



TECHNICAL SERVICES DEPARTMENT

BULLETIN

No. 105
April 2012

Fine-Stranded Cable Connections

There has been an increase in the use of fine-stranded conductors in recent years, notably for use with alternative energy and separately derived system installations. Unfortunately, many of the connectors, lugs and terminals used in these installations are not listed or intended for use with fine-stranded conductors.

Fine-stranded conductors require connectors that are specifically intended for the stranding method. While the meaning of "fine-stranded" varies in the industry, Section 110.14 of the 2011 NEC requires that connectors and terminals for conductors more finely stranded than Class B and Class C stranding be identified for the specific conductor class or classes. A new Table 10 has been added to Chapter 9 of the NEC[®] to help users of the code identify Class B and Class C stranding. Conductor strand counts may vary slightly such as in a manufacturing technique known as "single-input wire" (SIW), however SIW conductors are equivalent to Class B and the mechanical connectors used are tested to UL486A-B in the same manner.

Fine-stranded conductors are widely available in a number of higher classes (such as G, H, M, I and K), and are typically used where flexibility is desired. While NEC identified conductors (with insulations such as USE, XHHW, RHH, RHW, and THHN) are most commonly available with Class B stranding, these same insulation types may be used on fine-stranded conductors. The allowable ampacity of the conductor is determined in accordance with the National Electrical Code[®] and is limited by the equipment or connection temperature rating, the insulation temperature rating, or the installation conditions.

Fine-stranded cables are often used by photovoltaic (PV) system installers because of the flexibility of the conductors. PV modules and components may be supplied with fine-stranded interconnecting cables with attached connectors. Crimped-on connectors listed with the module are suitable for use with the fine stranded conductors, but if the end-of-

string conductor is supplied with a fine-stranded conductor, the un-terminated end of that conductor will not be compatible with typical mechanical terminals.

According to UL Standard 486 A-B,

"A connector, a unit container, or an information sheet packed in the unit container for a connector tested with conductors other than Class B, SIW, or Class C stranding shall also be marked with the conductor class or classes and the number of strands."

If there is no marking or other identification that indicates the connector may be used with a certain class, then that conductor may not be used with any stranding other than SIW, Class B, or Class C.

When fine-stranded cables are improperly used with set-screw type mechanical connectors, there is an increased risk of overheating and/or wire pullout. Strands may break or be forced between the connector screw and threads. A false torque reading could result, which increases the risk of overheating and wire pullout. Even if the strands do not break and the wires are not forced into the threads, the initial torque setting may not hold in a typical connector. Even if the connection is re-tightened later, the connection may continue to loosen and create a high resistance connection.

It should also be noted that most crimp-on compression type lugs are not listed for use with fine-stranded wire. When crimp-on compression lugs are listed for fine-stranded wire, they must be installed using the tools recommended by the manufacturer. There are pin connectors that may be used, but once again, not all pin connectors are listed for the use. The connector must be identified for use with the class of conductor that is installed.

Where fine-stranded cables are used, they should only be terminated with the appropriate connectors. On previously installed systems with improper connections, the installation should be inspected and the hazardous conditions should be corrected. This may be accomplished by replacing the wire or the connectors with the appropriate type.

Distribution List:

Standards and Conformity Assessment Policy Committee
Codes and Standards Committee
NEMA Technical Services Department