When faced with a failed motor or a comfort complaint, technicians need to make some quick decisions that will resolve the customer’s issue. But the best decision is not always obvious. This article reviews the advantages and disadvantages of some common solutions to meet the customer’s need. A quick overview of the most popular HVAC motor technologies is a good place to start.

Motor tech 101
It is important to remember that any time the blower motor is replaced, the operation in heating and cooling must be checked to ensure that it meets the OEM’s specification with the new motor installed. For heating, the installer should check for conformance with the specification for the temperature rise of the furnace while operating (in both the first and second stage on two-stage furnaces). For cooling, the installer should measure the airflow and confirm operation within the manufacturer’s air-flow specification.

Permanent split capacitor motors are widely used when starting torque requirements are not too high and moderate electrical efficiency is needed. They are typically used on fans, blowers, small pumps and gear motors. PSC motors, like most ac induction motors, have a peak efficiency that occurs at a speed point 5%–10% below synchronous speed. Synchronous speed is the speed of the rotating magnetic field from the stator windings. The speed is equal to 120 times frequency divided by the number of stator poles, or (120 x 60 Hz)/8-pole stator winding = 900 rpm. Typically, PSC motors are
designed with multiple speeds, only achieving peak efficiency on the highest speed. As lower speeds are used, such as in constant fan mode, the efficiency of the motor decreases dramatically.

Variable-speed electronically controlled motors include the category known as electronically commutated motors. ECMs are capable of controlling current and frequency to the motor winding, which in turn provides torque and speed control. Current and frequency control, along with the use of magnets in the construction of the motor, enable ECMs to operate up to the 80% efficiency range. While induction motors can be designed to run at good efficiencies at a single speed, ECMs maintain high efficiencies across wide speed ranges. The electronic control enables OEMs to work with motor manufacturers to optimize the motor for improved efficiency as well as comfort. With these levels of motor performance, OEMs continue to shift more system designs toward ECM technology.

**Replacement motor solutions**

So what is the best solution when faced with a failed PSC motor? Should the original equipment manufacturer be contacted and an identical motor be ordered? Perhaps the failed motor can be substituted with a stock replacement. Or maybe this situation would be a good candidate for a high-efficiency ECM replacement. If the system is still under warranty, then it is recommended to follow the OEM’s guidelines for warranty replacement.

Customer dissatisfaction with comfort can also present the need to replace a blower motor in the field. Inconsistent temperature (hot or cold spots), air quality and noise are common consumer complaints. These issues can often be addressed through replacement with an ECM.

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Each option must be carefully considered to meet the need of the customer (see Figure 1). Following is a closer look at each option along with some pros and cons.

- **PSC motors**
  Going direct to the manufacturer for an identical replacement motor may seem like the simplest solution for a failed
Since stock motors may provide more speeds than that of a direct replacement, a speed can be selected that provides more or less air flow to the system if needed.

ECM replacements can provide a host of benefits to the homeowner. ECMs provide a soft-start feature that reduces the common “clunk” startup noise experienced when using PSC motors. The hum and the speed-transition noises are also greatly reduced with the use of the ECMs. With PSC motors, the use of constant fan can be noisy and result in high operating costs. Constant fan will keep the air circulating,
Technicians should consider each option carefully to meet the needs of the customer when deciding between PSC and ECM motors.

resulting in cleaner air and reduced temperature differences throughout the home. Unlike PSC motors, ECM retrofits operate at constant fan speeds for a much lower cost, enabling the homeowner to use this as the default. Efficiency is a significant advantage, with an average 25% reduction in watts in operating mode and 74% less watts in constant fan mode.

Figure 2 shows the cost comparison between a PSC and a retrofit motor. The owner of this particular example adopted the ECM retrofit and was able to reduce the air flow (following the OEM’s recommendations), which resulted in quieter operation and watt reduction.

For the contractor, the ECM offers additional benefits: dual voltage, rotation sensing, multi-speed and multi-horsepower. Flexibility is another big advantage for the contractor. As few as two motors are all that are needed to cover almost all PSC applications. With fewer SKUs, the contractor can keep motors in the truck and avoid the trip to pick up a replacement motor.

However, there are drawbacks. The motor itself is slightly longer and sometimes requires separate mounting brackets. Installation may take an additional 5–10 minutes for an experienced installer and 15–20 for a first-time installer. The replacement cost is higher compared to that of other options. However, contractors should check with the local utilities for available rebates. Some areas of the country offer $50–$200 to customers installing ECM retrofits.

While there are advantages and disadvantages to each of the options provided, it all comes down to what the customer wants and needs. Is the customer concerned with air quality or noise? Does the customer have an IAQ system that they would like to better utilize with constant fan? Does the customer want to reduce their carbon footprint? Or did a blower motor failure occur in the middle of winter that requires a quick repair? In all cases—in terms of reliability, comfort, efficiency and flexibility of installation—the ECM retrofit motor provides the best solution for those needs.

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