

## THE CABLE OF CHOICE BETWEEN MOTOR AND VFD - CLX

VFD's or variable frequency drives, utilizing the pulse width modulation (PWM) technology have been a hot topic over the past several years. The use of these drives is becoming widespread within such industries as petrochemical, pulp, paper, steel, glass, etc. and other industries requiring the variable speed operation of an ac motor. The heart of the VFD is the insulated gate bipolar transistor (IGBT). This technology uses significantly increased switching rates in the 2-20 kHz range and a high rate of rise (dv/dt) output voltage. This advanced technology offers many benefits including smaller more economical drives, lower audible noise, enhanced performance at low speeds and reduced harmonic ripple currents which minimize motor overheating.

Along with these benefits come some unanticipated challenges to the drive systems. The increased switching rate has increased the frequency of the electromagnetic noise into the MHz range. These higher MHz ranges of operation cause detrimental reflective waves and EMI/harmonic effects. The problems that now arise, although intermittent, include trips, reduced cable and motor life, excessive bearing wear, and increased common mode currents. Therefore, drives, cables and motors must all perform together in this system. These three components must be evaluated as a system to assure optimum performance and reliability.



Numerous studies and technical papers have been written concerning the operation of the VFD system. As a result of all this work what was learned for the cable is that it should be symmetrical in design and have a continuous overall metal sheath. A symmetrically designed cable would have 3 phase conductors, 3 grounding conductors; one in each cable interstice, an overall continuously corrugated metal sheath, and an overall protective jacket. An example of a 600 volt cable design of choice is illustrated on the front. A cable of this design provides a low impedance path for the high frequency phase, ground, and sheath currents to ground. Therefore, grounding is an important consideration when installing VFD's.

Aluminum is the sheath metal of choice for VFD applications for several reasons.

- Forms easily in a continuous operation.
- Can be welded easily and continuously with standard argon gas welding.
- When corrugated exhibits EXCELLENT impact and crush strength as mandated by UL 2225 for Division 1 Hazardous Locations.
- It is a lightweight material.
- It has good corrosion resistance to many chemicals.
- Because it is a low resistance material it ALONE satisfies the ground requirements of the NEC Table 250 – 125.

In addition to the aluminum being an advantageous material the continuous corrugation process adds the following benefits:

- UL Listed as Type MC and MC-HL
- Recognized as “Metal-Clad Cable” by NEC Article 334
- May be installed in Hazardous (Classified) Locations as permitted by NEC Articles 501, 502, 503 and 504.
- Can be easily grounded with available UL 514B approved Type MC cable fittings.

Therefore, when considering the application of VFD's to motors, don't forget that the interconnecting cable is also an important part of the system. Okonite's CLX should be considered as the cable of choice. For additional information on the use of CLX cables call your local Okonite Sales Representative and obtain a copy of our technical paper on this subject entitled, “Cable Design for PWM Variable Speed AC Drives”.