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National Electrical Code 2008 Edition

250.134 Equipment Fastened in Place or Connected by Permanent Wiring Methods (Fixed) — Grounding.

(B) With Circuit Conductors. By connecting to an equipment grounding conductor contained within the same raceway, cable, or otherwise run with the circuit conductors.

National Electrical Code 2008 Edition Handbook

Commentary page 251

One of the functions of an equipment grounding conductor is to provide a low-impedance ground-fault path between a ground fault and the electrical source. This path allows the overcurrent protective device to actuate, interrupting the current. To keep the impedance at a minimum, it is necessary to run the equipment grounding conductor in the same raceway or cable as the circuit conductor(s). This practice allows the magnetic field developed by the circuit conductor and the equipment grounding conductor to cancel, reducing their impedance.

Magnetic flux strength is inversely proportional to the square of the distance between the two conductors. By placing an equipment grounding conductor away from the conductor delivering the fault current, the magnetic flux cancellation decreases. This increases the impedance of the fault path and delays operation of the protective device.

Soares – Book on Grounding and Bonding, IAEI

Chapter 9, pages 168-167 Equipment Grounding Conductor with Circuits Conductors.

A very important requirement for installing equipment grounding conductors is contained in 250.134(B). This requirement is that the equipment grounding conductor is generally required to be installed in the same raceway, cable or cord, or otherwise be run with the circuit conductors. This requirement is repeated in 300.3(B) where, in addition to the requirement for raceways, equipment grounding conductors are required to be contained in the same trench with other circuits conductors. This requirement is critical for the installation of alternating-current systems.

It has been proven that separating the equipment grounding conductor from the circuit conductors greatly increases the impedance of the circuit. Separation of these conductors will increase the inductive reactance of an ac circuit, which in turn increases grounding circuit conductor impedance values. The impedance of the equipment grounding conductor of a circuit should be kept as low as practicable.

This excessive separation can render an adequately sized equipment grounding conductor ineffective in carrying enough current to operate the circuit protective device and clear the faulted equipment.

Chapter 11, page 206 Long Conduit Run Designs.

If the impedance of the ground-fault circuit is higher than what will carry enough current to properly operate the overcurrent devices in a reasonable time, then a lower impedance can be obtained by adding an equipment grounding conductor within the conduit in parallel with the conduit, that is, run with the circuit conductors. The equipment grounding conductor should never be run outside the conduit or raceway through which the conductors serving the equipment are run. Where run external to the conduit, it becomes quite ineffective in the grounding circuit, for virtually all the ground-fault current will return on the conduit. Further, the equipment grounding conductor must be run as close to the phase conductors as is practical, right to the point where it connects to the neutral conductor at the service.