

Grounding and Bonding with Concentric and Eccentric Knockouts

There is often confusion with the grounding and bonding requirements of the National Electrical Code® (NEC)® when concentric or eccentric knockouts are encountered. To answer the question regarding whether or not a bonding jumper is required, one needs to look at the UL White Book, as well as several sections of the 2008 NEC. This article will help guide you through these important considerations.

Bonding at Services

NEC Section 250.92(B) is applicable to bonding at services, and in part states, "Bonding jumpers meeting the other requirements of this article [Article 250] shall be used around concentric or eccentric knockouts that are punched or otherwise formed so as to impair the electrical connection to ground." For services, this confirms that bonding jumpers are required unless all concentric or eccentric knockouts have been removed.

Bonding for Over 250 Volts

For bonding circuits over 250 volts, NEC Section 250.97 is applicable, and by exception, allows concentric and eccentric knockouts to be used without bonding jumpers, provided the box or enclosure with concentric or eccentric knockouts is listed to provide a reliable bonding connection. This is where the UL White Book comes into play.

For the UL product category for Metallic Outlet Boxes (QCIT), the UL Guide Information indicates "All boxes with concentric or eccentric knockouts have been investigated for bonding and are suitable for bonding without any additional bonding means around concentric (or eccentric) knockouts

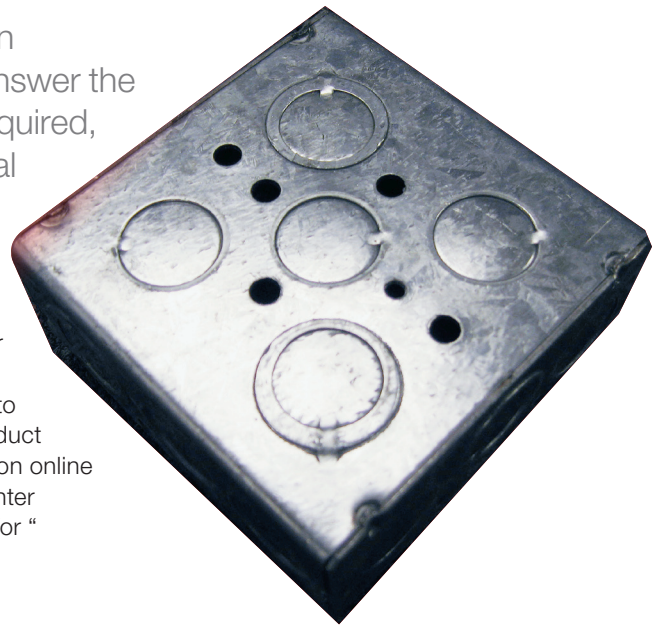
where used in circuits above or below 250 V, and may be marked as such." Please refer to the UL White Book for this product category, or view this information online at www.ul.com/database. Enter "QCIT" into the database field for "UL Category Code."

Electrical Testing of Metallic Outlet Boxes

The applicable requirements for UL Listing of metallic outlet boxes are located in UL 514A, the Standard for Safety for Metallic Outlet Boxes. In addition to knockout mechanical secureness testing, each box employing concentric or eccentric knockouts is required to comply with an electrical test, commonly known as a short time current test.

For this test, a 6 in. length of rigid metal conduit is secured to the smallest concentric or eccentric knockout by 2 locknuts. A test current of 1180 A for 4 seconds (1/2 trade size) or 1530 A for 6 seconds (3/4 and 1 trade sizes) is passed from the conduit to the outlet box. As a result of the application of the current, the outer knockout is

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required to remain in place, and continuity is required to be maintained between the box and the conduit. Arcing and burning during the test are common and are acceptable.

Other Types of Metallic Enclosures

Cabinets and cutout boxes, in accordance with NEC Article 312, as well as junction and pull boxes, in accordance with NEC Article 314, may also employ concentric or eccentric knockouts, and are evaluated for UL Listing in accordance with UL 50, the Standard for Safety for Enclosures for Electrical Equipment (CYIV and BGUZ).

In contrast with metallic outlet boxes, these other types of metallic enclosures with concentric or eccentric knockouts are not required to be subjected to a short time current test. As such, NEC Section 250.97 would require that bonding jumpers be used unless all concentric or eccentric knockouts were removed. For UL Guide Information, please refer to the UL White Book for these product categories, or view this information online at www.ul.com/database. Enter “CYIV” or “BGUZ” into the database field for “UL Category Code.”

Additional Code Considerations

In addition to the previously mentioned 2008 NEC sections, there are several other applicable

NEC requirements. When inspecting for proper grounding and bonding of electrical equipment that contains concentric or eccentric knockouts, the AHJ should verify that the integrity of the remaining concentric or eccentric rings has not been compromised during the installation process.

NEC Sections 250.4(A) & (B) have several provisions that require non-current-carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, to be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

NEC Section 250.90 generally requires that bonding shall be provided where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed. Section 250.96 requires enclosures, fittings, and other metal non-current-carrying parts that are to serve as grounding conductors, with or without the use of supplementary equipment grounding conductors, to be bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them.

In addition to Article 250, there is also a requirement in Article 300, specifically Section 300.10 that requires metal raceways, cable armor, and other metal enclosures for conductors to be metallically joined together into a continuous electrical conductor and to be connected to all boxes, fittings, and cabinets so as to provide effective electrical continuity.

Summary

- Metallic outlet boxes that contain concentric or eccentric knockouts covered by UL product category QCIT have been evaluated for grounding and bonding of electrical systems with voltages above and below 250 volts.
- When concentric or eccentric knockouts are encountered with service equipment, a bonding jumper would be required.
- Concentric or eccentric knockouts that are part of a cabinet, cutout box, junction box, or pull box, installed on an electrical system that has a voltage over 250 volts have not been investigated for grounding and bonding, and would therefore require a bonding jumper to be installed.
- If the integrity of the concentric or eccentric knockouts has been compromised during installation, a bonding jumper should be provided to ensure compliance with all of the requirements of the NEC.

