U. S. Department of Commerce
Malcolm Baldrige
Secretary
National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate

Standard Reference Material 1863

Aluminum Block

Eddy Current Conductivity – 30% IACS

This Standard Reference Material (SRM) is an aluminum block that is intended for use in the calibration of secondary electrical conductivity standards or in the direct calibration of eddy current conductivity meters.

The certified values of electrical resistivity and conductivity for block

Identification No: Orange

are:

	Top of Block*	Bottom of Block
Resistivity (ρ_{23})	x 10^{-8} ohm·m	x 10^{-8} ohm·m
Conductivity	% IACS	% IACS
Uncertainty	0.15% of Value	0.15% of Value

*When the block is resting on a surface so that the identification number is in an upright position, the exposed surface is defined to be the top.

The value in percent International Annealed Copper Standard (% IACS) is calculated from the relation

$$\%\,\mathrm{IACS} = \frac{100 \times 1.724 \times 10^{-8}}{\rho_{23}}$$

where ρ_{23} is the resistivity of the specimen at 23 °C and $1.724 \cdot 10^{-8}$ ohm·m is the defined value for 100% IACS. The certified values are valid if the block is tested at temperatures between 20 and 26 °C, using a coil the outside diameter of which is less than 0.85 cm, and an energizing signal frequency between 10 and 100 kHz. When correcting values determined at temperatures other than 23.0 °C, the following relation should be used:

$$\rho_{23} = \frac{\rho_t}{1 + 1.69 \cdot 10^{-3}(t-23)}$$

The uncertainty includes errors in determining the resistivity of NBS primary standards in a dc experiment, errors in comparing the resistivity of the block with the resistivity of NBS primary standards in an ac experiment, and the inhomogeneity of the block material. The homogeneity of the block material was checked by scanning the top surface (two scans, perpendicular to each other and crossing at the center of the block) with a coil energized at 10 kHz and by measurements at the center of the block with a coil energized at 8, 18, and 32 kHz.

The electrical resistivity of a nonmagnetic material (i.e., a material whose relative permeability is near unity) is a function of the alloying agents, impurities, grain boundaries, and work hardening. This aluminum alloy block is such a material and will be damaged if the surface is scratched or if it is exposed to temperature extremes. Care should be taken in handling and storing the block so that it is not exposed to undue mechanical or thermal stress.

R. Mehrabian, Chief, and personnel of the Metallurgy Division, Center for Materials Science, developed specifications for and coordinated the procurement of this material.

The measurements leading to certification were performed by G.M. Free of the Electrical Measurements and Standards Division, Center for Absolute Physical Quantities.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R.K. Kirby.

Washington, D.C. 20234
August 2, 1982

George A. Uriano, Chief
Office of Standard Reference Materials

(over)

This SRM was manufactured from aluminum plate stock (alloy and temper designation: 2024-T-351) that was determined to have relatively uniform electrical characteristics. The block was machined from the plate to be approximately 4.4 cm square and 0.95 cm thick, anodized, and marked with an identification number. The block has an indentation near one corner for attaching a ground wire.

The resistivity of each block was determined by a series of experiments. The unit of electrical resistivity is maintained in several reference metal bars of rectangular cross section. The resistivity of these bars is determined by a dc measurement using the relation

$$\rho = RA/L$$

where R is the resistance, A is the cross sectional area, and L is the distance over which the resistance is measured.[1] The SRM was calibrated by comparison with the reference bars using an eddy current instrument.[2] The eddy current measurements were made at approximately the center of the top and bottom surface with a coil, the mean diameter of which was 0.48 cm.

The temperature coefficient of the block was determined from measurements made at three temperatures.

References

1. G.M. Free, "NBS Eddy Current Standards Program," pp 133-136, in Eddy Current Nondestructive Testing, Edited by G.M. Free, NBS Special Publication 589 (1981).

2. G.M. Free, "High Accuracy Conductivity Measurements in Nonferrous Metals," pp 121-128, in Eddy Current Characterization of Materials and Structures, Edited by G. Birnbaum and G.M. Free, ASTM Special Technical Publication 722 (1981).