Tech Tip
Capacitors Part 1

Because of recent truck stock changes it has become apparent that service techs need to add a calculator to their toolboxes.

By wiring a capacitor in parallel most techs know that the uf ratings add up.
For example if he has a 30 uf 440 volt and a 15 uf 440 volt wired in parallel the resulting capacitance would be 45 uf 440 volt (30 + 15 = 45).

But what about if he needed something smaller than he has on his truck?

Let's go on a call with Rick.

9:00 pm, Rick gets a call that Mrs. Boudreaux's unit is out and we did a preventive maintenance call on it 1 month ago.

Rick quickly identifies the condenser fan motor is running backwards and upon further investigation finds the 3uf 370 volt capacitor is causing the problem.

Rick realizes the capacitor he needs is not among the stock on his truck.

Out comes the calculator…
Rick knows that by using the formula $\frac{C1 \times C2}{C1 + C2}$ for capacitors in series, he can get the new capacitance to be lower than either one of the capacitors he uses.

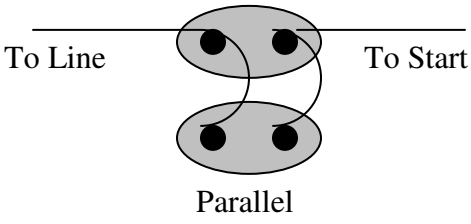
Rick knows he has a 5 uf 440 volt and a 7.5 uf 440-volt capacitor on his truck so he applies the math.

5 X 7.5 = 37.5 (C1 x C2) and 5 + 7.5 = 12.5 (C1 + C2)
Therefore 37.5 divided by 12.5 = 3

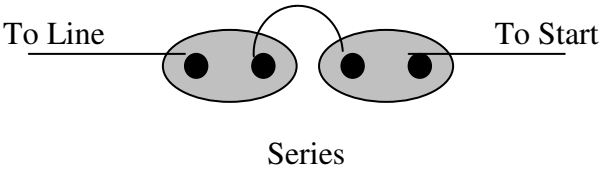
The 2 capacitors he has on his truck will allow him to make a 3uf 440volt capacitor that can be used on Mrs. Boudreaux's home without having to make a second trip.

This does not jeopardize the quality of the parts being installed or the quality of the job. Because most technicians do not know this, a note to future technicians may be attached to the capacitors for reference.

Second trips cost your company approximately $200 each time you don't complete the job the first time.



Parallel



Series

Tech Tip
Capacitors Part 2

Capacitors should be checked on a maintenance call to prevent motors and compressor failure during the hottest or coldest part of the year.
Rick has a setting his Voltmeter that allows him to check capacitance or uf (*micro farads*). ⊣⋲⊢
The wires should first be marked, and disconnected. Then the capacitor should be discharged with a **20,000-ohm resistor** prior to checking to prevent meter damage. (*Available at most electrical supply houses*)

Rick was talking to a young technician about a service call he made on Mrs. Boudreaux's unit that had a capacitor that was outside its tolerance rating. If the capacitor had been checked on the maintenance call, the warranty service call could have been prevented. Rick suggested that the tech purchase a meter to check the capacitors because over the last few years capacitors have been built into smaller and smaller cases. The failure rate of run capacitors seems to be much higher than it used to be. (*I may be wrong but nothing seems to last like it used to*)

Rick also had a suggestion for the young tech to help him through this until he purchases his new meter.
The tech should have a voltmeter and an ammeter in his possession. With these two tools capacitance can be calculated.
(*This can also be used to see if a capacitor is breaking down under a load)*

Turn the unit on and allow it to stabilize.
<u>Caution should be taken while taking readings on operating equipment.</u>
Take an amp reading on the start winding. (*This should be the wire that runs between the S terminal on the compressor and the run capacitor)*
Take a voltage reading across the terminals of the capacitor. (*C and Herm*)
The voltage reading will be higher than the line voltage, but should not be higher than the voltage rating stamped on the capacitor.
Example:

- 227 volts at the T1 and T2 of the contactor
- 3 amps measured on the start winding
- 313 volts across the terminals of the run capacitor (*This is called Back EMF*)
- 370 volts or 440 volts stamped on the capacitor.
- A 440-volt capacitor can always be used to replace a 370-volt capacitor.

Rick plugged in the numbers in the calculator to determine the operating capacitance.
2650 (*a constant number*) x 3 amps / 313 volts
2650 x 3 = **7950** and then
7950 / 313 = **25.4 uf**

<u>2650 X Amps (of start winding)</u>
Voltage (measured across Capacitor)

Rick shows the young tech that the rating stamped on the capacitor is 25uf and 370 volts with a tolerance of +/- 6%. (Sometimes 4%, 6%, or 10%; read the capacitor)

6% of 25 uf is 1.5 therefore if the calculation falls between 23.5uf and 26.5uf the capacitor is good.
The voltage read across the capacitor was 313 volts and that is well below the 370 volts the capacitor can handle.

+ 6% =	26.5 uf
OK	25.4 uf
- 6% =	23.5 uf