

***CTI* TECHNICAL BULLETIN**

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Paralleled Phase Conductors in Cable Trays Provide Copper Savings

Cable tray wiring systems have conductor advantages over conduit wiring systems where the installations involve phase conductors installed in parallel.

For large ampacity circuits, the most practical wiring system installations are those where reasonable size conductors are paralleled for each phase to adequately handle the circuit's ampere requirements. A more efficient use of conductor material is made by paralleling phase conductors than by using very large single conductors per phase.

A calculated load of 500 ampere - 480 volt three phase 600 feet long feeder that is installed where it is sometimes exposed to moisture and where the maximum ambient temperature is 110 degrees Fahrenheit is a practical circuit to be used as an example.

A good conductor choice for such a circuit would be 75 degree Celsius rated XHHW OR THHN/THWN insulated copper conductors per 2017 National Electrical Code (NEC) Table 310.15(B)(16). The ambient temperature ampacity correction adjusts the calculated 500 ampere circuit ampacity requirement to 610 amperes. ($500 \text{ amperes} / 0.82 = 610 \text{ amperes}$).

For the installation described above:

A conduit wiring system would require 6 - 500 kcmil conductors which contain **5558 pounds of copper**.

A cable tray wiring system would require 6 - 350 kcmil conductors which contain **3892 pounds of copper**.

The cable tray wiring system uses 1666 pounds less copper for the same capacity circuit than the conduit wiring system does plus there are installation cost savings available by using a cable tray wiring system instead of a conduit wiring system. This evaluation assumes that both the conduit and the cable tray are serving as the equipment grounding conductor. Where separate equipment grounding conductors are used, the copper savings values will be different than those stated above. See the details below for additional information.

Details for a Conduit Installation:

The ampacity adjustment factor for 6 conductors (2 conductors per phase) in the same conduit adjusts the circuit ampacity requirement to 763 amperes per 2017 NEC Table 310.15(B)(3)(a). ($610 \text{ amperes} / 0.8 = 763 \text{ amperes}$).

Size of the conductors required is 500 kcmil per 2017 NEC Table 310.15(B)(16). (763 amperes/2 conductors per phase = 382 amperes 500 kcmil XHHW or THHN/ THWN insulated copper conductor's maximum ampacity rating is 380 amperes). Pulling large cables into conduits subjects the insulation to abrasion. For this type of installation, the XHHW insulation is preferred due to its superior mechanical characteristics over those of the THHN/THWN insulation.

The equipment grounding conductor options available for this type of installation are as follows: The metal conduit may serve as the equipment grounding conductor per 2017 NEC 250.118

A separate #2 AWG equipment grounding conductor may be installed in the conduit if the owner does not desire to use the conduit as the equipment grounding conductor. 2017 NEC Table 250.122 specifies a #2 AWG copper equipment grounding conductor for a 500 ampere protective device rating or setting. For a #2 AWG equipment grounding conductor 123 pound of copper is required. ($0.205 \text{ lbs/ft} \times 600 \text{ feet} = 123 \text{ pounds}$).

Details for a Cable Tray Installation with Multiconductor Cables (3 THHN/THWN insulated copper conductors with a PVC jacketed cable):

No ampacity adjustment factor correction is required for three conductor cables paralleled in cable tray per the 2017 NEC Section 392.80(A)(1)(a). Size of the conductors required is 350 kcmil (610 amperes/2 conductors per phase = 305 amperes). A 350 kcmil THHN/THWN insulated copper conductor's maximum ampacity rating is 310 amperes per 2017 NEC Table 310.15(B)(16).

The equipment grounding conductor options available for this type of installation are as follows: The cable tray may be used as the equipment grounding conductor for qualifying commercial and industrial installations per 2017 NEC Section 392.60 A #2 AWG copper equipment grounding conductors may be in the three conductor cables. If this is done, a fully rated equipment grounding conductor must be in each cable per 2017 NEC Section 250.122. For this case 246 pounds of copper is required. ($0.205 \text{ lbs/ft.} \times 600 \text{ feet} \times 2 = 246 \text{ pounds}$).

A single #2 AWG copper equipment grounding, conductor may be installed in or on the cable tray. For this case 123 pounds of copper is required. ($0.205 \text{ lbs/ft} \times 600 \text{ feet} = 123 \text{ pounds}$).

Details for a Cable Tray Installation with Single Conductor Cables:

Single Conductor Cable installations are restricted to qualifying industrial establishments only as per 2017 NEC Section 392.10(B). Single Conductor Cable installations shall comply with 2017 NEC Section 392.20(C) Connected in Parallel.

Size of the conductors required is 350 kcmil per 2017 NEC Section 392.80(A)(2). Per 2017 NEC 392.80(A)(b) ampacity values are limited to 0.65 percent of the values indicated in 2017 NEC Table 310.15(B)(17). [610 amperes/ 2 conductors per phase = 305 amperes] A 350 kcmil 75 degree Celsius rated XHHW or THHN/ THWN insulated copper conductor's maximum ampacity rating in 2017 NEC Table 310.15(B)(17) is 505 amperes. $505 \text{ amperes} \times 0.65 = 328 \text{ amperes}$ therefore 350 kcmil is the size of conductor that must be selected to carry 310 amperes.

The copper conductor material for this installation is 3892 pounds. ($1.081 \text{ lbs/ft} \times 600 \text{ feet} \times 6 \text{ conductors} = 3892 \text{ pounds}$)

The equipment grounding conductor options available for this type of installation are as follows:

1. The cable tray may be used as the equipment grounding conductor as per 2017 NEC Section 392.60

S2. A single #2 AWG copper equipment grounding conductor may be installed in or on the cable tray for this case 123 pounds of copper is required. ($0.205 \text{ lbs/ft} \times 600 \text{ ft} = 123 \text{ pounds}$).

A PUBLICATION OF THE CABLE TRAY INSTITUTE

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