Consequences of Using the Wrong VFD Cable

A well-designed cable can help reduce premature motor and drive failure, bearing fluting, controls and communications interference, and other problems.

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A variable-frequency drive (VFD) cable is a special cable construction for the inverter-to-motor cable that has some or all of the following attributes:

- An overall shield that keeps bad stuff such as electrical magnetic interference (EMI) from escaping.
- A robust insulation system that keeps good stuff such as voltage and current from escaping.
- A symmetrical design that reduces the amount of bad stuff in the cable, such as common mode current electromagnetic interference (EMI).

Not all VFD cables offer each of these attributes, but each attribute helps the cable to reduce problems that occur in installations using VFDs.

And these problems aren't restricted to premature cable failure. They include interference with radios, controls

EDITOR'S NOTE This article is adapted from the white paper, "All About VFD Cables." Download the full paper at https://bit.ly/3so21zq to learn the importance of a VFD cable's function, its overall shield and its robust insulation. Find out about THHN cable limitations, how quality cable is constructed, the importance of surface area, and more.

and communication systems; shock hazards; premature motor failure; bearing fluting; drive trips; drive failures; and even having that precious magic smoke leak out of programmable logic controllers (PLCs), causing them to fail.

All these problems can make it harder to keep a facility up and running, and the wrong inverter-to-motor cable can contribute to any or all of these issues. How can a power cable at one end of a plant affect a PLC at the other end of the plant when it's not even connected to it?

Prevent These Cable Issues

Using the incorrect cable between your inverter and motor can lead to:

- **Premature cable failure due to overvoltage and corona discharge.**
- **Operating issues with nearby equipment due to uncontrolled EMI.**
- **Wasting energy sending it to ground and bypassing the motor, via capacitive coupling.**
- **Unnecessary drive trips due to high cable capacitance.**

A properly designed VFD cable will minimize these issues. However, the wrong cable — or an improperly designed VFD cable — will fail to minimize these issues, and can contribute to the severity of drive-related problems. It can do this by increasing the amount of common mode current (CMC) in the cable itself.

Let's look at what CMC is and why it's important.

DOWNLOAD THE WHITE PAPER

All About VFD Cables

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What is Common Mode Current?

CMC is defined as the total sum of current flowing in the cable. Add up all the current flowing in all the conductors, grounds and shields, and if you get a number close to zero, life is good. In traditional 60-Hz power systems, the CMC flowing in the cable is very close to zero. In today's high-speed drive systems, CMCs of 100A have been measured. That is a very big number.

100A is a problem. Let's see how we can have such a large amount of CMC flowing in the cable in a VFD system. To simplify things, let's just look at the power conductors, where all the current is supposed to be flowing.

In traditional 60-Hz power systems, each phase consists of a nice-looking sine wave that's out of phase by 120° from the other phases. When we add up three equal amplitude sine waves that are 120° out of phase, we get zero — thanks to the wonders of trigonometry.

In the world of VFD pulse width modulated waveforms, things are not so nice. Imagine a simple two-state drive that outputs either +V, or -V on each phase. Any way you look at it, you can't add up the three phases to be anything close to zero. The closest you can come is +V + +V + -V or +V + -V + -V in either case, the amplitude is V, and that's not going to equal zero unless V equals zero. And if V equals zero, this drive that has no output.

Design Matters

A well-designed cable can help reduce premature motor and drive failure, bearing fluting, controls and communications interference, and other problems. Learn much more about this by downloading our white paper, "All About VFD Cables," at https://bit.ly/3so21zq. ●

SOUTHWIRE COMPANY Based in Carrollton, Georgia, Southwire is a Rockwell Automation Technology Partner. The company manufactures electrical wire and cable products.