What Does It Mean When A Rewound Motor Runs 'Hot'?

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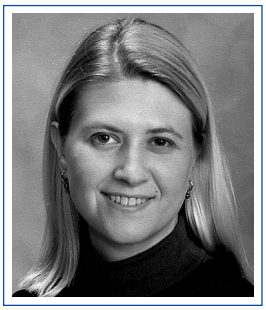

"We have rewound a motor, and now that it is back in service, our customer says it's running hot. The frame is getting so hot that he can't put his hand on it, and now he is blaming us for rewinding the motor incorrectly!"

Has this ever happened to you? You have rewound a motor without changing the design at all; you tested the motor before you sent it out, and everything appeared to be fine. But now your customer wants you to figure out what is wrong, or rewind the motor again. Before you consider this, there are a few things to check to see if the motor is, in fact, running properly. It is quite possible that the motor ran "hot" before it failed, but what are the chances that someone on-site put their hand to the frame before it had to be rewound?

You Can't Tell By Frame Temperature

There is not a way to determine the winding temperature of a motor just by feeling the frame. The maximum temperature rating, based on the class of insulation, applies to the winding temperature at the hottest spot inside the motor. The temperature of the frame can be between 20°C and 40°C (or less, or more) cooler, depending on the design of the frame and the enclosure.

Insulation Class

The insulation class of a winding is determined by the maximum temperature it can withstand before complete breakdown. The majority of motors manufactured today use a Class F (155°C) or Class H (180°C) system. Many service centers will use a Class H system on all rewinds. Assuming that the ambient temperature is 40°C, NEMA states that at 1.0 service factor, the maximum winding temperature rise for a Class F system is 105°C. *Note: It is very important to remember that even though the insulation system may be able to withstand very high temperatures, for every 10°C rise in total winding temperature, the insulation life will be cut in half.*

Example

This example will illustrate that the motor frame can be quite hot even if it is running perfectly fine. Let's assume that a particular motor is wound with Class F insulation and has a 40°C ambient temperature. Let's also assume that this motor is a high efficiency design that operates with a Class B temperature rise (80°C winding temperature rise). At full load, we can assume that the total winding temperature is somewhere around 120°C, well below the design limit for the Class F insulation. If we estimate that the frame temperature is 40°C lower than the winding temperature (pretty liberal), then that means the frame is going to be about 80°C on the surface. 80°C equals 176°F, and I don't know about you, but I certainly couldn't hold my hand on a frame that hot for any length of time!

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Check The Amps!

The best way to determine if the motor is running properly is to check the current draw with an ampmeter. If the current is less than or equal to the nameplate current, then you are probably not overheating the motor. If the current is higher than the nameplate reading, then it is possible that the motor is running too hot. Overloading, high or low voltage, or high ambient are the most common causes of motor overheating.

Older Motors

In general, the old NEMA U-frame motors ran cooler than the today's T-frames, mainly because the insulation systems were not as good, so the motors were required to run at much lower temperatures. If a U-frame motor is replaced with a T-frame, it may be alarming to your customer that it runs much hotter, when actually it may be running even more efficiently than the old one.

Explosion-Proof Motors

There is one case where it is very important that the frame surface temperature be kept somewhat cool. An explosion-proof motor requires that the surface temperature be below the ignition point of the hazardous material in the environment. These motors come equipped with temperature sensors that will trip the motor offline when the winding temperature exceeds a certain level. UL sets the standard temperatures based on the gas, vapor, or dust present in the environment. However, there is no standard for other general purpose motors.

The best way to determine whether a motor is running within a safe operating temperature is to use temperature sensors, like thermostats or RTD's to monitor the winding temperature. As mentioned before, you can also monitor the current to get a basic idea of how the motor is running. But do not rely solely on the frame surface temperature because it is in no way an accurate method to determine the "safe" operating temperature.