parallel (electrically joined at both ends) only in sizes 1/0 AWG and larger and shall be installed in accordance with 310.10(G)(2) through (G)(4).

Conductors connected in parallel are treated by the *NEC* as a single conductor with a total cross-sectional area of all conductors in parallel. The use of parallel conductors is a practical and cost-effective means of installing large-capacity feeders or services. Using conductors larger than 1000 kcmil in raceways is neither economical nor practical unless the conductor size is governed by voltage drop. The ampacity of larger sizes of conductors would increase very little in proportion to the increase in the size of the conductor. Where the cross-sectional area of a conductor increases 50 percent (e.g., from 1000 to 1500 kcmil), a Type THW conductor ampacity increases only 80 amperes (less than 15 percent). A 100-percent increase (from 1000 to 2000 kcmil) causes an increase of only 120 amperes (approximately 22 percent). Generally, where cost is a factor, installation of two (or more) paralleled conductors per phase could be beneficial.

The parallel connection of two or more conductors in place of using one large conductor depends on compliance with 310.10(G)(2) to ensure equal current division to prevent overloading any of the individual paralleled conductors.

Where individual conductors are tapped from conductors in parallel, the tap connection must include *all* of the conductors in parallel for that phase. Tapping into only one of the parallel conductors would result in unbalanced distribution of tap load current between parallel conductors, resulting in one of the conductors carrying more than its share of the load, which could cause overheating and conductor insulation failure. For example, if a 250-kcmil conductor is tapped from a set of two 500-kcmil conductors in parallel, the splicing device must include both 500-kcmil conductors and the single 250-kcmil tap conductor.

Exception No. 1: Conductors in sizes smaller than 1/0 AWG shall be permitted to be run in parallel to supply control power to indicating instruments, contactors, relays, solenoids, and similar control devices, or for frequencies of 360 Hz and higher, provided all of the following apply:

(1) They are contained within the same raceway or cable.
(2) The ampacity of each individual conductor is sufficient to carry the entire load current shared by the parallel conductors.
(3) The overcurrent protection is such that the ampacity of each individual conductor will not be exceeded if one or more of the parallel conductors become inadvertently disconnected.

Exception No. 2: Under engineering supervision, 2 AWG and 1 AWG grounded neutral conductors shall be permitted to be installed in parallel for existing installations.

Informational Note: Exception No. 2 can be used to alleviate overheating of neutral conductors in existing installations due to high content of triplen harmonic currents.

The word *triplen* refers to a third-order harmonic current, such as the third, sixth, ninth, and so on. The concern is limited to odd-number triplen harmonic currents, such as the third, ninth, and fifteenth, since they are additive currents in the neutral conductor and do not cancel.

See also

Chapter 10 of NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*, for additional information on power quality and harmonics

Δ **(2) Conductor and Installation Characteristics.** The paralleled conductors that comprise each ungrounded conductor, grounded conductor, neutral conductor, equipment grounding conductor, equipment bonding jumper, or supply-side bonding jumper shall comply with all of the following:

(1) Be the same length
(2) Consist of the same conductor material
(3) Be the same size in circular mil area
(4) Have the same insulation type
(5) Be terminated in the same manner

To avoid excessive voltage drop and to ensure equal division of current, different phase conductors must be located close together. Each phase conductor, grounded conductor, and the grounding conductor (if used) must also be grouped together in each raceway or cable. However, isolated phase installations are permitted underground where the phase conductors are run in nonmetallic raceways that are in close proximity.

All conductors of the same phase or neutral are required by 310.10(G)(2) to be of the same conductor material. For example, if 12 conductors are paralleled for a 3-phase, 4-wire, 480Y/277-volt ac circuit, four conductors could be installed in each of three raceways. The *NEC* does not intend that all 12 conductors be copper or aluminum but does intend that the individual conductors in parallel for each phase, grounded conductor, and neutral be the same material, insulation type, length, and so forth. For example, the conductors in phases A and B might be copper, and those in phase C might be aluminum. Also, the three raceways are intended to have the same physical characteristics (e.g., three rigid aluminum conduits, three steel IMCs, three EMTs, or three nonmetallic conduits), not a mixture (e.g., two rigid aluminum conduits and one rigid steel conduit).

See also

300.3(B)(1) for more information on paralleled installations

(3) Separate Cables or Raceways. Where run in separate cables or raceways, the cables or raceways with conductors shall have the same number of conductors and shall have the same electrical characteristics. Conductors composing one paralleled set shall not be required to have the same physical characteristics as those of another paralleled set.

All parallel raceways or cables for a circuit are required to be of the same size, material, and length. In this case, "cables" means wiring method-type cables such as Type MC. The impedance of a