 – 229 = 2 V. L3 to L1 = 235 – 229 = 6 V.

Five volts is the maximum unbalance. Use it in the formula: % unbalance is the maximum unbalance divided by the average voltage times 100.

\[
\% \text{ Unbalance} = \frac{8}{229} \times 100 = 3.49\%
\]

This voltage unbalance is greater than 2% and therefore is not acceptable. The customer should be advised. Having said that, most power companies will say that is well within their tolerance. Not all problems in this area are easily resolved.

### Current Unbalance

Voltage unbalance will cause a current unbalance, but a current unbalance does not mean that a voltage unbalance necessarily exists. Take a three-phase situation, where there is a loose terminal connection on one leg or where there is a buildup of carbon or dirt on one set of contacts of the contactor. Using L1 as our problem leg would cause a higher resistance on that leg than on L2 and L3. As we know, the current will follow the path of least resistance and cause the current to increase in the other legs. Higher current causes more heat to be generated in the windings. Lately, some problems have been brought to light involving the use of inverters on the same distribution lines as other loads. That, plus capacitor and inductance unbalance of modern lighting systems, can unbalance the three phase lines feeding the motors. Percent of current unbalance is calculated like voltage unbalance.

### Single Phasing

Single Phasing, where one leg of a three-phase system is lost will react much the same as the conditions just described, but the motor failure may be more rapid. When a three phase motor single phases, one phase is unaffected but the other generally show signs of overheating. The pattern of failure shows up below:

One phase is bright, shiny and clearly unaffected. This was the open phase. The other two phases are burned. Many times the visual effects are not as dramatic as shown here, but are evidenced in broken end ties and slight discoloration. In single phasing if the compressor is operating and one phase of a three phase motor supply opens, the motor may continue to run. The other two phases will attempt to pick up the load that the lost phase was carrying. The current draw of the remaining two phases will increase to about one to two times normal. If the compressor is loaded, it will push the current draw of the motor beyond the must trip current of the overload protection. Under light load conditions, the current may not reach the trip current of the overload and will remain running. The windings will run hot and depending on the type of motor protection, will trip. Once the motor stops, it generally cannot
restart, tripping on the overload protectors again and again, which normally leads to motor failure.

Supply Voltage

Overheating can also occur if the supply voltage is too high or too low, and outside the maximum minimum limits set by the manufacturer. For a compressor with single rating of 230 volts, the operating limits are within + or – 10% of the 230 (207 to 253 v.). On a dual rated voltage or spread voltage unit such as a 208/230 volt three phase system, the operating parameters are within 10% below the 208 and 10% above the 230-name plate voltage (187 to 253v.). And on a motor rated for 200/230 the lower voltage allowable is a full 180v. Keep in mind some single phase 208/230 rated motors will be rated for only 5% below the nameplate of 208 or 197V. The use of a single rated 208-volt single-phase motor will give better reliability.

In a single-phase motor another cause for overheating is faulty or improper start components as well as the run capacitor, if applied. It could be the start of run capacitor, or any of the contactor relay devices used in conjunction with the start winding components. Without the proper voltage and microfarad rating, the compressor will not operate within the design tolerance or might fail to start. If it fails to start, it could cause a locked rotor situation, which brings on overheating of the windings and rapid failure. Pay careful attention to the run capacitor, if applied. Existing designs of run capacitors tend to become weak and out of specs. Check them during a service call.

Short Cycling

Finally, one of the causes of overheating often overlooked as a cause of compressor failure is rapid cycling. The start stop cycling of controls and safety devices can result in shorted motor windings like the one listed below. Each time the motor starts, the current draws locked rotor amps. It takes a few minutes of running to get rid of the heat caused by locked rotor current. Frequent cycling causes a buildup of heat because the heat from the previous start has not been removed. In addition, wires and end turn coils in the motor can also rub together due to induced wire vibration that occurs during rapid current and temperature changes that happen every time the motor starts. In the case of many starts, wire rubbing may eventually result in the erosion of the insulation, causing a short. In summary electrical problems are usually caused by electric supply unbalance or rapid compressor on off cycling. All four typical electrical problems shown below can lead to overheating and eventual burnout. In addition, rapid cycling can cause failure of the motor windings due to constant flexing of insulated turns and connections.
**Motor Failure Caused by Mechanical Problems**

More common among motor failures are the ones that result from a mechanical problem within the compressor. When these occur, the resulting motor failure is quite often thought to be a “motor burn” when it is actually not the motor’s fault. Analysis of the failed compressor is the only way to determine the true cause of the problem.

