

Additionally, all cables except polyethylene (not cross-linked) withstand, for moderate periods, temperatures substantially greater than their rated operating temperatures. This is a change recently developed from work done within ICEA and published by that organization (see 9.9). For example, EPR and XLP cables have emergency ratings of 130 °C, based on maximum time per overload of 36 h, three such periods per year maximum, and an average of one such period per year over the life of the cable. Thermoplastic cables degrade in this marginal range by progressive evaporation of the plasticizer and can operate for several hours at the next higher grade operating temperature (90 °C for 75 °C rating, and so forth) with negligible loss of life. Therefore, emergency operating overloads may reasonably be applied to cables within the time and temperature ratings. This capability should be the basis of application of protection of the cables.

The complete relationship for determining intermediate overload rating is as follows:

$$\text{Percent overload capability} = \frac{I_E}{I_N} \% = \sqrt{\frac{\frac{T_E - T_O}{T_N - T_O} - \left(\frac{I_O}{I_N}\right)^2 (e^{-\theta K})}{1 - e^{-\theta K}} \left(\frac{230 + T_N}{230 + T_E}\right)} 100$$

where

- $I_E$  is emergency operating current rating,
- $I_N$  is normal current rating,
- $I_O$  is operating current prior to emergency,
- $T_E$  is conductor emergency operating temperature,
- $T_N$  is conductor normal operating temperature,
- $T_O$  is ambient temperature,
- K is a constant, dependent on cable size and installation type (see Table 9-5),
- 230 is zero-resistance temperature value (234 for copper, 228 for aluminum),
- e is base for natural logarithms.

**Table 9-5—K factors for equations in 9.5.2.4**

Cable size	Air		Underground duct	Direct buried
	No cond	In cond		
<#2	0.33	0.67	1.00	1.25
#2–#4/0	1.00	1.50	2.50	3.00
≥250 kcmil	1.50	2.50	4.00	6.00

If the cable has been operated at its rated current prior to the excursion, then  $I_O / I_N = 1$  so the relation is simplified to: