



**TECHNICAL SERVICES DEPARTMENT**

# **BULLETIN**

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## **Fine-Stranded Conductor** **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. Fine-stranded conductors are found in photovoltaic wire, flexible cords, portable power cables, and other wire and cable products. Unfortunately, many of the connectors 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 construction. While the meaning of “fine-stranded” varies in the industry, Section 110.14 of the 2020 National Electrical Code<sup>®</sup> (NEC) requires that connectors and terminals for conductors more finely stranded than Class B and Class C stranding as shown in Chapter 9, Table 10, shall be identified for the specific conductor class or classes. Conductor strand counts may vary slightly such as in a manufacturing technique known as “single-input wire” (SIW), however SIW conductors are considered equivalent to Class B and the mechanical connectors used are tested to UL 486A-486B in the same manner.

Fine-stranded conductors are widely available in several higher strand count 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 types may contain fine-stranded conductors.

Fine-stranded conductors 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 fine-stranded, the un-terminated end of that conductor will not be compatible with typical mechanical terminals.

According to Section 10.12 of UL Standard 486A-486B, 3<sup>rd</sup> Edition (revised 5/5/2021),

“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 (see 9.1.5.5) shall also be marked with the conductor class or classes.”

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

When fine-stranded conductors 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 or the wires are not forced into the threads, the initial torque setting may not hold in a typical connector and the connection may continue to loosen and create a high resistance connection. Note that, as discussed in NEMA Bulletin 120 (Using Torque Tools for Terminating Building Wire), it is not recommended to re-torque or re-tighten terminations after the initial conductor installation.

It should also be noted that most crimp-on compression type connectors are not listed for use with fine-stranded conductors. As with any crimp-on compression connection, crimp-on compression connectors listed for fine-stranded conductors 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 conductors are used, they should only be terminated with the appropriate connectors. On previously installed systems with improper connections, the installation should be inspected and corrected by replacing the conductors or the connectors with the appropriate type.

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