Articles

How to Calculate Ambient Derating Factors for 600 Volts and Less

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Learning how to calculate the derating factors found at the bottom of table 310-16 can save time and material for systems located out of doors that operate only in colder temperatures.

The equations

By using the Neher-McGrath equation found in Section 310-15 of the NEC and remembering that Delta TD equals zero for 600 volt and less systems we can derive the equation used to calculate derating factors found at the bottom of Table 310-16. This simple equation then can be used to increase the ampacity for conductors used at lower temperatures. For instance, the ampacity for a No. 12 copper conductor with 90 degree Centigrade insulation at zero degrees Fahrenheit is 40 amperes. This means that when we use the derating factors in Note 8 to Table 310-16, we can install up to 40 No. 12 copper conductors with a 90 Centigrade insulation in the same raceway and protect each with a 20 ampere circuit breaker. How do we do this? The derating factor is 40 per cent and .4 x 40 is 16 amperes; rounding up allows the 20 ampere circuit breaker. This assumes that the branch circuit is not used to supply multiple outlets used to supply cord and plug connected portable loads.

The derivation of the equation for calculating the ambient derating factors is given below. I1 is the ampacity for a conductor at an ambient of TA1, that is 30 degrees C for Table 310-16. TA2 is the new ambient for which we want to find the derating factor. In the following diagram I2 equals the new ampacity and the quantity in the radical after I1 in the last equation is the derating factor. The second diagram graphs the ampacity of a No. 12 copper conductor with 90 degree C. insulation (TC) for changes in the ambient down to -50 degrees F. (TA2). In doing the calculation 30 amperers is used for I1 and 30 degrees C is used for TA1. Remember C=5/9(F-32) and TA1 and TA2 must be in degrees C.

$$I_1 = \sqrt{\frac{TC - TA_1}{RDC(1+Yc)RCA}}$$

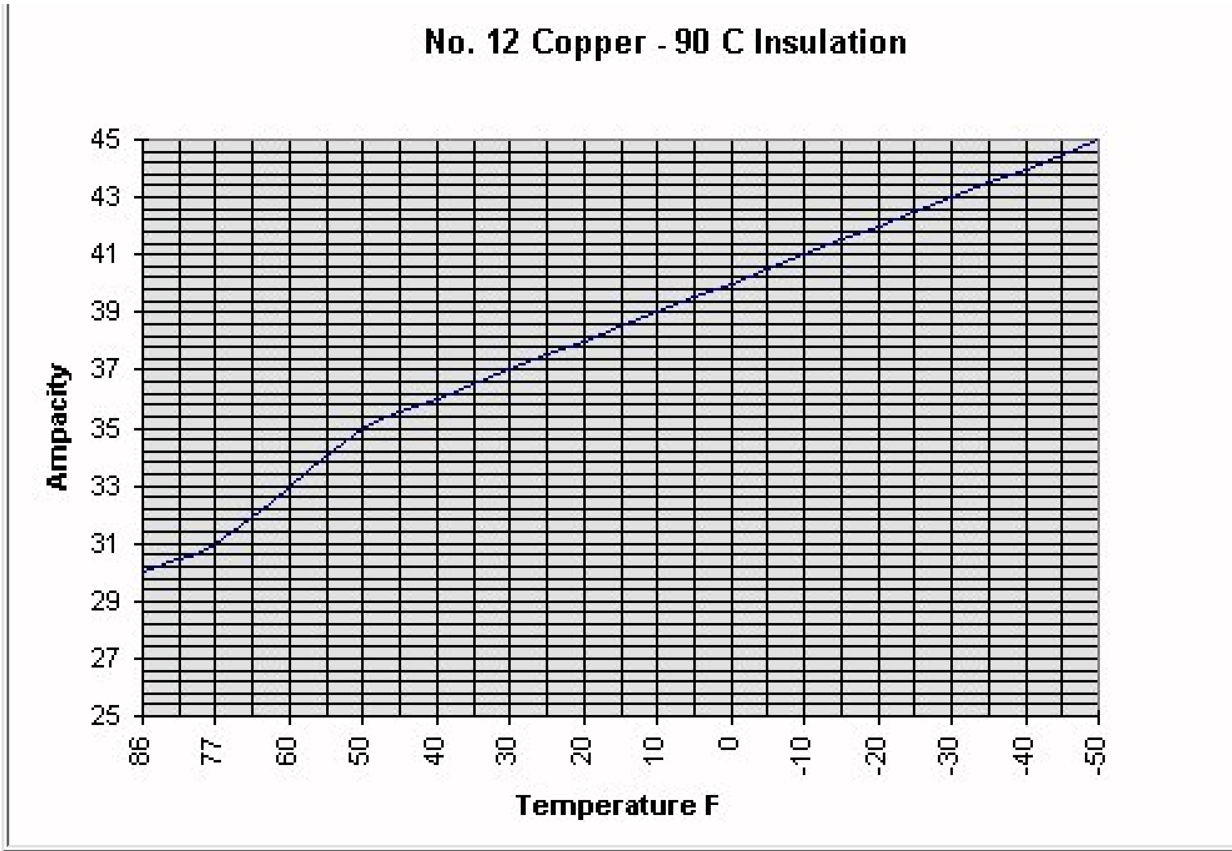
$$I_2 = \sqrt{\frac{TC - TA_2}{RDC(1+Yc)RCA}}$$

$$I_2\left(\sqrt{\frac{TC - TA_1}{RDC(1+Yc)RCA}}\right) = I_1\left(\sqrt{\frac{TC - TA_2}{RDC(1+Yc)RCA}}\right)$$

$$I_2^2\left(\frac{TC - TA_1}{RDC(1+Yc)RCA}\right) = I_1^2\left(\frac{TC - TA_2}{RDC(1+Yc)RCA}\right)$$

$$I_2^2 = I_1^2\frac{\left(\frac{TC - TA_2}{RDC(1+Yc)RCA}\right)}{\left(\frac{TC - TA_1}{RDC(1+Yc)RCA}\right)}$$

$$I_2 = I_1\sqrt{\frac{TC - TA_2}{TC - TA_1}}$$


No. 12 Copper - 90 C Insulation
Ampacity
45
43
41
39
37
35
33
31
29
27
25
86
77
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
Temperature F