250.190 Grounding of Equipment.

(A) Equipment Grounding. All non-current-carrying metal parts of fixed, portable, and mobile equipment and associated fences, housings, enclosures, and supporting structures shall be grounded.

Exception: If isolated from ground and located such that any person in contact with ground cannot contact such metal parts when the equipment is energized, the metal parts shall not be required to be grounded.

Informational Note: See 250.110, Exception No. 2, for pole-mounted distribution apparatus.

(B) Grounding Electrode Conductor. If a grounding electrode conductor connects non-current-carrying metal parts to ground, the grounding electrode conductor shall be sized in accordance with Table 250.66, based on the size of the largest ungrounded service, feeder, or branch-circuit conductors supplying the equipment. The grounding electrode conductor shall not be smaller than 6 AWG copper or 4 AWG aluminum or copper-clad aluminum.

(C) Equipment Grounding Conductor. Equipment grounding conductors shall comply with 250.190(C)(1) through (C)(3).

(1) General. Equipment grounding conductors that are not an integral part of a cable assembly shall not be smaller than 6 AWG copper or 4 AWG aluminum or copper-clad aluminum.

(2) Shielded Cables. The metallic insulation shield encircling the current-carrying conductors shall be permitted to be used as an equipment grounding conductor, if it is rated for clearing time of ground-fault current protective device operation without damaging the metallic shield. The metallic tape insulation shield and drain wire insulation shield shall not be used as an equipment grounding conductor for solidly grounded systems.

Shields comprised of copper tape and drain wires cannot be used as the EGC in solidly grounded systems. The use of shielded cables is specified in 315.44. Those requirements are based on the system voltage, installation conditions, and cable construction. As explained in the informational note, the primary purposes of the shielding are to confine voltage stresses on the insulation, dissipate insulation leakage current, and drain off the capacitive charging current.

Exhibit 250.51 shows three different types of single-conductor shielded cable construction. Shielded cables are also available in multiconductor configurations such as Type MV (Article 315) and Type MC (Article 330) cables. Where the ground-fault current is relatively low (as in impedance grounded neutral systems), the metallic shield of any of the cable types pictured in Exhibit 250.51 is permitted to serve as the EGC if it is rated for clearing time of ground-fault current without being damaged. Cable manufacturers can provide permissible short-circuit currents for a metallic shield based on the fault clearing time of the OCPD.

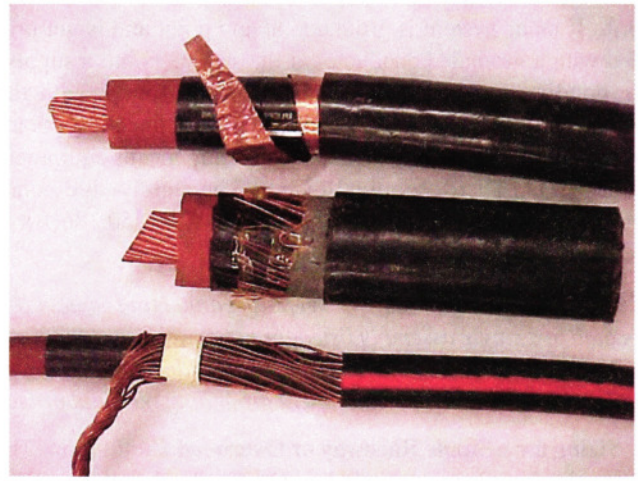

EXHIBIT 250.51 Three different types of single-conductor shielded cables. *(Courtesy of Chuck Mello)*

Where the system is solidly grounded, neither the metallic tape insulation shield (top cable in Exhibit 250.51) nor the drain wire insulation shield (middle cable) can be used as the EGC, because they do not have sufficient circular mil area to provide the effective ground-fault return path required by 250.4(A)(5). A metallic insulation shield encircling the conductor (bottom cable), commonly called concentric neutral cable, has larger conductor strands in the concentric wrap. Because of its larger overall circular mil area, this concentric neutral cable is permitted to be used as an EGC in a solidly grounded system if the metallic shield will not be damaged during the time it takes to open the circuit OCPD. The copper metallic tape is typically 5 mils thick and is helically applied with a 12.5 percent or larger overlap over the insulation shield. Drain wires are typically 24 AWG bare copper wires.

Where the cable shield cannot carry ground-fault current without damage, a separate EGC must be installed. A separate EGC would also be required where tape or drain-wire-type shields are not permitted to carry fault current. The EGC can be integral to a cable assembly, can be run as a separate conductor in a raceway or cable tray, or can be one of the types of EGCs specified in 250.118, such as rigid metal conduit or intermediate metal conduit. Wire-type EGCs are sized in accordance with 250.122.

See also

250.190(C)(3), Informational Note, for more information on how the rating of OCPDs used in systems operating over 1000 volts is determined

(3) Sizing. Equipment grounding conductors shall be sized in accordance with Table 250.122 based on the current rating of the fuse or the overcurrent setting of the protective relay.

Informational Note: The overcurrent rating for a circuit breaker is the combination of the current transformer ratio and the current pickup setting of the protective relay.