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 20ºC (68ºF).

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 gauges.

Definitions

- Electrical Resistivity
- A 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
- 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
- A 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 unites per ºC (or units per ºF).

Conductor Resistance

$$R = \rho L/A$$

Where R is resistance in ohms, ρ is volume resistivity, L is length of specimen and A is the cross-sectional area of the specimen.

Conductivity and Resistivity (ρ) of Common Conductor Alloys

CONDUCTOR MATERIAL	%1ACS	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

Note: The coefficient α varies with the material, the conductivity, and the temperature range. The value for 100% IAC conductivity copper at 20ºC (68ºF) is 0.00393. Values for coefficients of other materials, conductivities, and temperatures can be found in NBS Handbook-100, table 2.

Custom constructions are available, please contact the sales department

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Fisk Alloy Wire, Inc. • P.O. Box 26 • 10 Thomas Road • Hawthorne, NJ 07507 U.S.A.
Phone: 855-4-PERCON (855-473-7266) • Fax (973) 427-4585 • E-mail: sales@fiskalloy.com

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 20ºC (68ºF), for proper interpretation.

The formula for temperature correction is:

$$RT = Rt/1+\alpha(t-T)$$

Where RT is resistance at reference temperature T, Rt is resistance measured at temperature t, α is temperature coefficient of resistance, T is the reference temperature (normally 20ºC (68ºF), and t equals the measurement temperature.

Temperature Correction Factors (α) for Common Conductor Alloys at 20ºC (68ºF)

CONDUCTOR MATERIAL	A (PER ºC)
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

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