**Refrigerant Flood Back**

One of the most common types of mechanical causes of motor failure is flood back. Liquid refrigerant returns down the suction line into the compressor. The compressor is a vapor pump, and the entering liquid will eventually cause damage. The liquid refrigerant returns to the suction cooled type motor compressor at the bottom of the compartment or barrel and make it’s way under the motor, where it will chill the motor. The remaining liquid will travel with the oil into the crankcase where it may boil off a little more until the oil is chilled. Now begins the problem. Surviving liquid will be on the bottom of the oil refrigerant mixture. The oil pump pickup is at the bottom of the sump, and it will conduct the liquid rich oil into the pump and then into the first bearing. Liquid refrigerant will flash off, displacing the oil, and result in a shortage of lubricant for the remaining bearing surfaces farther down the drive train such as those shown below. The progressive shortage of oil will worsen as you travel to the bearings farthest away from the oil supply, the motor end bearings. In a semi hermetic compressor, as those bearings wear, the stator air gap is lost and the rotor will finally drop to a point where it will touch and rub on the stator with a resulting spot burn. An internal inspection of the failed compressor will reveal the true cause of the motor failure. The welded compressor has a vertical shaft: while running, the rotor remains somewhat centered. When the compressor stops, the worn bearings and lost air gap allow the rotor to become magnetically locked against the stator. Since we cannot inspect the internals of the welded compressor very easily, we must logically assume that if a welded compressor draws locked rotor amps at start, it is most probably the result of liquid flood back. The problem remains one of the most serious and all too common in the industry. Less common but still a frequent occurrence is the damage done to the motor windings from pieces of metallic debris.

**Slugging**

The motor windings are quite close to the suction areas of the cylinders. Parts or small pieces from broken suction valves or even discharge valves like those shown below and backers or casting particles broken during a liquid slug will make their way back to the giant magnet called a motor. Those little pieces then act as a worm and bore into the winding or bridge the gap of poles and air gap, resulting in a spot burn. Again, the true cause cannot be determined without an internal inspection.

**Overheating**
Less often, the possible motor failure may stem from a compressor operating at high discharge temperatures. When the discharge temperature is high enough to destroy the lubricants ability to keep the metal rings and pistons apart, minute cast iron particles from the cylinder walls and rings become suspended in the oil. That oil will eventually find its way to the motor where the magnetic action can build a gap between the poles of the stator iron or become imbedded in windings causing a spot burn.

**Notes:**
CARRIER/CARLYLE 06D SINGLE VOLTAGE
THREE PHASE COMPRESSORS WITH
INTERNAL WINDING THERMOSTAT

Three Phase Across-the-Line Start
Internal Thermostat
Actual Startup of New Compressor

Understanding and implementing proper start up of replaced compressors is the most critical procedures in the operation and maintenance and longevity of any compressor replacement. Imagine telling your customer that you just burnt up the new compressor from failing to check the power coming into the contactor? How confident would your customer then be of you and your company?

Starting from the beginning:

1. Lock out the breakers and tag for safety. Double verify this procedure to insure that no one can be electrocuted by live wires. Check voltages with a meter to ensure the power is off.

2. Determining the failure of the “old” compressor is paramount in the installation and startup of the “new” compressor.

3. Once you have the old compressor out you could take off the heads and valve plates. Look for broken valves, look for excessive heat on the valves (carbon etc.). Look for oil laying in the cylinders, look for broken pistons, look for scarred cylinder walls. If you find broken valves, broken pistons, broken rods and blown gasket then, you will be looking for excessive oil traveling throughout your system. Excessive heat shows up as carbon on the valves and blued valve plates. Remedy---excessive superheat or work load, dirty condensers.

4. Open up the end bell of the compressor and look at the motor. If you check the terminals and found a shorted compressor or an incorrect reading across the terminals the motor will give you evidences of the type of failure. If you have a feeler gauge insert it between the motor and the rotor. Most clearances are around .010 thousands of an inch. Rotor drag will show up as no clearance and the cause of this is liquid freon wearing down
the bearings to reduce the air gap clearance between the motor and rotor.

5. Checking the end of the motor will help you in determining the type of electrical failure (if this is your cause) that has occurred. Refer to the pages prior with the pictures to identify the type of failure you have.

6. On to the installation of the “new” compressor. After installation and proper evacuation start by opening up your discharge service valve. No leak back or very very small leak should be present. Now open the suction service valve and charge the equipment if necessary.

7. Check to ensure the heater is on and working. Place your hand around (with caution) the area of the body next to the heater.

8. Let the heater run for approximately twenty four hours before start up.

9. Recheck the oil level in the sight glass. No more than 1/8” from the bottom. Most compressor valve plates are blown out due to excessive oil in the sump. Also remember that the old compressor could have pumped oil into the system and that will return to the new compressor in approximately two to three hours run time.

10. If you rewired the terminal double check that the wiring is correct. If you crossed a phase you will short out the windings immediately upon startup.

11. Check your contactor---replace if necessary

12. Check your oil safety switch.

13. Check your low pressure switch. Pump down the suction side of the compressor with the suction service valve closed.

14. Check your high pressure switch by placing a charge onto it with your dry nitrogen bottle and your gauges.
15. Double check that you have a circuit made from the bottom of the contactor by ohming across the L1 to L2 and then from L2 to L3 and then from L3 to L1. This will ensure that you have the proper ohm values for the compressor and that no overloads are locked out.

