Table 310.15(B)(2)(a) Adjustment Factors for More Than Three Current-Carrying Conductors in a Raceway or Cable

Number of Current-Carrying Conductors	Percent of Values in Tables 310.16 through 310.19 as Adjusted for Ambient Temperature if Necessary
4–6	80
7–9	70
10–20	50
21–30	45
31–40	40
41 and above	35

(b) *More Than One Conduit, Tube, or Raceway.* Spacing between conduits, tubing, or raceways shall be maintained.

Spacing is normally maintained between individual conduits in groups of conduit runs from junction box to junction box because of the need to separate the conduits where they enter the junction box, to allow room for locknuts and bushings. Field experience has indicated that this degree of spacing between runs has not caused any problems.

(c) *Conduits Exposed to Sunlight on Rooftops.* Where conductors or cables are installed in conduits exposed to direct sunlight on or above rooftops, the adjustments shown in Table 310.15(B)(2)(c) shall be added to the outdoor temperature to determine the applicable ambient temperature for application of the correction factors in Table 310.16 and Table 310.18.

FPN: One source for the average ambient temperatures in various locations is the ASHRAE Handbook — *Fundamentals*.

In the 2005 *Code*, the former FPN No. 2 of 310.10 pointed out the possibility of additional heat rise for some rooftop conductors in conduit placed near the roof in direct sunlight. At that time, the panel prudently decided that explanatory material should be added to this section in the form of a fine print note. During the 2008 *Code* cycle, additional technical substantiation was received and the issue was reconsidered by the code-making panel. For the 2008 *Code*, the heat rise issue related to conduits exposed to sunlight on rooftops is now a requirement in mandatory text within 310.15(B)(2)(c) and the associated Table 310.15(B)(2)(c). See the following example and Exhibit 310.5.

Calculation Example

A feeder installed in intermediate metal conduit, Type IMC, supplies a panelboard inside a mechanical room on top of a commercial building in the St. Louis, MO, area. The calculated load on the feeder is 175 amperes. The lateral portion of the raceway is secured to elevated supports, crosses the rooftop, and is exposed to sunlight. The elevated supports are not less than 15 in. above the finished rooftop surface. Determine the minimum size circuit conductor using alumi-num 90°C XHHW-2 insulation, taking into consideration only the exposure of sunlight. In this example, none of the loads are continuous and the neutral is not considered a current-carrying conductor. For this example, the design temperature is based on the averaged June, July, and August 2 percent design temperature from the 2005 ASHRAE Handbook. The 2008 *NEC* references are 310.15(B)(2)(c), Table 310.16, and 110.14(C).

Solution

STEP 1.

Determine the ambient temperature (compensated for proximity of conduit to the rooftop exposure to sunlight).

a. Ambient temperature (compensated for proximity of conduit to the rooftop exposure to sunlight) = design temperature + value from Table 310.15(B)(2)(c).

b. Design temperature for St. Louis area = 94° F.

c. Temperature adder from Table 310.15(B)(2)(c) for raceway elevated 15 in. above rooftop = 25°F.

d. Compensated ambient temperature = 94°F + 25° F = 119°F.

