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HVAC Motor Doctor®
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Magnetics, Heat and Motor Efficiency

Motor efficiency remains one of the top issues in our industry, but when you talk about efficiency, often you're talking about trade-offs. In other words, it is relatively easy to make a motor efficient, if money is no object. But since cost is a factor, motor manufacturers keep seeking the right balance of increasing motor output without driving up the price of the product.

Occasionally, a technician or service person asks, "Why not just increase the output by increasing the voltage (the current flow) to the motor?" While that may seem logical, increasing the voltage (in effect, creating an over voltage situation) does not necessarily boost the output of the device. To understand why, you need to become familiar with a physical characteristic called "hysteresis loss."

Think of the atoms of magnetic material as an unruly herd of cattle. Running electric current through the material polarizes these atoms, creating the magnetic field. As mentioned, this is an unruly herd, so it takes time for the current to bring all those atoms into formation.

As you might suspect, when the current in an alternating current motor is reversed, it takes time for those atoms to get going in the opposite direction. And the amount of time is not necessarily the same as the time it takes to get the herd moving properly in the first place.

Without getting into a lengthy physics lecture, this process of reversing polarity produces heat (or wasted energy). This is known as hysteresis loss. And that helps explain why increasing the voltage into the motor does not necessarily increase the output. Instead, it can fight the resistance of magnetic materials to reverse polarity--and simply heat iron.

For service technicians, this is also an explanation why a motor heats unexpectedly when the voltage supplied is higher than the device's nameplate voltage.

One way to overcome this situation is by using "magnetically soft" material. Magnetically soft material has atoms that readily reverse polarity when exposed to alternating current. Naturally, since the reversing process happens more quickly, there is less wasted energy.

Here's where metallurgy comes into play. A motor rich in magnetically soft material is more efficient, producing more work with less heat. And since the magnetic capacity of a motor also is influenced by the amount of active material (more core, more laminations), the tendency might be to try to add as much magnetically soft material to your design as possible.

Magnetically soft materials, however, tend to be more expensive. The motor manufacturer must find that proper blend of just enough magnetically soft material to do the work required without putting too big a dent in the customer's wallet.

It's important to keep this struggle between performance and cost in mind when talking to customers about energy-efficient motor-driven equipment. Yes, efficiency is probably more important to homeowners now than ever, but that efficient operation comes at a price. And motor manufacturers keep working to strike that balance between motor performance, efficiency and cost.