16. Take the 3 or 6(pw start) leads off the compressor at the terminals. Engage the power and read the voltages at the leads(be cautious this is live power). Voltages should be within a few volts of each other. If voltages are out of balance compressors will run hot or even not start. Watch for the contactor to chatter. Replace if necessary.

17. Within ninety seconds of engaging the contactor the oil safety should disengage the contactor. If not recheck the device and replace if necessary.

18. Replace the leads correctly back onto the compressor (do not put 6 lead machines out of phase. If you are uncertain about the wiring call us and we will direct you on how to properly wire the machine.)

19. To check the low pressure switch you can pump the compressor down by closing the suction service valve until the low pressure switch shuts off the contactor. If it fails to disconnect replace it and recheck the switch. **DO NOT ALLOW THE MACHINE TO GO INTO A VACUUM WHILE RUNNING.** Reopen the suction service valve and recheck all devices ready for equipment start.

20. Place an ampmeter onto one of the legs of power. Place gauges into proper positions. Place a separate gauge onto the oil pump. Have you temperature laser ready for use.

21. Start the compressor. Read the oil pressure first then go to the amp probe and then to the discharge and suction pressures. Read these constantly for the next five minutes passing thru each one quickly. Watch the sight glass for any foaming. After several minutes of run time go to the suction service valve and
six inches downstream check the temperature of the line, check the pressure temperature on the gauge and subtract it from the temperature you read on the line. **Most compressors run 15 degrees superheat at the suction service valve.** This is your superheat in basic form. Read the discharge line temp six inches from the discharge service valve then read the pressure temperature chart on your gauges subtract the gauge temperature from the temperature on your infrared and this is your discharge superheat. **Most compressors run 60 to 75 degrees of discharge superheat.** If your compressor is running high superheat at the suction then the superheat at the discharge should be high also. This does not apply to refrigeration compressors.

22. Watching over the compressor over the next few hours taking all of the temperatures listed in our charts. This is very important. **Compressors are designed to run within a selected set of parameters and running temperatures outside these will self destruct the compressor.** This will tell you if any contacts are chattering or if any lock out devices are not functioning properly.

**Notes:**
OHM’S LAW

In the preceding example, we know the following values:

\[
I = \text{amps} = 10 \quad R = \text{ohms} = 12 \\
E = \text{volts} = 120 \quad P = \text{watts} = 1200
\]

We can now see how the twelve formulas in the Ohm’s Law chart can be applied.

\[
\text{WATTS } P \quad 1200 \\
\text{AMPS} = \frac{P}{R} = \frac{1200}{12} = 100 = 10A
\]

\[
\text{OHMS } R \quad 12 \\
\text{WATTS } P \quad 1200 \\
\text{AMPS} = \frac{P}{R} = \frac{1200}{12} = 100 = 10A
\]
VOLTS  E  120
VOLTS  E  120
AMPS = \frac{E}{R} = \frac{120}{12} = 10A
OHMS  R  12
VOLTS2  E2  120^2  14,400
WATTS = \frac{E \times I}{R} = \frac{120 \times 10}{12} = 1200W
OHMS  R  12  12
WATTS = AMPS2 \times OHMS  P = I^2 \times R = 100 \times 12 = 1200W
WATTS = WATTS \times OHMS  E = P \times R = 1200 \times 12 = 14,400 = 120V
VOLTS = WATTS \times OHMS  E = I \times R = 10 \times 12 = 120V
WATTS  P  1200
VOLTS = \frac{E}{AMPS} = \frac{120}{10} = 120V
AMPS  I  10
VOLTS2  E2  120^2  14,400
OHMS = \frac{R}{AMPS} = \frac{12}{10} = 1.2 = \frac{120}{100} = 1.2
CARRIER/CARLYLE 06D SINGLE VOLTAGE
THREE PHASE COMPRESSORS WITH PART
WINDING START AND NO INTERNAL WINDING
THERMOSTAT

Carrier/Carlyle 06D
Three Phase Part Winding Start
Two Contactors
CARRIER/CARLYLE 06D SINGLE VOLTAGE
THREE PHASE COMPRESSORS WITH
INTERNAL WINDING THERMOSTAT

06D
Three
Phase

HEAD

(Customer wiring shown dotted)

Three Phase Across-the-Line Start
Internal thermostat
CARRIER/CARLYLE 06E THREE PHASE COMPRESSORS

06E COMPRESSORS

ACROSS - THE - LINE START (XIL)  
6 - Pin Terminal Plate  
3 - Lead XIL Start

PART - WINDING START (PW)  
6 - Pin Terminal Plate  
6 - Lead PW Start

9 - Pin Terminal Plate  
(208-230/460V 300 Series Models)  
208-230 XIL Start

9 - Pin Terminal Plate  
(208-230/460V 300 Series Models)  
208-230 PW Start Only

9 - Pin Terminal Plate  
(208-230/460V 300 Series Models)  
460V XIL Start

9 - Pin Terminal Plate  
(208-230/460V 300 Series Models)  
460V PW Start

WARNING
With 208-230/460V 300 Series Models, the 460V cannot be wired for PW start. Use distinct 460V 600 Series Models for any 460V PW applications.