National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 663

Chromium-Vanadium Steel (Modified)

This Standard Reference Material (SRM) is intended primarily for use in chemical methods of analysis. A unit of SRM 663 is in the form of a rod 3.2 mm (1/8 in) in diameter and 51 mm (2 in) long.

The certified values for selected elements are listed in Table 1; information values for 18 additional elements are listed in Table 3. For all elements, values are reported as mass fractions [1]. The uncertainties for all elements, with the exception of boron, reflect the guidance given in NBS Monograph 148 [2]. The uncertainty for boron is assessed according to the ISO/JCGM Guide [3].

Certified Values and Uncertainties: All elements in Table 1 were measured at NIST and the cooperating laboratories using a variety of chemical methods. The certified values and uncertainties for these elements are the present best estimates of the true values based on the results of the cooperative analytical program. The measurand is the mass fractions for the elements listed. The certified value is metrologically traceable to the SI unit of mass, expressed as a percent.

Table 1. Certified Values for SRM 663

Element	Composition mass fraction (in %)			Element	Composition mass fraction (in %)		
Aluminum (total)	0.24	±	0.01	Molybdenum	0.030	±	0.001
Antimony	0.002	±	0.001	Nickel	0.32	±	0.01
Arsenic	0.010	±	0.001	Niobium	0.049	±	0.001
Carbon	0.57	±	0.01	Phosphorus	0.029	±	0.005
Chromium	1.31	±	0.01	Silicon	0.74	±	0.01
Cobalt	0.048	±	0.001	Sulfur	0.0055	±	0.0001
Copper	0.098	±	0.005	Titanium	0.050	±	0.001
Gold	0.0005	±	0.0001	Tungsten	0.046	±	0.005
Lanthanum	0.0006	±	0.0001	Vanadium	0.31	±	0.01
Lead	0.0022	±	0.0001	Zirconium	0.050	±	0.001
Manganese	1.50	±	0.01				

Expiration of Certification: The certification of **SRM 663** is valid indefinitely, within the measurement uncertainty specified. Periodic recertification of this SRM is not required. The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification, NIST will notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

Overall direction and coordination of the original technical measurements leading to certification were performed under the direction of K.F.J. Heinrich, O. Menis, B.F. Scribner, J.I. Shultz, and J.L. Weber, Jr., of what is now the NIST Chemical Sciences Division. Coordination of the boron measurements leading to the reference value was performed by R.R. Greenberg of what is now the NIST Chemical Sciences Division.

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Robert L. Watters, Jr., Director
Office of Reference Materials

Original chemical analyses were performed by R. Alvarez, J.R. Baldwin, D.A. Becker, R.K. Bell, R.W. Burke, B.S. Carpenter, E.L. Garner, T.E. Gills, G.J. Lutz, L.A. Machlan, E.J. Maienthal, J. McKay, L.J. Moore, C.W. Mueller, T.J. Murphy, P.J. Paulsen, T.C. Rains, S.D. Rasberry, T.A. Rush, K.M. Sappenfield, B.A. Thompson, S.A. Wicks, and J. Wing of what is now the NIST Chemical Sciences Division. Prompt gamma neutron activation analyses were performed by R.M. Lindstrom of what is now the NIST Chemical Sciences Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Office of Reference Materials.

Reference Value and Uncertainty: The reference value for boron in provided Table 2. A NIST reference value is a noncertified value that is the best estimate of the true value based on available data; however, the value does not meet the NIST criteria for certification [2] and is provided with associated uncertainties that may reflect only measurement reproducibility, may not include all sources of uncertainty, or may reflect a lack of sufficient statistical agreement among multiple analytical methods. The value is report in mass fraction units [1] and the uncertainty for assessed according to the ISO/JCGM Guide [4].

Table 2. Reference Value for Boron in SRM 663

Reference Value of Boron:	11.80 mg/kg ± 0.31 mg/kg

The measurand is the value for boron as determined by thermal prompt gamma activation analysis at NIST. The reference value is metrologically traceable to the SI unit of mass, expressed as milligrams per kilogram. The expanded uncertainty for boron is calculated as $U = ku_c$, where u_c is intended to represent, at the level of one standard deviation, the combined effect of uncertainty components associated with the measurements and with element inhomogeneity. The coverage factor, $k = 2$, is determined from the Student's t-distribution with 4.6 degrees of freedom and corresponds to an approximate 95 % confidence interval.

Information Concentration Values: Information values for additional elements are listed in Table 3. An information value is considered to be a value that will be of use to the SRM user, but insufficient information is available to assess the uncertainty associated with the value or only a limited number of analyses were performed [2]. Information values cannot be used to establish metrological traceability.

Table 3. Information Values from a Single Method of Analysis for SRM 663

Element	Mass Fraction (%)	Element	Mass Fraction (%)
Bismuth	0.0008	Nitrogen	0.0041
Calcium	< 0.0001	Oxygen	0.0007
Cerium	0.0016	Praseodymium	0.00018
Germanium	0.010[(a)]	Selenium	0.0001[(a)]
Hafnium	0.0015[(a)]	Silver	0.0038
Hydrogen	< 0.0005[(a)]	Tantalum	0.053
Iron (by difference)	94.4	Tellurium	0.0022
Magnesium	0.0005	Tin	0.095
Neodymium	0.0007	Zinc	0.0004

[(a)]Approximate value from heat analysis.

PREPARATION, TESTING, AND ANALYSIS

The material for this standard was vacuum melted and cast, by the Carpenter Technology Corporation, Reading, PA, to provide material of the highest possible homogeneity. Following acceptance of the material, selected portions of the ingots were extensively tested for homogeneity by J.L. Weber, Jr., of the NIST Electromagnetics Division and J.R. Baldwin, D.M. Bouchette, and S.D. Rasberry formerly of NIST. Certification analyses were made on composite samples representative of the accepted lot of material.

REFERENCES

[1] Thompson, A.; Taylor, B.N.; *Guide for the Use of the International System of Units* (*SI*)*;* NIST Special Publication 811, U.S. Government Printing Office, Washington, DC (2008); available at http://www.physics.nist.gov/Pubs (accessed July 2015).

[2] May, W.; Parris, R.; Beck II, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G.; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definitions of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements*; NIST Special Publication 260-136; U.S. Government Printing Office: Washington, DC (2000); available at: http://www.nist.gov/srm/publications.cfm (accessed July 2015).

[3] Cali, J.P. et al; *The Role of Standard Reference Materials in Measurement Systems*; NBS Monograph 148, p. 21 (1975).

[4] JCGM 100:2008; *Evaluation of Measurement Data - Guide to the Expression of Uncertainty in Measurement*; (GUM 1995 with Minor Corrections), Joint Committee for Guides in Metrology (JCGM) (2008); available at http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed July 2015); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297, U.S. Government Printing Office: Washington, DC (1994); available at http://www.nist.gov/pml/pubs/index.cfm (accessed July 2015).

Certificate Revision History: 30 July 2015 (Change of expiration date; correction of typographical error in molybdenum value; editorial changes); 29 May 2001 (This revision reflects changes in the boron value and editorial changes); 25 December 1991 (This revision reflects editorial changes); 01 October 1981 (This revision reflects changes in the antimony, sulfur, tungsten, and zirconium values); 12 February 1973 (This revised provisional certificate reflects changes in the carbon value); 15 August 1972 (This revised provisional certificate reflects changes in the cerium, nitrogen, oxygen, tantalum, and tin information values, and the addition of two certified elements and two information values); 15 October 1970 (Originally issued as a provisional certificate).

Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.