

# Instructions: Calculations to Determine Adjusted Resistance Tolerance for 3-Wire Configurations

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## 1. Purpose

Inherent error in 3-wire resistance measurement techniques and differences in leadwire resistances necessitate adjustment of acceptance criteria (resistance tolerance). The magnitude of the adjustment is dependent on wire diameter (AWG) and wire length. The following calculations are based on an RSS (Root Sum Squared) error analysis of leadwire resistances, assuming the leadwire resistances are statistically independent, and are within  $\pm 5\%$  of the average leadwire resistance.

## 2. Application

Use this instruction to calculate leadwire adjustments to the resistance tolerances for 3-wire RTDs. **Use this calculation only for leadwires AWG 20 or smaller, and minimum length per Table 1.**

Step	Operation	Value
a	High resistance specification	
b	Low resistance specification	
c	Lead length in feet (inches $\div$ 12)	
d	Lead error adjustment factor (from <i>Table 1</i> )	
e	Total adjustment = $(c \times d)$ , rounded to 2 decimals	
f	Adjusted high resistance limit = $(a + e)$	
g	Adjusted low resistance limit = $(b - e)$	

## 3. Example (AWG #28 leads, 76 inches long)

Step	Operation	Class A example	Class B example
a	High resistance specification	100.06	100.12
b	Low resistance specification	99.94	99.88
c	Lead length in feet (inches $\div$ 12)	$76 \div 12 = 6.33$	$76 \div 12 = 6.33$
d	Lead error adjustment factor (from <i>Table 1</i> )	.0045	.0045
e	Total adjustment = $(c \times d)$ , rounded to 2 decimals (3 decimals for CA element)	.03	.03
f	Adjusted high resistance limit = $(a + e)$	100.09	100.15
g	Adjusted low resistance limit = $(b - e)$	99.91	99.85

## 4. Table 1

Leadwire Size (AWG)	Lead Error Adjustment Factors						
	20	22	24	26	28	30	32
Adjustment Factor (ohms/ft)	0.0007	0.0011	0.0018	0.0029	0.0045	0.0071	0.0120
Minimum Length*	14 ft (168")	9 ft (108")	6 ft (72")	4 ft (48")	2 ft (24")	1.5 ft (18")	0.8 ft (10")
Minimum Length (CA element only)	6 ft (72")	4 ft (48")	2.5 ft (30")	1.5 ft (18")	1 ft (12")	0.6 ft (7")	All

\* For parts (other than CA) with calibration tolerance less than  $\pm 0.06 \Omega$ , please consult Minco Engineering.