Conductor Facts

Electrical Resistance

Electrical resistance of conductors is usually expressed in terms of ohms per unit length. In the English system, it is Ω/mft (ohms per 1000 feet), in metric Ω/km (ohms per 1000 meters) at a standard temperature of 20°C (68°F).

Measurement

Standard procedure measures the DC resistance of a 5 foot minimum length (1.5 meters) and converts into the units Ω/mft or Ω/km. Utilizing a resistance bridge prevents resistance heating of the sample, especially in smaller gages.

Definitions

Electrical Resistivity: is the material's electrical resistance per unit volume. Resistivity is a material property and is independent of its geometry (cross-sectional area and length). High resistivity designates the material as a poor conductor of electricity. Electrical resistivity is expressed in Ω-inch (or Ω-cm) etc.

Electrical Conductivity: is the inverse of resistivity. It is a measure of a material's ability to conduct electric current, usually compared to copper, and is generally stated in terms of %IACS (International Annealed Copper Standard).

Temperature Coefficient of Resistance: is a material constant which reflects the change in a material's electrical resistance (resistivity) due to a change of one degree in temperature. It is expressed in units per °C (or units per °F).

Conductor Resistance

$$R = \frac{\rho L}{A}$$

Where:

- R = Resistance (ohms)
- ρ = Volume Resistivity
- L = Length of specimen
- A = Cross-sectional area of specimen

Conductivity and Resistivity (ρ) of Common Conductor Alloys

	%IACS	Ω-cmil/ft
Copper (C110)	100	10.37
PERCON® 24	90	11.52
C18135	85	12.20
PERCON® 11	90	11.52
PERCON® 17	85	12.20
PERCON® 19	73	14.21
Cadmium Copper (C162)	85	12.20
Copper Clad Steel 40%	39	26.45

Temperature Correction

Ambient temperature affects the electrical resistance of most metals. In general, a higher temperature will increase the resistance. Readings must be corrected to a standard reference temperature, generally 20°C (68°F), for proper interpretation.

The formula for temperature correction is:

$$R_T = \frac{Rt}{1 + \alpha(t-T)}$$

Where:

- RT = Resistance at reference temperature T.
- Rt = Resistance measured at temperature t.
- α = Temperature coefficient of resistance
- T = Reference temperature (normally 20°C)
- t = Measurement temperature.

Temperature Correction Factors (α) for common conductor alloys @ 20°C

Conductor Material	α (per °C)
Copper (C110)	0.00393
PERCON® 24	0.00342
C18135	0.00342
PERCON® 11	0.00354
PERCON® 17	0.00322
PERCON® 19	0.00305
Cadmium Copper (C162)	0.00322
Copper Clad Steel (40%)	0.00378

Note: The coefficient α varies with the material, the conductivity, and the temperature range. The value for 100% IAC conductivity copper at 20°C is 0.00393. Values for coefficients of other materials, conductivities, and temperatures can be found in NBS Handbook-100,Table 2.

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