National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1762a

Low Alloy Steel

This Standard Reference Material (SRM) is a low alloy steel. This SRM is intended for use in the evaluation of chemical and instrumental methods of analysis and in calibration of analyses. A unit of SRM 1762a consists of a disk approximately 34 mm in diameter and 19 mm thick.

Certified Mass Fraction Values: Certified mass fraction values for SRM 1762a are reported in Table 1. For all elements, values are reported as mass fractions [1]. Value assignment categories are based on the definition of terms and modes used at NIST for chemical reference materials [2]. A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account. A certified value is the present best estimate of the "true" value based on the results of analyses performed at NIST and collaborating laboratories.

Information Mass Fraction Values: Information mass fraction values are reported in Table 2. An information value is considered to be a value that will be of interest to the SRM user, but insufficient information is available to assess the uncertainty associated with the value. Information values cannot be used to establish metrological traceability.

Expiration of Certification: The certification of **SRM 1762a** is valid indefinitely, within the uncertainty specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Use"). 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.

Coordination of the technical measurements for certification of this SRM was performed by J.R. Sieber of the NIST Chemical Sciences Division.

Analyses leading to certification of this SRM were performed by J.R. Sieber and A.F. Marlow of the NIST Chemical Sciences Division. Additional measurements were made by L. Dilks, Laboratory Testing, Inc., Hatfield, PA and W. Souronis and K.L. Aumend, ArcelorMittal, East Chicago, IN.

Measurements of the original SRM 1762 were made at NIST by D.E. Brown, R.W. Burke, L.-T. Chen, L.E. Creasy, J.W. Gramlich, W.R. Kelly, W.F. Koch, A.F. Marlow, J.A. Norris, P.A. Pella, M.V. Smith, T.W. Vetter, and F.Z. Xu of the former NIST Inorganic Analytical Research Division. Measurements of SRM 1762 were also made by the collaborating laboratories listed in Appendix A.

Statistical consultation was provided by J.H. Yen of the NIST Statistical Engineering Division.

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

Carlos A. Gonzalez, Chief
Chemical Sciences Division

Gaithersburg, MD 20899
Certificate Issue Date: 13 May 2015
Certificate Revision History on Page 3

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

INSTRUCTIONS FOR USE

The test surface is the side opposite from the surface labeled with the SRM number. The entire thickness of the unit is certified. However, the user is cautioned not to measure disks less than 2 mm thick. Each packaged disk has been prepared by finishing the test surface using a milling machine. The user must determine the correct surface preparation procedure for each analytical technique. The user is cautioned to use care when either resurfacing the disk or performing additional polishing as these processes may contaminate the surface. Abrasive paper must be changed frequently during surface grinding. Used paper loses its ability to remove contaminants from the surface of the steel. When not in use, the material should be stored in its original container in a cool, dry location. This material was tested using both the solid disks and chips prepared from the disks.

PREPARATION AND ANALYSIS[1]

The material for SRM 1762 and SRM 1762a was vacuum induction melted followed by vacuum arc re-melting at the Carpenter Technology Corporation, Reading, PA. The ingots were processed by Carpenter Technology to provide a material of high homogeneity. The materials for both SRM 1762 and SRM 1762a came from the same batch of steel prepared in 1989. The value assignments for SRM 1762a are based on comparison of this SRM with the original SRM 1762. The two lots were shown to be indistinguishable for most elements. The test methods employed in value assignment are listed in the appendix to this certificate.

Certified Mass Fraction Values: The measurands are the mass fractions of the elements in Table 1. The certified values are metrologically traceable to the SI unit of mass, expressed as a percent. The values in Table 1, except for Mn, were obtained from a high-precision comparison of SRM 1762 and SRM 1762a. The uncertainty of a certified value is expressed as an expanded uncertainty, U, and is calculated according to the method described in the ISO/JCGM Guide [3]. The expanded uncertainty is calculated as $U = ku_c$, where u_c is calculated, at the level of one standard deviation, by combining a between-method variance, a pooled, within-method variance, and a variance representing the uncertainty of the comparison of SRM 1762 and SRM 1762a. The coverage factor, $k = 2$, was chosen to approximate a 95 % confidence level [4]. The value for Mn is the mean of results from three test methods. The expanded uncertainty for Mn incorporates observed differences among the methods, their respective uncertainties and a component for possible inhomogeneity, in a manner consistent with the ISO/JCGM Guide and with its Supplement 1 [3–6].

