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Conductors Connected in Parallel
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Parallel conductors are often installed where large ampacity feeders or services are used. Total understanding of the paralleling requirements permitted in the National Electrical Code is necessary before attempting to design a large electrical system or install these conductors.

Section 310.4 provides specific information and requirements for paralleling of conductors and should certainly be the first reference that a user would choose for an understanding of the basics for paralleling conductors. The first paragraph in this section permits aluminum, copper-clad aluminum and copper conductors that are at least 1/0 AWG or larger to be connected in parallel if these parallel conductors are electrically joined at both ends to form a single conductor.

Where used as parallel conductors, the circular-mil areas of these conductors are added together to provide the total cross-sectional area for the overall size of the parallel conductors.

These parallel conductors can be used as phase conductors, neutral conductors or grounded conductors. Be careful though, since one of the primary concerns when installing parallel conductors is ensuring that each conductor in the paralleled set has the same electrical characteristics as the others in the same set.

All of the paralleled conductors in each phase, neutral or grounded set must be the same length and be made from the same conductor material. They must be the same circular mil area and have the same type of insulation. Finally, all parallel conductors must be terminated in the same manner. This ensures that each conductor in the parallel set will carry the same amount of current.

However, one-phase, neutral or grounded circuit conductors are not required to have the same physical characteristics as those of another phase, neutral or grounded conductor. For example, in a 400A, single-phase, 120/240V parallel run, Phase A could be composed of two 3/0 copper conductors in parallel and Phase B composed of two 250 kcmil aluminum conductors in parallel with the neutral being two 3/0 copper conductors.

Any taps made to the paralleled sets of conductors must be made to all the conductors in the set, not just one. Tapping only one of the conductors in the set could result in an imbalance with one of the conductors carrying more current than the other, resulting in heating of that one conductor and possible insulation damage or failure.

For example, if three 500 kcmil conductors are run per phase, a tap from that particular phase must be a tap from all of the 500 kcmil conductors, not just one of the set. This would require a common terminal point for all three parallel conductors with a tap conductor connection to the common terminal.

Where paralleled conductors are run in separate raceways or cables, the raceways or cables must have the same physical characteristics. For example, if there are four 500 kcmil conductors in a paralleled set of phase conductors, the four separate raceways enclosing the conductors must be all rigid steel, all IMC, or all PVC, etc.

If the raceways were of different characteristics, such as three rigid ferrous metal conduits with one rigid nonmetallic conduit, the conductor in the PVC raceway would carry more current than the conductors in each of the metal raceways. This would result in more impedance in the conductors within the ferrous metal raceways than in the PVC raceway.

The higher current in the conductor in the PVC raceway would result in possible overheating of the conductor and insulation damage.
Section 300.3(B)(1) deals with parallel conductor installations and the reference within this section to 310.4 provides permission for parallel conductors to be installed separate from each other.

Each phase and each neutral or grounded conductor must be present within each separate raceway, auxiliary gutter, cable tray, cable bus assembly, cable or cord. For example, in an installation where three sets of 3/0 AWG conductors are paralleled for each phase and the neutral of a three-phase, four-wire system, there will be one 3/0 AWG for Phase A, one for Phase B, one for Phase C, and one for the neutral in each of three raceways.

There is an exception to this general rule located in 300.3(B)(1) that permits conductors installed in nonmetallic raceways run underground to be arranged as isolated phase installations with all of one phase in one conduit, all of another phase in another conduit, all of the final phase in one conduit, with all of the neutrals in the final conduit.

These raceways must all be installed in close proximity to each other, such as in a duct bank, but care must be taken to ensure there isn't any steel rebar or other ferrous metal installed between these raceways. Care must also be taken for compliance with Section 300.20(B) where connecting these raceways into a ferrous metal enclosure.

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