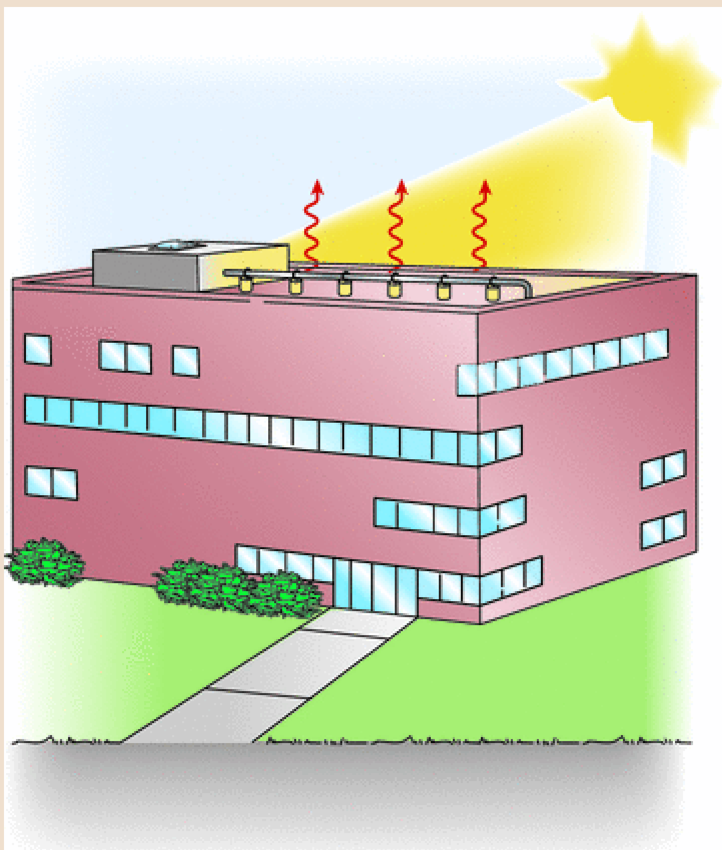

Exhibit 310.5 An IMC conduit crossing a rooftop and exposed to sunlight.

STEP 2.

Determine the temperature correction factor for this application.

From Table 310.16 for aluminum 90°C XHHW-2 insulated conductors, select the proper temperature correction factor. Using the aluminum 90°C column and the temperature correction factor row for 119°F, the temperature correction factor is 0.82.

STEP 3.

Using aluminum 90°C XHHW-2 insulated conductors, determine the proper conductor size to be used in the IMC to supply the 175-ampere load.

a. Because the load is calculated at 175 amperes noncontinuous, and the neutral conductor is not considered to be a current-carrying conductor, the conductor ampacity is calculated as follows:

$$175 \text{ amperes} \div 0.82 = 213 \text{ amps}$$

b. Now, moving back to the 90°C column of Table 310.16, select a conductor not less than 213 amperes, or a minimum size conductor of 250 kcmil aluminum XHHW-2:

250 kcmil aluminum XHHW-2

c. Verify that the conductor ampacity at 75°C is sufficient for the calculated load to comply with terminal temperature requirements of 110.14(C): The 75°C aluminum column of Table 310.16 ampacity equals 205 amperes, which is greater than the 175-ampere calculated load.

Using a very specific set of circumstances, this example demonstrates that roughly an 18 percent loss of usable conductor material occurred. This loss is due solely to high ambient heat present where a cable or raceway is subjected to sunlight and is installed within a specific proximity to the rooftop.

Table 310.15(B)(2)(c) Ambient Temperature Adjustment for Conduits Exposed to Sunlight On or Above Rooftops

	Temperature Adder	
Distance Above Roof to Bottom of Conduit	**°C**	**°F**
0 – 13 mm (1/2 in.)	33	60
Above 13 mm (1/2 in.) – 90 mm (3 1/2 in.)	22	40
Above 90 mm (3 1/2 in.) – 300 mm (12 in.)	17	30
Above 300 mm (12 in.) – 900 mm (36 in.)	14	25

FPN to Table 310.15(B)(2)(c): The temperature adders in Table 310.15(B)(2)(c) are based on the results of averaging the ambient temperatures.

(2) The conductors are 12 AWG copper, and

(3) No more than 20 current-carrying conductors (ten 2-wire cables or six 3-wire cables) are bundled.

Author's Comment: When eleven or more 2-wire cables or seven or more 3-wire cables (more than 20 current-carrying conductors) are bundled or stacked for more than 24 in., an ampacity adjustment factor of 60 percent must be applied.

(c) Raceways Exposed to Sunlight on Rooftops. The ambient temperature adjustment contained in Table 310.15(B)(2)(c) is added to the outdoor ambient temperature for conductors or cables that are installed in raceways exposed to direct sunlight on or above rooftops when applying ampacity adjustment correction factors contained in Table 310.16.

FPN No. 1: See ASHRAE Handbook—*Fundamentals* (www.ashrae.org) as a source for the average ambient temperatures in various locations.

