



TECHNICAL SERVICES DEPARTMENT

BULLETIN

No. 120
March 17, 2021

Using Torque Tools for Terminating Building Wire

The 2017 National Electrical Code® (NEC) added an explicit requirement in 110.14(D) that requires the use of a torque tool to terminate conductors when a numerical value is provided by the equipment manufacturer. Requirements for torquing to a manufacturer's specification are not new to the NEC. Section 110.3(B) first appeared in the 1975 NEC, and it requires all installations to be done in accordance with the manufacturer's instructions. The specified torque values provided by the manufacturer are part of those instructions and are to be used for all terminations. However, the large number of termination failures and the demonstrated lack of use of torque tools in the industry prompted the addition of 110.14(D) to the NEC. This new rule brings clarity to the requirements for using the right tools and emphasis to the importance of proper terminations and adhering to the specified torque values.

While there are usually no immediate ramifications to improper terminations, the long-term effects can be dangerous and quite costly. The following are some identifiable problems that improper termination techniques can cause:

- Loose connections due to improper torquing lead to increased resistance over time at the termination causing a temperature rise at the connection. The increased heat can degrade the termination and any protective insulation at the termination.
- Aluminum and copper can develop oxidation at the termination point where exposed to air. The oxidation at the improperly torqued connection may result in increased resistance at the termination resulting in increased heat, which reduces the reliability of the termination.
- Arcing from phase to phase, phase to neutral, or even phase to ground can occur at improperly torqued terminations where bare conductive material is torqued improperly. The resulting arcing condition due to gaps in the conductive components of the termination may lead to a high resistance connection, and the increased heat will degrade the termination and ultimately the system reliability.
- When terminations are not properly torqued, there may also be a voltage drop across the poor connection. In reduced voltage conditions, electrical equipment may not operate effectively, and the equipment's lifecycle may be significantly reduced.

In the 2020 NEC, section 110.14(D) entitled "Terminal Connection Torque" was modified to require proper torquing using an approved means for all terminations where the manufacturer has provided specific torque values. Informational Note 1 gives examples of approved means, including torque tools and devices like shear bolts and breakaway-style devices with visual

indicators. The use of a torquing tool or device is an important step in preventing failures in the electrical distribution system.

It should be noted that in NFPA 70B “Recommended Practice for Electrical Equipment Maintenance” provides some guidance in this area. Section 8.11 of this document is titled “Threaded Connections and Terminations” and addresses the initial installation and recommendations for after the initial installation. Annex I in the NEC contains information about what to do in the absence of manufacturer’s recommended torque values, along with three tables of torque values taken from UL Standard 486A-486B. This information is only applicable when torque values are not provided by the equipment manufacturer and cannot be obtained from that manufacturer.

It is not recommended to “re-torque” terminations after the initial application of the proper torque during installation. NFPA 70B recommends using infrared scans and visual inspections to detect loose connections. If absolutely necessary, a torque tool set to 90% of the recommended torque value may be applied to the connection to detect a loose connection. Be sure to de-energize the circuit before applying the tool.

Inspection authorities may find it a challenge to determine overall compliance with 110.3(B) and 110.14(D) of the NEC. Some common practices include site verification of torque tools and calibration certificates, random or periodic observation of connections on the jobsite, and obtaining a certification or affidavit from the installer that torque values were properly applied. Remote inspections using photos and videos are also becoming common and may help with verification of torquing.

NEMA recommends that all terminations performed on building wire conductor products be torqued in accordance with the NEC and the connector and/or the electrical equipment manufacturer’s recommendations.

Distribution List:

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

Disclaimer

The standards or guidelines presented in a NEMA standards publication are considered technically sound at the time they are approved for publication. They are not a substitute for a product seller's or user's own judgment with respect to the particular product referenced in the standard or guideline, and NEMA does not undertake to guarantee the performance of any individual manufacturer's products by virtue of this standard or guide. Thus, NEMA expressly disclaims any responsibility for damages arising from the use, application, or reliance by others on the information contained in these standards or guidelines.