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Franklin Application/Installation Data (AID) ... For The Professional Driller-Installer

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# CONTACTOR COILS AND LONG CONTROL CIRCUIT CABLE RUNS

In the last issue we spoke of contactor coil characteristics and how both high and low voltage could cause coil burn-out. We also described how a typical three-phase pump panel and a Franklin deluxe control box has both a main power circuit and a separate control circuit.

In this issue we will discuss circumstances which can result in contactor coil burn-out or the failure of the contactor to dropout (shut off the motor) even though the control switch has opened. **Figure 1** shows a contactor and control circuit for a single-phase unit, although this condition could affect either a single- or three-phase contactor. Note that in the example there is more than 300

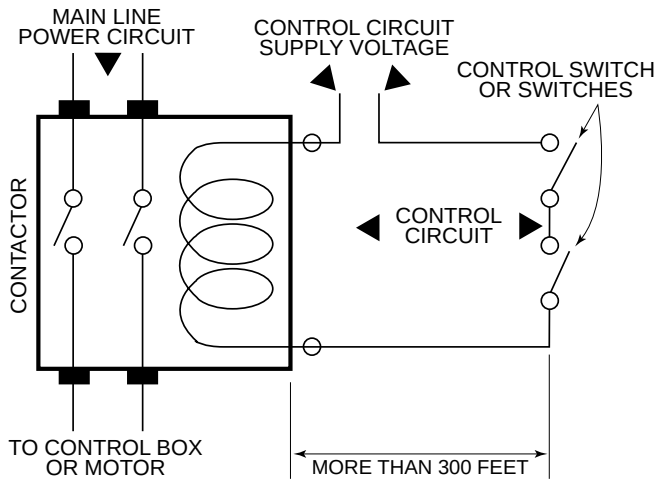


Figure 1

feet of wire between the contactor and the control circuit switch. Again the control switch could be a pressure switch, float switch, time clock, or other control device(s).

There will always be some capacitance between the two wires in the control circuit. With normal control circuit lengths, this capacitance causes negligible voltage on the coil. However, if the length of the wire is long enough, this voltage may exceed the coil's "sealing" or "must hold" voltage rating and keep the coil energized. The resultant coil voltage can also be either high or low enough to cause coil burn-out (remember the contactor characteristics' example from the last issue). If the capacitance happens to be near a specific ratio to the coil's inductance, a phenomenon called **"series resonance"** can cause the coil volts, or cable volts, or both, to exceed the line voltage. One test demonstrated that 0.8 microfarad open-switch control cable capacitance created 420 volts across the coil-with only 240 volts input! Specific tests conducted at Franklin Electric have shown that cable capacitance of as little as 0.1 microfarad could keep a contactor closed even though the control switch had opened. Tests have also shown that as little as 0.2 microfarad could cause contactor coil burn-out.

The length of control circuit wire necessary to set up this type of capacitance will vary from a few hundred to several thousand feet. Factors such as cable type, cable size, and burial locations (wires side by side or separated) are some of the factors contributing to this condition. In addition, different brands and types of contactors are affected differently.

Also, keep in mind that these same symptoms may be caused by wiring problems such as ground fault or shorts between the wires. With all power removed and ***all*** control switches opened, if there is any continuity between the two control circuit wires, the wires are shorted or connected together somewhere. Continuity is always checked with the **POWER OFF** and generally an ohmmeter is used. Always

carefully troubleshoot the control circuit before assuming the coil problems are caused by control cable capacitance. Shorted connections can also be caused by a malfunctioning switch or timer. You should also eliminate possible damage caused by mice, moles, fire-ants, or other insects.

While there is no known "one size fits all" method of curing conditions of high control cable capacitance, it can usually be solved by connecting either a resistor or capacitor across the contactor coil.

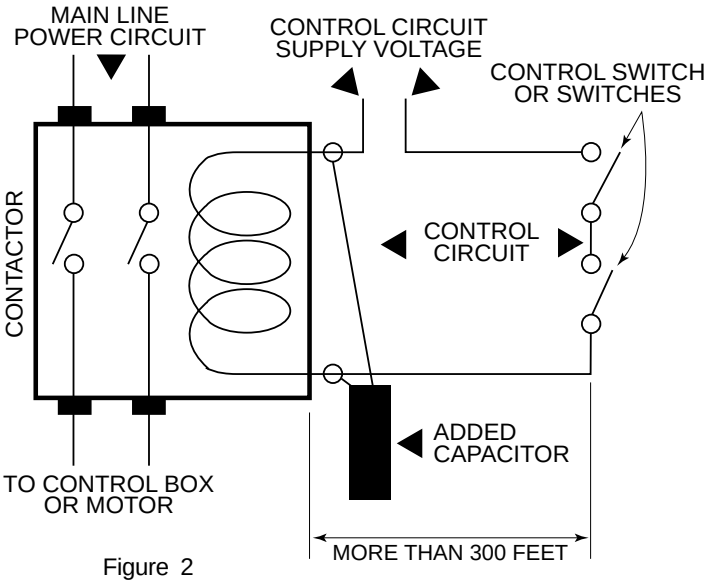


Figure 2

Franklin recommends that any time there is more than 300 feet of cable between the contactor and the control switch, a capacitor should be added across the contactor coil **(Figure 2)**. The capacitor should be a continuous duty, AC capacitor, like the gray or silver run capacitors used in Franklin's larger control boxes. **Note: Run capacitors are available in both plastic and metal cases. If metal cased capacitors are used, they must be grounded.** Recommended ratings are shown in **Figure 3**. The contactor Franklin uses typically has four (4) quick-connect terminals located on the contactor's coil. Two are used to supply power to the coil and two are not used. Connect the new run capacitor to the two empty terminals. Connecting a run capacitor to the coil terminals normally assures drop-out and safe coil voltages with all cable lengths and contactor models. **Note: this run capacitor is an additional capacitor. You can not use an existing control box run capacitor for both the motor power circuit and the control circuit. Run capacitors are typically found inside Franklin's 1 1/2 through 15 Hp single-phase control boxes.**

**RECOMMENDED CAPACITOR RATINGS**

| COIL RATED VOLTS | CAPACITOR MICROFARADS | CAPACITOR MINIMUM VOLTAGE RATING |
|---|---|---|
| 24 | 50 - 100 | 30 |
| 115 | 10 - 20 | 120 |
| 230 | 5 - 10 | 240 |
| 460 | 3 - 10 | 480 |

Figure 3

## TOLL-FREE HELP FROM A FRIEND

Phone Franklin's toll-free SERVICE HOTLINE for answers to your installation questions on submersible pump motors. When you call, a Franklin expert will offer assistance in troubleshooting submersible systems and provide immediate answers to your motor application questions.

**Franklin Electric SERVICE HOTLINE 800/348-2420 FAX 219-827-5102**

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