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Basics of Multi-Speed Motors

Every service technician should have at least one multi-speed motor in his or her truck to help in making acceptable substitutions in the field.

Multi-speed motors come in two basic varieties. The first variety has an extra set of windings called a booster winding that behaves like a transformer. The second variety comes with two distinct separate sets of windings.

So how do these motors work? First remember that motor speed is calculated by the number of poles divided by the constant 7,200 to arrive at the revolutions per minute. When the motor is under load, however, the rotating part of the motor slows down or "slips."

If the load is constant, one can increase the slip by weakening the strength of the spinning magnetic field. One way is to decrease the voltage to the magnet wire that makes up the poles.

You can decrease the voltage externally by using a speed control or internally through the use of the booster winding in a multi-speed motor. In other words, the booster winding acts like a transformer, changing incoming line voltage to a lower voltage at the windings.

The booster winding may come with taps that allow you to apply different voltages to the poles, creating different speeds in the motor. Remember that "speed" taps just affect the strength of the spinning field—not the actual speed—meaning you can only affect motor speed with a load on the shaft. This is because slip occurs when the load works against the weakened magnetic field. Consequently, if you bench test a multi-speed tapped motor using a tachometer or strobe, you will detect little variation between speed taps since there's no load.

Since the booster winding method of creating multiple speeds involves using a motor with just a single set of pole windings, you'll find that the horsepower is always lower as the speed (voltage) is reduced. Consequently, this design is generally unsuitable for loads other than fans.

The second type of multi-speed motor with two completely separate sets of windings allows you to use one or the other speed at a given time. Having two pole sets wound independently offers you more flexibility to produce constant horsepower in mechanical applications since you are energizing just one set of poles at a time.

We also refer to a multi-speed motor "weakened" by speed taps as a multi-horsepower motor. For example, if you have a 1/3 horsepower three-speed motor, it generally would deliver 1/3 horsepower when connected to its high-speed tap, 1/4 horsepower at its middle-speed tap, and 1/6 horsepower on low speed.

Knowing this, one can begin to appreciate the versatility of multi-speed motors in the field. You could use the above multi-speed motor to replace single-speed 1/3 horsepower, 1/4 horsepower, or 1/6 horsepower motors with the same number of poles. To achieve the correct results, simply select the correct tap and carefully insulate the two unused taps. The result would be a motor that produces the same performance, similar fan noise characteristics, and the same static pressure as the original single-speed model.

Multi-speed motors give the service technician another versatile tool in the field. That's why is always good to have some in stock for emergency substitutions.