Table 1. Certified Mass Fraction Values for SRM 1762a

Constituent	Mass Fraction (%)		
Aluminum (Al)	0.0706	±	0.0089
Arsenic (As)	0.0173	±	0.0030
Boron (B)	0.0042	±	0.0012
Carbon (C)	0.341	±	0.039
Cobalt (Co)	0.0616	±	0.0037
Chromium (Cr)	0.923	±	0.019
Copper (Cu)	0.1186	±	0.0019
Manganese (Mn)	1.912	±	0.047
Molybdenum (Mo)	0.353	±	0.015
Niobium (Nb)	0.0692	±	0.0054
Nickel (Ni)	1.156	±	0.031
Phosphorus (P)	0.0346	±	0.0018
Sulfur (S)	0.0295	±	0.0014
Silicon (Si)	0.351	±	0.012
Tin (Sn)	0.0479	±	0.0030
Tantalum (Ta)	0.0203	±	0.0024
Titanium (Ti)	0.0952	±	0.0063
Vanadium (V)	0.2010	±	0.0039
Zirconium (Zr)	0.0285	±	0.0045

[1] Certain commercial equipment, instruments or materials are identified in this certificate to adequately specify the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Information Mass Fraction Values: The values in Table 2 are intended to provide additional information on the composition of SRM 1762a.

Table 2. Information Mass Fraction Values for SRM 1762a

Constituent	Mass Fraction (%)
Iron (Fe)	94.2
Nitrogen (N)	0.002

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://physics.nist.gov/cuu/pdf/sp811.pdf (accessed May 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.; *Definition 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/upload/SP260-136.PDF (accessed May 2015).

[3] 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 May 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 May 2015).

[4] JCGM 101:2008; *Evaluation of Measurement Data – Supplement 1 to the "Guide to the Expression of Uncertainty in Measurement" - Propagation of Distributions using a Monte Carlo Method*; JCGM (2008); available at http://www.bipm.org/utils/common/documents/jcgm/JCGM_101_2008_E.pdf (accessed May 2015).

[5] Efron, B.; Tibshirani, R.J.; *An Introduction to the Bootstrap*; Chapman & Hall, London, UK (1993).

[6] Searle, S., Casella, G, McCulloch, C., *Variance Components*; John Wiley, Hoboken, NJ (1992).

Certificate Revision History: 13 May 2015 (Correction of name for element Sn; editorial changes); 02 February 2015 (Change of manganese value and uncertainty; editorial changes); 09 September 2009 (Original certificate date).

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.

APPENDIX A

In 1989, the overall coordination of the technical measurements leading to certification of SRM 1762 was performed under the direction of J.I. Shultz, Research Associate (retired), ASTM/NIST Research Associate Program. The following laboratories performed analyses leading to certification.

Collaborating Laboratories

Analytical determinations for certification of the original SRM 1762 were performed by the following laboratories:

Amax Research and Development Center, Golden, CO; R. C. Binns

American Cast Iron Pipe Company, Birmingham, AL; R.N. Smith, D.R. Denney, C.E. Meads, R.J. Huffman; J.M. Hudson, and R.G. Moffett

ARMCO Research and Technology, Middletown, OH; C.C. Borland, M.D. Kaehler, J.W. Leeker, T.M. Minor, G.D. Smith, R.L. Swigert, H. P. Vail, S.B. Warman, and B.J. Young

Carpenter Technology Corporation, Carpenter Steel Division, Reading, PA; T.R. Dulski

The Timken Company, Canton, OH; N.J. Stecyk, D. Gapen, G. Hanni, L. McFarland, and M. Moffat

Data for nitrogen was provided by AISI Technical Committee on Chemical Analysis courtesy of ARMCO Research and Technology, Middletown, OH; D.E. Gillum

Test Methods Employed at NIST and the Collaborating Laboratories

Atomic absorption spectrophotometry (AAS):	Al, Ti, Cr, V, Co, Ni, Cu, As, Zr, Mo, Sn
Combustion with infrared detection (IR):	C, N, S
Direct current plasma optical emission spectrometry (DCP-OES):	B, Ti, Co, Zr, Nb, Mo, Sn
Gravimetry:	C, Si, P, Ni
Inductively coupled plasma optical emission spectrometry (ICP-OES):	B, Al, P, Ti, Cr, V, Co, Ni, Cu, As, Zr, Nb, Mo, Sn, Ta
Isotope dilution mass spectrometry (ID-MS):	S
Spectrophotometry:	B, P, Ti, Cr, Cu, Mo
Spark source optical emission spectrometry (SS-OES):	B, C, Al, Si, P, S, Ti, Cr, V, Mn, Co, Ni, Cu, As, Zr, Nb, Mo, Sn, Ta
Titrimetry:	P, S, Cr, Mn, Ni
X-ray fluorescence spectrometry (XRF):	Al, Si, P, S, Ti, V, Cr, Mn, Co, Ni, Cu, As, Zr, Nb, Mo, Sn, Ta