Time-Overcurrent Curves

Standard Inverse-Time Characteristic Curves

The information in *Table 3.5* and *Table 3.6* describes the curve timing for the curve and time dial settings made for the time-overcurrent elements. The time-overcurrent curves in *Figure 3.30* through *Figure 3.39* conform to IEEE C37.112-1996 IEEE Standard Inverse-Time Characteristic Equations for Overcurrent Relays.

Where:

T_p = Operating time in seconds

T_R = Electromechanical induction-disk emulation reset time in seconds (if you select electromechanical reset setting)

TD = Time-dial setting

M = Applied multiples of pickup current [for operating time (T_p), M > 1; for reset time (T_R), M ≤ 1]

Table 3.5   Equations Associated with U.S. Curves

Curve Type	Operating Time	Reset Time	Figure
U1 (Moderately Inverse)	$T_p = TD \bullet \left(0.0226 + \dfrac{0.0104}{M^{0.02} - 1} \right)$	$T_R = TD \bullet \left(\dfrac{1.08}{1 - M^2} \right)$	*Figure 3.30*
U2 (Inverse)	$T_p = TD \bullet \left(0.180 + \dfrac{5.95}{M^2 - 1} \right)$	$T_R = TD \bullet \left(\dfrac{5.95}{1 - M^2} \right)$	*Figure 3.31*
U3 (Very Inverse)	$T_p = TD \bullet \left(0.0963 + \dfrac{3.88}{M^2 - 1} \right)$	$T_R = TD \bullet \left(\dfrac{3.88}{1 - M^2} \right)$	*Figure 3.32*
U4 (Extremely Inverse)	$T_p = TD \bullet \left(0.0352 + \dfrac{5.67}{M^2 - 1} \right)$	$T_R = TD \bullet \left(\dfrac{5.67}{1 - M^2} \right)$	*Figure 3.33*
U5 (Short-Time Inverse)	$T_p = TD \bullet \left(0.00262 + \dfrac{0.00342}{M^{0.02} - 1} \right)$	$T_R = TD \bullet \left(\dfrac{0.323}{1 - M^2} \right)$	*Figure 3.34*

Table 3.6   Equations Associated with IEC Curves (Sheet 1 of 2)

Curve Type	Operating Time	Reset Time	Figure
C1 (Standard Inverse)	$T_p = TD \bullet \dfrac{0.14}{M^{0.02} - 1}$	$T_R = TD \bullet \left(\dfrac{13.5}{1 - M^2} \right)$	*Figure 3.35*
C2 (Very Inverse)	$T_p = TD \bullet \dfrac{13.5}{M - 1}$	$T_R = TD \bullet \left(\dfrac{47.3}{1 - M^2} \right)$	*Figure 3.36*
C3 (Extremely Inverse)	$T_p = TD \bullet \dfrac{80}{M^2 - 1}$	$T_R = TD \bullet \left(\dfrac{80}{1 - M^2} \right)$	*Figure 3.37*

Table 3.6   Equations Associated with IEC Curves (Sheet 2 of 2)

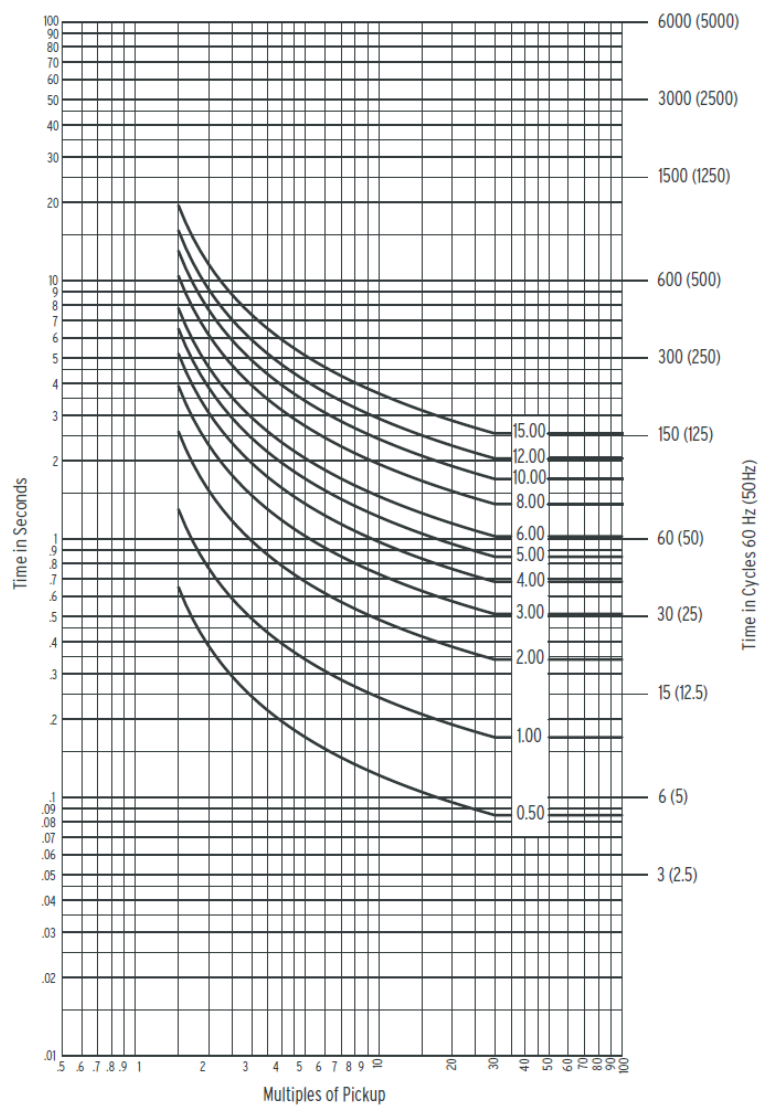| Curve Type	Operating Time	Reset Time	Figure
C4 (Long-Time Inverse)	$T_p = TD \cdot \dfrac{120}{M - 1}$	$T_R = TD \cdot \left(\dfrac{120}{1 - M}\right)$	Figure 3.38
C5 (Short-Time Inverse)	$T_p = TD \cdot \dfrac{0.05}{M^{0.04} - 1}$	$T_R = TD \cdot \left(\dfrac{4.85}{1 - M^2}\right)$	Figure 3.39

Figure 3.30   U. S. Moderately Inverse Curve: U1