

H V A C S O L U T I O N S

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CAPACITORS

Purpose

Purpose - causes current to lead voltage by 90 degrees. Provides similar starting and or running properties to 2 phase motors if there was such a thing.

Types

Paper - motor **run capacitors** are made by rolling 2 or more layers of paper between 2 layers of aluminum foil, and then inserting the foil plates into a metal case which is then sealed with a metal cover. The terminals are attached to the foil. A small hole in top of the case is where insulating oil is put into the case and the hole is then sealed. They are designed for continuous use. The metal case helps to dissipate heat

Electrolytic - motor **starting capacitors** may have 20 times the capacitance of motor running capacitors of the same physical size. They are used for starting a motor only. They are not able to be subjected to continuous use. A centrifugal switch or start relay usually disconnects the start capacitor from the circuit after the motor starts. Start capacitors require a bleed resistor be installed across the terminals so the stored charge is bled off during a run cycle. This resistor increases the life of the start relay.

Specified bleed resistors are normally 15,000 or 20,000 ohm, 2 watt.

Terms

Capacitance is expressed in microfarads (μF , MF, MFD).

Voltage indicates the maximum voltage a given capacitors insulation can handle. Has no direct relationship to the applied voltage.

Testing

Capacitors have the ability to store potent electrical charges. Before testing they should be discharged with a start capacitor bleed resistor, or your volt meter when set to a high scale. Do not discharge capacitors with a screw driver—it may be damaged. Be certain power of off first.

Testing with a ohmmeter — the following test/s will not indicate microfarads.

Analog Meter: After discharging the capacitor and disconnecting the wires, set your ohmmeter to R x 10,000 (10K). Your meter needle should swing to a relatively low resistance and then slowly return to infinity. A shorted capacitor will be indicated by a very low or 0 resistance. An open capacitor will be indicated by no needle deflection: needle stays on infinity (∞).

Digital Meter: After discharging the capacitor and disconnecting the wires, set your ohmmeter to your highest scale: preferably 10 megohms or greater. When touching the

meter probes to the capacitor terminals your meter display should begin to go to a relatively low resistance value and then begin to slowly return to very high value. - this happen very quickly and if you blink you might miss it. A shorted capacitor will be indicated by a very low or 0 resistance. An open capacitor will be indicated by open circuit (usually OL).

Testing with a capacitor analyzer — will verify the capacitance in microfarads. Many digital multi-meters (DMM's) have a capacitance testing function built in.

Replacement Rules

Run capacitors: microfarads of the replacement must be $\pm 10\%$ of the original.

Start capacitors: microfarads of the replacement must be -0% , $+20\%$ of the original.

Voltage of the replacement must be equal or greater than the original.

Breaking these rules can damage the motor, the capacitor, or you.

Selection

Follow manufacturer's recommendations. They spend a lot of time and energy determining the right capacitance and voltage rating. You cannot do it in the field

Start relay, if used, must also be selected by the manufacturer. Failure to get the correct pickup voltage, dropout voltage, and coil voltage rating may create the same problems, possibly more severe, than selecting the wrong capacitor.

If 2 capacitors, C1 and C2, are connected together in **parallel**, the total capacitance (CT) the motor will see is:

$$CT = C1 + C2$$

The voltage rating of the 2 capacitors in parallel is the voltage rating of the lowest voltage capacitor.

If 2 capacitors, C1 and C2, are connected together in **series**, the total capacitance (CT) the motor will see is:

$$CT = \frac{C1 \times C2}{C1 + C2}$$

The voltage rating of the 2 capacitors in series is the sum of the voltage rating of the 2 capacitors.

Remember the voltage of the replacement must be equal or greater than the voltage rating of the original capacitor.

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