FPN No. 2: The temperature adders in Table 310.15(B)(2)(c) are based on the results of averaging the ambient temperatures.

Table 310.15(B)(2)(c) Ambient Temperature Adder for Raceways On or Above Rooftops

Distance of Raceway Above Roof	C°	F°
0 to ½ in.	33	60
Above ½ in. to 3 ½ in.	22	40
Above 3 ½ in. to 12 in.	17	30
Above 12 in. to 36 in.	14	25

Author's Comment: This section requires the ambient temperature used for ampacity correction to be adjusted where conductors or cables are installed in conduit on or above a rooftop and the conduit is exposed to direct sunlight. The reasoning is that the air inside conduits in direct sunlight is significantly hotter than the surrounding air, and appropriate ampacity corrections must be made in order to comply with 310.10.

For example, a conduit with three 6 THWN-2 conductors with direct sunlight exposure that is ¾ in. above the roof will require 40°F to be added to the correction factors at the bottom of Table 310.16. Assuming an ambient temperature of 90°F, the temperature to use for conductor correction will be 130°F (90°F + 40°F), the 6 THWN-2 conductor ampacity after correction will be 57A (75A x 0.76). **Figure 310–20**

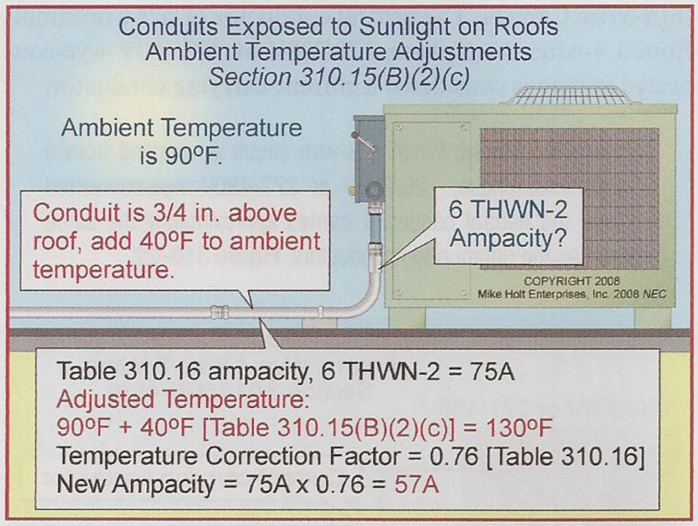

Figure 310–20

When adjusting conductor ampacity, use the conductor ampacity as listed in Table 310.16 based on the conductors' insulation rating; in this case, it's 75A at 90°F. Conductor ampacity adjustment is not based on the temperature terminal rating as per 110.14(C).

(4) Neutral Conductors.

(a) Balanced Circuits. The neutral conductor of a 3-wire, single-phase, 120/240V system, or 4-wire, three-phase, 120/208V or 277/480V wye-connected system, isn't considered a current-carrying conductor. **Figure 310–21**

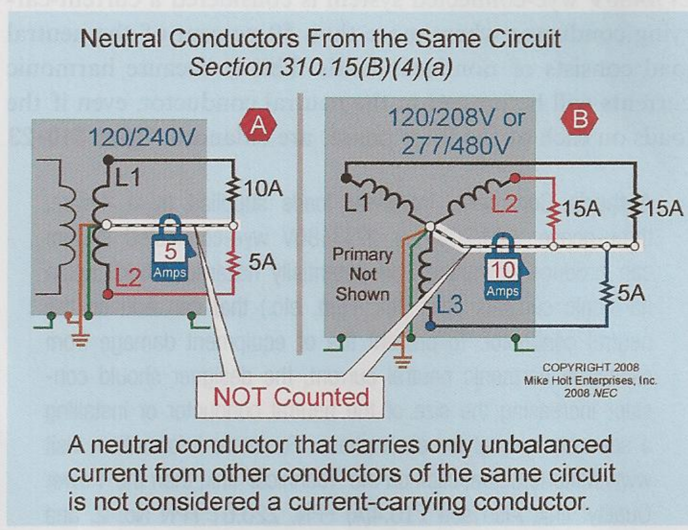

Figure 310–21