VFD Cable Advantages in Industrial Automation Applications

Today's manufacturing and processing environments are relying on increased automation to improve productivity. As a result, there is more focus and awareness around minimizing downtime and improving safety. The use of Variable Frequency Drive (VFD) cable in industrial automation applications provides a reliable solution to address these issues.

When are VFD Cables needed?

Whenever you are installing a VFD drive system, VFD cables should be strongly considered for use between the inverter and the motor. Standard power cable is not designed to handle the high frequency components of the drive's inverter output.

Why are VFD Cables needed?

Many problems that are common in VFD systems can be fixed or their impact lessened by simply using a properly terminated VFD cable. These problems include, but are not limited to:

- intermittent issues with other factory control or communication systems
- alarm system malfunctions
- premature motor bearing failure
- premature cable failure
- drive failure and drive problems
- shock hazards (to maintenance and other personnel)

How does a VFD Cable address these issues?

VFD cable features a properly designed overall electrical shield, symmetrically designed conductors, and thermoset insulation with a low dielectric constant.

Proper Shielding

VFD cable is designed with an overall electrical shield in the form of armor, copper tape or a copper braid. General Cable offers all three designs so you can choose the construction that best meets your needs. However, not all shields are created equal. The shield must be designed to effectively handle the high frequency components of the inverter waveform and minimize inductive loading.

This shield, along with proper cable termination, will minimize electromagnetic radiation that will be broadcast from the cable. Unshielded cable acts like a broadcast antenna, radiating these unwanted electrical signals in the form of noise throughout your plant. This radiation can cause issues with alarm systems, other control and communication systems, and other drives. As factories become more automated, these issues become more prevalent.

Shielding also minimizes electromagnetic induction (a signal produced in nearby electrical circuits when they are exposed to a varying magnetic field). It has been shown that when unshielded inverter-motor cables are installed in tray, a potentially lethal current can be induced in a cable that is locked out from the electromagnetic induction

generated by the other energized cables in the tray. Many people feel that human safety alone justifies the utilization of VFD cables for their motor-inverter connections.

Shielding also has an effect of reducing the risk of premature motor bearing failure by providing a low impedance path for common mode current to return to the inverter frame. Without this low impedance path, the current can end up flowing through motor bearings causing bearing fluting.[1]

Proper Conductor Design

Common mode (CM) current is a frequent cause of drive system issues (including false trips). One way to deal with CM current is to direct it back to the inverter frame via the shield. Some VFD cables go further and actually reduce the generation of CM current. A cable designed with a symmetrical relationship between the phase conductors and the grounds provides the cancellation effects that will minimize the CM current in the system. These designs typically have three phase conductors with three ground conductors in the interstices of the phase conductors.

Proper Insulation

Cable insulation also plays a critical role in keeping your VFD system performing reliably. VFD Cables should have a thermoset, cross-linked insulation which will provide more protection than less expensive PVC insulation. General Cable uses thermoset, cross-linked insulations in all their VFD cable constructions. Using THHN cable as your inverter motor cable is not recommended. The PVC insulation on THHN cable possesses two undesirable characteristics in VFD applications:

(1) It is hydroscopic, meaning it can absorb moisture from the air which drops its dielectric withstand to as low as 55% of its rated voltage.
(2) It can experience cold-flow, causing the insulation to displace when under pressure resulting in the reduction of insulation wall thickness.

Furthermore, THHN cable is rated for 600 volts RMS or 850 volts peak, but reflected waves (standing waves) in VFD cables can reach 1300 volts in a run as short as 35 feet. The 1300 volts places a lot of stress on a cable that is rated for 850 volts. When you factor in the decreased insulation strength due to moisture and the decreased wall thickness, you may experience problems.

In addition, PVC insulated cables have a high capacitance associated with them causing the cable to leak current through the insulation resulting in false trips. The cables also have a higher charging current associated with them which requires a drive with more power (and more cost). In order to minimize these problems, choose a cable with thermoset insulation that is rated to handle the peak standing wave voltage.

The Right Cable Solution for VFD Applications

VFD cable offers three key attributes to mitigate the issues that arise in these applications: shielding, robust insulation and symmetrical design. VFD cable is a more expensive alternative to standard power cables, but in today's environment with increased automation, more focus on safety and limited tolerance for downtime, it proves to be a very wise investment.

[1]Bearing fluting is addressed in further detail in the white paper *General Cable VFD Cables, An Overview of Variable Frequency Drives Cables*, November 2013.

4 Tesseneer Drive, Highland Heights, Kentucky 41076-9753

Telephone: 888.295.5896
E-mail: info@generalcable.com
www.generalcable.com