U. S. Department of Commerce
Philip M. Klutznick
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards Certificate of Analysis

Standard Reference Material 393

Unalloyed Copper - Cu"O"

(In cooperation with the American Society for Testing and Materials)

This Standard Reference Material (SRM) is in the form of fine millings, sized between 0.5 mm and 1.4 mm sieve openings (35 - 14 mesh). The SRM is intended for use in trace analysis of copper materials, and is the high-purity end member of a series of copper "Benchmark" standards. It is designed for all techniques applicable to compositional analysis of unalloyed copper and it is particularly well suited for calibration with optical emission methods of analysis.

SRM No.	393				
Designation	Cu "O"				
Element	Value	Element	Value	Element	Value
	PPM by Wt. (μg/g)		PPM by Wt. (μg/g)		PPM by Wt. (μg/g)
Aluminum	<0.1[a]	Iron	<1	Silicon	<0.5
Antimony	0.25 ± 0.05[b]	Gold	<0.05	Silver	0.10 ± 0.02
Arsenic	0.41 ± 0.02	Lead	0.039 ± 0.002	Sulfur	<1
Beryllium	<0.01	Lithium	<0.01	Tellurium	<0.5
Bismuth	<0.1	Magnesium	<0.1	Tin	<0.1
Boron	<0.01	Manganese	<0.01	Titanium	<0.5
Cadmium	<0.1	Nickel	0.05 ± 0.01	Zinc	<0.1
Calcium	<0.05	Palladium	<0.05	Zirconium	<0.5
Chromium	<0.5	Phosphorus	<0.05		
Cobalt	0.02 ± 0.01	Selenium	<0.05		
Element	Percent by Weight				
Copper, assay	99.998 ± 0.001				

[a] Less than, <, numbers are conservative upper limits as determined by several methods including spark source mass spectrometry, atomic absorption, optical emission, and residual resistivity ratios.

[b] Numbers underlined represent the *present best estimate* of the "true" value along with the *estimated uncertainty* for samples of 1.0 g or more. The methods include isotope dilution mass spectrometry, spectrophotometry, and electrogravimetry.

The overall coordination of the NBS analytical measurements leading to certification was under the direction of I.L. Barnes.

The technical and support aspects involved in the issuance of this SRM were coordinated through the Office of Standard Reference Materials by R.E. Michaelis.

Washington, D.C. 20234
September 16, 1980

George A. Uriano, Chief
Office of Standard Reference Materials

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PLANNING, PREPARATION, TESTING, ANALYSIS:

This material is one in a series of twelve different composition copper "Benchmark" materials, Cu "O" through Cu XI, that are being prepared in a cooperative Industry-ASTM-NBS program.

The material for the preparation of Cu "O" was obtained, under contract with NBS, from the American Smelting and Refining Company, Globe Plant, Denver, Colorado. Selection of the material was based on residual resistivity ratio measurements made at NBS, Boulder, J.G. Hust. Only that material exhibiting high electronic purity and acceptable gross material variability was acquired.

At NBS, Washington, the rod material was cleaned and converted to fine millings, which were sieved and thoroughly blended. Special precautions were taken throughout the entire processing to avoid contamination.

Extensive homogeneity studies were made at NBS, Boulder, by residual resistivity ratio measurements, J.G. Hust. The results indicate the maximum gross material variability to be less than ± 5%.

Cooperative analyses were made in the following analytical laboratories:

Anglo American Corporation of South Africa Limited, Johannesburg, Republic of South Africa, R. Murray-Smith.

Council for Scientific and Industrial Research, National Physical Research Laboratory, Pretoria, Republic of South Africa, L.R.P. Butler, D.B. de Villiers, and J.H. Wepener.

Kennecott Copper Corporation, Kennecott Research Center, Salt Lake City, Utah, A.P. Langheinrich and T.N. Andersen.

Kennecott Refining Corporation, Baltimore, Md., A.A. Di Leonardi.

Magma Copper Company, San Manuel Division, San Manuel, Ariz., S.K. Young.

National Research Council of Canada, Division of Chemistry, Ottawa, Ontario, Canada, D.S. Russell.

Analyses were performed in the NBS Inorganic Research Division by the following: K.A. Brletic, B.I. Diamondstone, J.D. Fassett, E.L. Garner, J.W. Gramlich, W.R. Kelly, L.A. Machlan, J.R. Moody, P.J. Paulsen, and M.J. Seward; and by R.K. Bell, ASTM-NBS Assistant Research Associate.

ADDITIONAL INFORMATION:

Analysts should use the millings in the "as received" conditions.

Some surface oxidation (discoloration) may be present on this chip material, but the amount is not analytically significant for the elements certified. The analyst should keep the container tightly capped when not in use.