

# METROPOLITAN NY CHAPTER Refrigeration Service Engineers Society

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April 2014

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## The Start Capacitor

Troubleshooting single-phase refrigeration compressors requires a technician to have a proficient understanding of capacitors. The start capacitor is one of two types of capacitors that could be found on single-phase compressors. Understanding how to troubleshoot and replace a defective start capacitor is essential when working with these compressors.

The start capacitor is used to boost the starting torque of a compressor's motor. This is done by placing the start capacitor in series with the start winding during the starting of the compressor. As current flows through the start capacitor and the start winding, the capacitor causes the start winding to become out of phase with the run winding. This causes the motor to start with a higher torque than would normally be possible.

The addition of a start capacitor increases the starting torque of the compressor by 300% to 500%. The start capacitor is designed to stay in the circuit only until the compressor reaches 2/3 to 3/4 of its operating speed. If left in longer the start capacitor could be damaged. It is not designed to dissipate the heat that will build up from continuous operation.

Defective start capacitors can and will lead to problems with the operation of single-phase compressors. A start capacitor can be damaged by a sticking relay, which will cause it to stay in the circuit longer than normal and overheat. A start capacitor can also overheat from rapid cycling of a compressor. It is recommended that a start capacitor be limited to a maximum of 20 starts per hour.

When replacing a capacitor there are two important specifications that must be determined: its microfarad rating and its rated operating voltage. The microfarad rating of the replacement capacitor should be equal to its original. If the exact rating cannot be found, a capacitor with no more than a 20% greater microfarad rating can be used. A lower microfarad rating should not be used.

The voltage rating on the capacitor should also be matched to the original. If the original voltage rating cannot be found, a capacitor with a higher rated voltage can be substituted. Do not use a capacitor with a lower rated voltage.



When replacing capacitors, if a single capacitor cannot be found to replace the original, multiple capacitors can be wired either in series or parallel to replace the original. To determine the capacitance of capacitors wired in series, use the formula

$$1/C_t = 1/C_1 + 1/C_2 + 1/C_3 + \dots$$

The rated voltage of capacitors wired in series is the sum of the individual operating voltages. The voltage applied to each individual capacitor is inversely proportionate to the applied voltage. For this reason it is not recommended to connect capacitors of unequal values in series.

Capacitors can also be wired in parallel. To determine the total capacitance of capacitors wired in parallel use the formula

$$C_t = C_1 + C_2 + C_3 + \dots$$

The total rated voltage will be that of the lowest rated voltage of an individual capacitor.

When replacing a start capacitor it is a good idea to also change the starting relay. The contact points of the relay current could be damaged causing it to stick closed when starting. It is difficult to inspect the contact points so replacing the relay is a precautionary item.

A start capacitor will normally fail open. This could be tested with an ohmmeter or a capacitor tester. Normally a visual inspection of a capacitor will indicate if it is defective. The membrane on top of a defective capacitor will normally blow out when the capacitor fails.

Many single-phase compressors use a start capacitor to assist in the starting of the compressor. Understanding how to troubleshoot and identify a defective start capacitor is essential when working with these compressors. It prevents a good compressor from being replaced because it

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- \* It has more than 20,000 members in the United States and Canada.
- \* It has more than 400 chapters throughout the United States and Canada.



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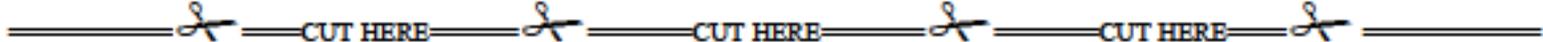
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