U. S. Department of Commerce
Maurice H. Stans
Secretary

National Bureau of Standards
A. V. Astin, Director

Certificate of Analysis

Standard Reference Material 953
Neutron Density Monitor Wire[a]

(Cobalt in Aluminum)

The standard is provided as a reference source of a cobalt in aluminum alloy to serve as a neutron density monitor wire standard. Accurate determination of thermal neutron densities is essential for irradiation tests in order to obtain a basis for comparison of densities among reactors, to apply the data in the design of reactors, to understand the mechanisms of radiation damage and to use in neutron activation analysis.

SRM No.	Description	Cobalt, percent by weight
953	Neutron Density Wire (Co in Al)	0.116[b] ± 0.002[c]

[a] The neutron density monitor material is in the form of wire 0.5 mm in diameter and is available in one meter lengths, (approx. 0.6 g), or in multiples thereof (continuous length).

[b] The reported value is the average of the results of three analytical methods.

[c] The uncertainty limit reported is the sum of the following (in weight percent): 1. 0.0009, the estimated limit of the systematic error in the average; 2. 0.0010, the estimated limit of the inhomogeneity at the 95% confidence level, for samples $\geq$4 mg; and, 3. 0.0004, the estimated limit of the random error in the average at the 95% confidence level.

Fourteen 10-meter lengths of wire equally spaced over the entire lot of selected material were analyzed. The methods used, the weight (w) of samples taken from each of the fourteen lengths, the standard deviation (S_x) of a single measurement due to imprecision of the analytical method, the number of determinations (N) made by each method, and the average obtained ($\overline{X}$) are given below.

Method	w (mg)	S_x	N	$\overline{X}$
1	50–60	0.0013	14	0.1161
2	4–5	0.0007, 0.0005[a]	5 sets of 6	.1158
3	20	0.0015	41	.1173

[a] The standard deviation was 0.0007 within a set and 0.0005 between sets.

The analytical methods used were:

Methods 1 and 2: Two variations of a spectrophotometric method using 2,3-quinoxalinedithiol (E. R. Deardorff and R. W. Burke).

Method 3: Activation analysis, nondestructive, relative to cobalt metal foil and cobalt metal powder (T. E. Gills and D. A. Becker).

The use of gamma-ray spectroscopy to measure the induced radioactivity of this material is recommended. Gross counting will result in systematic errors due to the presence of ^{24}Na (from the n,α reaction on ^{27}Al) and ^{198}Au (from the n,γ reaction on a small amount of gold impurity present, estimated at ~5 ppm).

Washington, D. C. 20234
March 12, 1969

W. Wayne Meinke, Chief
Office of Standard Reference Materials

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This standard has been established to provide a homogeneous and well-characterized neutron density monitor primarily for use in irradiation test programs on reactor materials. It will also be useful for the nuclear activation analyst in monitoring neutron densities and mapping neutron density variations in irradiation containers and in various irradiation locations within reactors. The 0.1 percent cobalt in aluminum monitor material was chosen as having (1) a well-known neutron cross section in all neutron energy ranges, (2) a suitable half life, and (3) a well-characterized energy spectrum and decay scheme.

The material for SRM 953 was prepared at the Materials Research Corporation, Orangeburg, New York, with special melting, casting and fabrication procedures designed to produce a large quantity of material of the highest possible homogeneity.

Extensive homogeneity testing was performed at the NBS laboratories in Gaithersburg, Maryland, and the material was found to be satisfactory for its intended use as a neutron density monitor.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of J. R. DeVoe.

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