The Beginning of the End for 5 kV Non-Shielded Cables?

Effective January 1, 2005 the National Electrical Code (NEC) was changed to require the use of shielded power cables in all circuits operating at voltages above 2,400 V. As a result of this change, the use of shielded 5 kV cables has increased while the use of non-shielded 5 kV cables has declined dramatically. This Wire Wisdom details the change, why it was made and a few side effects of the change.

The Change

Prior to the 2005 edition of the NEC, most circuits operating at voltages up to and including 8,000 volts were permitted to be wired with either shielded or non-shielded cables. The choice of shielded versus non-shielded for a given application was usually left up to the system design engineer. In circuits operating at 2,001 to 5,000 volts, roughly a quarter of the circuits were wired with 5 kV shielded cables and the remainder were wired with non-shielded cables. In circuits operating at 5,001 to 8,000 volts, virtually all were wired with shielded 8 kV rated cables. However, with the publication and adoption of the 2005 edition of the NEC, the use of shielded cables was made mandatory on all circuits operating at over 2,400 volts.1

Approximately half of all “5 kV” circuits actually operate at a voltage of 4,160 volts. These and similar circuits will now have to be wired with shielded rather than non-shielded cables. Most of the remaining “5 kV” circuits actually operate at 2,300 volts or similar voltages. These lower voltage circuits can continue to be wired with non-shielded cables as long as the cables are Listed as Type MV-90 or MV-105 cables by a qualified testing laboratory2.

1 2005 NEC Article 310.6
2 UL 1072 Standard for Medium-Voltage Power Cables
Note that directly buried cables are a special case and that the NEC requires them to be shielded if the circuit’s operating voltage is over 2,000 volts unless the cable has an overall metallic sheath such as interlocked armor. This requirement was in previous Codes and continues to be a requirement in the 2005 NEC.

Why The Change?

Non-shielded 5 kV cables have been used for many years because they were permitted by the NEC, are lower in cost than shielded cables, require less space, require smaller and lower cost terminations and provide adequate performance in most applications. However, the National Fire Protection Association’s (NFPA) code-making panel received reports that cable users have sometimes experienced problems with arcing in non-shielded 5 kV installations and that this can present a possible safety hazard. The arcing is usually the result of partial discharges (corona) on the surface of the insulation caused by an accumulation of dirt and moisture.

Cable engineers have long known that shielded 5 kV cables are preferred for maximum safety and reliability. A properly grounded shield combined with properly applied stress-relief terminations provides more uniform distribution of the electrical stress in and on the surface of the insulation. This greatly reduces the possibility of arcing and maximizes cable reliability. A grounded shield also reduces the risk of electric shock to anyone that accidentally comes in contact with an energized cable.

Lost in Space

Some 5 kV electrical equipment, especially motors, have very limited space for attaching the power cables. Shielded MV cables are usually larger in diameter than non-shielded cables and also require the use of stress-relief terminations that take up even more space. Therefore, the NEC’s new shielded cable requirement is likely to magnify the problem. Possible solutions include the use of small diameter shielded cables as well as small diameter splice and termination devices. Manufacturers of 5 kV motors and other equipment may also need to increase the size of their equipment’s electrical terminal boxes to accommodate the larger cable diameters.

Labeling

In 2006, UL revised UL Standard 1072 to harmonize its requirements with the new 2005 NEC shielding requirements. As a result, UL now requires non-shielded cables previously printed “5 kV” to be labeled instead with a “2400 V” rating.

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1 2005 NEC Article 310.7
2 UL 1072 Standard for Medium-Voltage Power Cables

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