



# National Institute of Standards & Technology

## Certificate of Analysis

### Standard Reference Material<sup>®</sup> 663

#### Chromium-Vanadium Steel (Modified)

This Standard Reference Material (SRM) is intended primarily for use in chemical methods of analysis. 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 22 elements are listed in Table 1; information values for 18 additional elements are listed in Table 2. 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 Guide [3].

Table 1. Certified Values for SRM 663

Element	Composition mass fraction (in %)			Element	Composition mass fraction (in %)		
Aluminum (total)	0.24	±	0.01	Molybdenum	0.30	±	0.01
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				

**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.

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

**Reference Value and Uncertainty:** The reference value for boron was determined by thermal prompt gamma activation analysis at NIST. 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. A reference value is a noncertified value that is the best estimate of the true value; however, the value does not meet NIST criteria for certification and is provided with an associated uncertainty that may reflect only measurement precision and may not include all sources of uncertainty.

**Expiration of Certification:** The certification of SRM 663 is valid, within the measurement uncertainties specified, until **30 April 2016**. This certification is nullified if the SRM is damaged, contaminated, or modified in any way other than its intended use.

The technical and support aspects involved in the original preparation, certification, and issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by R.E. Michaelis. Revision of this certificate was coordinated through the NIST Standard Reference Materials Program by C.R. Beauchamp.

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Certificate Issue Date: 29 May 2001  
*See Certificate Revision History on Last Page*

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Table 2. Information Values From a Single Method of Analysis For SRM 663

Element	Composition mass fraction (in %)	Element	Composition mass fraction (in %)
Bismuth	0.0008	Nitrogen	0.0041
Calcium	< 0.0001	Oxygen	0.0007
Cerium	0.0016	Praseodymium	0.00018
Germanium	0.010 <sup>a</sup>	Selenium	0.0001 <sup>a</sup>
Hafnium	0.0015 <sup>a</sup>	Silver	0.0038
Hydrogen	< 0.0005 <sup>a</sup>	Tantalum	0.053
Iron (by difference)	94.4	Tellurium	0.0022
Magnesium	0.0005	Tin	0.095
Neodymium	0.0007	Zinc	0.0004

<sup>a</sup> Approximate value from heat analysis

The 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 the NIST Analytical Chemistry Division. Coordination of the boron measurements leading to the reference value was performed by R.R. Greenberg of the NIST Analytical Chemistry Division.

The 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 the NIST Inorganic Analytical Research Division. Prompt gamma neutron activation analyses were performed by R.M. Lindstrom of the NIST Analytical Chemistry Division.

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#### PREPARATION, TESTING, AND ANALYSIS

The material for this standard was vacuum melted and cast, under contract, by the Carpenter Technology Corporation, Reading, PA, to provide material of the highest possible homogeneity. The contract was made possible by a grant from the American Iron and Steel Institute (AISI). Following acceptance of the material, selected portions of the ingots were extensively tested for homogeneity by J.R. Baldwin, D.M. Bouchette, S.D. Rasberry, and J.L. Weber, Jr., of the NIST Inorganic Analytical Research Division. Certification analyses were made on composite samples representative of the accepted lot of material.

#### REFERENCES

- [1] Taylor, B.N., "Guide for the Use of the International System of Units (SI)," NIST Special Publication 811, 1995 Ed., (April 1995).
- [2] Cali, J.P. et al, "The Role of Standard Reference Materials in Measurement Systems," NBS Monograph 148, p. 21, (1975).
- [3] *Guide to the Expression of Uncertainty of Measurement*, ISBN 92-67-10188-9, 1<sup>st</sup> Ed., ISO, Geneva, Switzerland, (1993); see also Taylor, B.N. and 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://physics.nist.gov/Pubs/>.

**Certificate Revision History:** 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 in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-6776; fax (301) 926-4751; e-mail [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet <http://www.nist.gov/srm>.*