U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate of Analysis

Standard Reference Material 400

Unalloyed Copper - Cu VII

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

This Standard Reference Material (SRM) is in the form of small chips, sized between 0.5 mm and 1.4 mm sieve openings (35 - 14 mesh).* The SRM is intended for use in trace elemental analysis of copper materials. 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.

Element	Certified Value[a] µg/g	Estimated Uncertainty[b]	Element	Certified Value[a] µg/g	Estimated Uncertainty[b]
Antimony[c]	102	4	Lead[d]	128	3
Arsenic[c]	140	13	Nickel[d]	603	3
Bismuth	24.5	1.5	Selenium[c]	214	10
Cobalt[c]	0.6	0.1	Silver[d]	181	6
Iron[d]	41	2	Tellurium[c]	153	2
			Zinc[c]	114	4

Element	Certified Value[a]	Estimated Uncertainty[b]
	Percent by Weight	
Copper[c], assay	99.70	0.02

[a]The value listed for an element is the *present best estimate* of the "true" value based on the results of the analytical program for certification.

[b]The estimated uncertainty listed for a constituent is based on judgment and represents an evaluation of the combined effects of method imprecision, possible systematic errors among methods, and material variability for samples of 0.25 g or more. (No attempt was made to derive exact statistical measures of imprecision because several methods were involved in the analysis of most constituents.)

[c]Values for Sb, As, Co, Zn, Se, Te, and Cu are based on agreement of determinations at NBS and cooperating laboratories; values for Bi are based on agreement of determinations at cooperating laboratories.

[d]Values for Fe, Pb, Ni, and Ag are based on determinations at NBS by two or more of the following methods: atomic absorption and flame emission spectrometry, isotopic dilution mass spectrometry, neutron activation analysis, and spark source mass spectrometry.

*Material from the same original ingot was processed to the form of rods 6.4 mm (1/4 in) in diameter, designated SRM 500.

Gaithersburg, MD 20899
April 10, 1986
(Revision of Certificate
dated 1-23-78)

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

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.

Base materials for the preparation of Cu VII were supplied by the Anaconda Copper Company, Perth Amboy, N.J.; Hecla Mining Co., Casa Grande, Ariz.; International Nickel Company of Canada Limited, Ontario, Canada; Kennecott Refining Corporation, Baltimore, Md.; and Nassau Smelting and Refining Co., Inc., Staten Island, N.Y. Melting and casting of Cu VII were done at the Esco Corporation, Portland, Ore. Some of the additions were provided by the Wolverine Tube Co., Decatur, Ala., courtesy of R.E. Stanton.

Preliminary analyses, primarily by optical emission methods of analysis, were performed in the analytical laboratories of:

Anaconda Company, Primary Metals Division, Raritan Copper Works, Perth Amboy, N.J., P.F. Stryker and A.J. Simon.

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

Kennecott Refining Corporation, Baltimore, Md., A.A. DiLeonardi.

Reading Metals Refining Corp., Reading, Pa., W.P. Darrow.

U.S. Metals Refining Company, AMAX Copper Division, Carteret, N.J., R.M. Kennedy.

The ingot was processed by the U.S. Bureau of Mines, Albany, Ore., R.A. Beall, to provide material of the highest possible homogeneity, both in billet and rod forms. The ingot was approximately 24 cm (9 1/2 in) in diameter, 81 cm (32 in) long, and weighed about 318 kg (700 lb). The ingot was forged to produce a bar 15 cm (6 in) square. Five percent of the total volume was cropped from the end of the bar representative of the bottom of the original ingot and fifteen percent from the top. The bar was then cut into equal lengths of approximately 46 cm (18 in) to form three billets. One billet, selected for the chip material, was end-milled at NBS. The lot of chips was sieved and blended.

Cooperative homogeneity studies were made at Kennecott Refining Corp., Baltimore, Md., by optical emission spectrochemical analysis, A.A. DiLeonardi. Extensive homogeneity studies were made at NBS Boulder, by residual resistivity ratio measurements, J.G. Hust, and at NBS Gaithersburg, by chemical analyses (see listing below). The results indicated the maximum gross material variability to be less than 5%.

Cooperative chemical analyses for certification were made on composite samples 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. deVilliers, and J.H. Wepener.

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

Kennecott Refining Corporation, Baltimore, Md., A.A. DiLeonardi.

South African Bureau of Standards, Physical Chemistry Division, Pretoria, Republic of South Africa, H.P. Beyers and P.G. Odendaal.

Analyses were performed in the NBS Analytical Chemistry Division by the following: I.L. Barnes, R.W. Burke, B.I. Diamondstone, M.G. Diaz, E.L. Garner, L.A. Geldner, J.W. Gramlich, G.J. Lutz, L.A. Machlan, T.J. Murphy, P.J. Paulsen, L.J. Powell, P.A. Sleeth, and R.K. Bell, ASTM-NBS Assistant Research Associate.

The overall direction and coordination of the preparation and fabrication of this material were performed by J.G. Hust, NBS, Boulder, Colorado.

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 preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R.E. Michaelis.

ADDITIONAL INFORMATION: Details concerning the planning, preparation, testing, and analysis of this material and other copper "Benchmark" materials are to be published in an NBS Special Publication (260 Series). Information that should be of immediate interest to the user laboratories follows:

Analysts should use this chip material in the "as received" condition.

Some surface oxidation (discoloration) is present on the 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.

Elements other than those certified may be present in this material as indicated below. These are *not certified* but are given as additional information on the composition.

Elements Detected	Information Value, $\mu g/g$
Aluminum	(<2)
Cadmium	(<1)
Chromium	(0.5)
Gold	(10)
Magnesium	(<1)
Manganese	(0.2)
Oxygen*	(1025)
Silicon	(<2)
Sulfur	(9)
Tin	(~200)
Elements Not Detected	
Calcium	(<0.3)
Titanium	(<1)

*The value of oxygen for this chip material is subject to change because of surface oxidation.