National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material 1764

Low Alloy Steel

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

This Standard Reference Material (SRM) is in the form of a disk, approximately 34 mm (1 3/8 in) in diameter and 19 mm (3/4 in) thick, and is intended for use in optical emission and X-ray spectrometric methods of analysis.

Element	Certified Value[1] % by Wt.	Estimated[2] Uncertainty
Carbon	0.592	0.006
Manganese	1.21	0.02
Phosphorus	0.020	0.001
Sulfur	0.012	0.001
Silicon	0.057	0.002
Copper	0.51	0.01
Nickel	0.202	0.004
Chromium	1.48	0.02
Vanadium	0.106	0.003
Molybdenum	0.200	0.006
Titanium	0.028	0.002
Arsenic	0.010	0.002
Aluminum (total)	0.009	0.002
Niobium	0.042	0.004
Tantalum	0.029	0.001
Zirconium	0.0015	0.0005
Boron	0.0010	0.0001
Nitrogen	0.0023	0.0004

[1]The certified value listed for a constituent is the present best estimate of the "true" value based on the results of the cooperative program for certification.

[2]The estimated uncertainty listed for a constituent represents an evaluation of the combined effects of method imprecision, possible systematic errors among methods, and material variability and is based on judgment. No attempt is made to derive exact statistical measures of imprecision because several methods were used in the determination of most constituents

The overall coordination of the technical measurements leading to certification was performed under the direction of J.I. Shultz, Research Associate, ASTM/NIST Research Associate Program.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Standard Reference Materials Program by P.A. Lundberg.

Gaithersburg, MD 20899
February 26, 1993
(Revision of certificate dated 6-5-89)

William P. Reed, Chief
Standard Reference Materials Program

(over)

SUPPLEMENTAL INFORMATION

Atomic emission and X-ray spectrometric homogeneity test results showed the following standard deviations of the mean (1 σ) for this SRM. Values are given in percent. These standard deviations are attributed to both material and instrumental variability and are method specific.

Standard Deviation of the Mean

Element	Atomic Emission[3]	X-ray[4]
Carbon	0.0056	---
Manganese	0.012	0.0023
Phosphorus	0.0008	0.0016
Sulfur	0.0003	0.0004
Silicon	0.0012	0.0021
Copper	0.0056	0.0017
Nickel	0.0024	0.0015
Chromium	0.013	0.0003
Vanadium	0.0024	0.0004
Molybdenum	0.0022	0.0007
Titanium	0.0008	0.0002
Arsenic	0.0029	---
Aluminum	0.0005	0.0002
Niobium	0.0014	0.0007
Tantalum	0.0054	---
Zirconium	0.0003	---
Boron	0.0001	---
Cobalt	0.0005	0.0015
Tin	0.0035	---

[3]ASTM Method E415-85.
[4]ASTM Method E322-67 (1985).

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.

Element	Concentration, % by Wt.
Cobalt	(0.01)
Tin	(0.02)
Iron	(95.2)

PLANNING, PREPARATION, TESTING, ANALYSIS

The material for this standard was vacuum induction melted followed by vacuum arc remelting at the Carpenter Technology Corporation, Reading, PA, under a contract with NIST. The ingots were processed by Carpenter Technology Corporation to provide material of high homogeneity.

Following acceptance of the composition based on analyses at NIST, selected portions of the ingot material were extensively tested for homogeneity at NIST by J.A. Norris and D.E. Brown. Only that material meeting a critical evaluation was processed to the final size. The final material was tested for homogeneity by atomic emission and X-ray spectrometry at NIST.

Cooperative analyses for certification were performed in the following laboratories:

Amax Research & Development Center, Golden, CO, R.C. Birns.

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 & 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.

National Institute of Standards & Technology, Inorganic Analytical Research Division, R.W. Burke, L.E. Creasy, W.F. Koch, A.F. Marlow, P.A. Pella, M.V. Smith, T.W. Vetter, Xie Guirong, and Xu Fu Zheng.

The Timken Company, Canton, OH, N.J. Stecyk.

Central Bureau for Nuclear Measurements, Geel, Belgium, A. Lamberty, L. Van Nevel, and P. DeBievre.

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

The following laboratories participated in the testing program:

Acme Steel Company, Riverdale, IL, V. Beaucaire, D. Bekeza.

Algoma Steel Corporation, Sault Ste. Marie, Ontario, Canada, J. DeJong, J. Gale.

Armco Research & Technology, Middletown, OH, D.E. Gillum, T. Minor.

Armco Steel Company, Ashland, KY, R. Peterson, G. Richardson, E. Connelly, T. Scherer.

Bethlehem Steel Corporation, Steelton, PA, D. Vares.

Lukens Steel, Coatesville, PA, J. Morris, S. Forese.

Mc Louth Steel, Trenton, MI, M. Wiers, D. Robillard.

Inland Steel, East Chicago, IN, R. Hawkins.

Wheeling-Pittsburgh Steel, Steubenville, OH, B. Fazio, G. Wayt.

Dofasco Steel, Hamilton, Ontario, Canada, R. Dalrymple, K. Barker.