Century®
Formerly A. O. Smith Electrical Products Company

HVAC Motor Doctor®
a distribution HVAC newsletter

In Case of Emergency

It's 10:30 on a Sunday night, and you get a call from a nearby hospital. The door operator has failed at the hospital's emergency entrance. Or it's minutes before the dinner hour at a popular restaurant, and their air conditioning system isn't working. The nearest wholesaler is 75 miles away, and they close at 5:00 p.m. Or there's a flood, and your telephone is ringing off the hook with customers needing replacement motors for their jet pumps.

The question you always face in emergency situations is: what's okay or, more importantly, what's not okay when it comes to replacing failed electric motors. You do have one element in your favor when replacing motors in an emergency--NEMA provides you with a set of minimum standards for performance and mechanical interchangeability of motors. Even with these standards, however, emergency replacements represent a particular challenge for the service technician.

The advice I'm about to give applies to squirrel cage induction motors of general purpose construction without special mechanical or electrical features that would make an exact replacement mandatory. For that reason, I'm excluding special motors, such as residential garage door opener motors, but including motors used in general-purpose applications such as commercial garage door openers.

Before the Motor Doctor gives you any replacement advice, however, let me state two important cautionary notes:

Safety is your first—and foremost—consideration. Never do anything that your experience, common sense, or good practice would tell you is unsafe. If the motor you are using as a replacement is not an exact match with the original, the minimum check you must do is to measure the input amps to the substitute motor. Never exceed the input amps specified by the manufacturer for that motor.

Second, consider any emergency replacement a temporary solution. This is particularly true when you are using a motor that does not exactly match the original in terms of manufacturer specifications. In an emergency situation, you must weigh the desirability of making the substitution against the customer's immediate health, property, and economic needs.

Keeping those precautions in mind, let me give you seven possibilities you can consider:

Capacitors. In general, you may make substitutions for oil-filled run capacitors on permanent split capacitor (PSC) motors by going to the next standard or stock microfarad rating. For example, a 10 microfarad capacitor may be substituted for a 7 ½ microfarad capacitor. It is always safe to use a capacitor with a higher voltage rating—but it is never safe to attempt to use a capacitor with a lower voltage rating. Another possibility when substituting capacitors is to wire them together in parallel to add microfarad ratings. For example, you may wire a 5 microfarad capacitor in parallel with a 7 ½ microfarad capacitor to achieve the equivalent capacitance of a 12 ½ microfarad capacitor. You also may use the same procedures when making substitutions for the start capacitor on a motor.

Fractional horsepower direct drive motors that are designed for air handling applications generally are either shaded pole or PSC type motors. You may always safely replace a shaded pole motor with the equivalent rated PSC motor. Keep in mind however, that it is never safe to replace a PSC motor with the equivalent shaded pole design. The reason is that the relatively lower efficiency of the shaded pole motor will create problems with heat dissipation.

Motor speeds. This advice applies to all squirrel cage induction motors, including single phase (shaded pole, PSC, split phase and capacitor-start split phase) as well as most three-phase motors. When making replacements here, the important factor to keep in mind is to match the number of poles of the replacement motor to that of the original. This is not a tricky process. Remember that the relationship of the number of poles to nameplate speed causes the speed of that squirrel cage motor to fall into discrete bands. For example, two-pole motor speeds cluster around 3,400 revolutions per minute (typically ranging from 3,000 to 3,600 RPM). Four-pole motors cluster around 1,750 RPM (in a range from 1,500 to 1,800 RPM). The point to remember is that nameplate speeds need not match exactly—but the number of poles must.

Multi-speed motors. This advice applies primarily to single-phase, direct-drive motors. It is acceptable emergency practice to replace a multi-speed motor with the equivalent-rated single speed motor, and vice versa. Remember to properly treat the unused speed taps of any multi-speed motor used to substitute for a single-speed design. Each unused tap connection must be electrically insulated individually at the electrical connection. Leaving unused taps uninsulated or connected together likely will result in motor failure.

Voltage. Any motor built to NEMA standards must be capable of delivering its nameplate horsepower without overheating over a voltage range of plus or minus 10 percent of its nameplate voltage. This means that a 115-volt motor could replace a motor rated from 110 volts to 120 volts. It also means you could replace a 208-volt motor with a 230-volt motor (230 volts minus 10 percent equals 207 volts). Be careful when making this substitution. Most local power companies specify that line voltage will be plus or minus 5 percent of nominal voltage. This means a 208-volt system might have actual line voltage as low as 197 volts. If the line voltage is at the low end of the power company's range, it may be out of range for the substitute motor you are considering.

Here's an important tip: motors with multiple voltages separated by a dash on the nameplate (208-230, for example) are called "wide-voltage band" motors. Properly designed, they are capable of operating in a range that extends from 10 percent below the lower of the two voltages to 10 percent above the higher voltage. Take it from the Motor Doctor—you need some of these motors on your shelf.

Enclosures. Fully enclosed motors carry the nameplate designations TENV or TEFC. These are generally designed to operate under a wider range of environmental conditions than an equivalently rated open motor. For that reason, an enclosed motor can usually replace the equivalent-rated open motor in an emergency substitution—but not vice versa. Remember, however, that an enclosed motor may have a harder time dissipating heat generated during operation. That would make it less than an ideal candidate in any enclosure that does not allow for the free exchange of air. If the motor comes with thermal protection, it may be prone to nuisance tripping.

There are some motors built specifically for a multitude of replacement purposes, and you should be familiar with these products and have them available for your customers. You can use them with the confidence that they will do the job for an extended period of time in an emergency situation. In many cases, however, the advice I have provided is to get you through the emergency at hand.