National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1158

High-Nickel Steel (36 % Ni)

This Standard Reference Material (SRM) is intended for applications in optical emission and X-ray fluorescence spectrometric methods of analysis. A unit of SRM 1158 is in the form of an annealed solid disk 3.2 cm × 1.9 cm. This material is also available in chip form as SRM 126c for use in chemical methods of analysis.

Certified Values: Certified values for four constituents in SRM 1158 are provided in Table 1. All values are reported as mass fractions [1]. The uncertainty listed with the value is an expanded uncertainty, $U = ku_c$, based on a 95 % confidence level [2] and is calculated according to the method in the ISO Guide [3]. 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 [4]. A certified value is the present best estimate of the "true" value based on the results of analyses performed at NIST and collaborating laboratories. Test methods used to determine these elements are identified in the Appendix and the accompanying key.

Reference Values: Reference values for six constituents are provided in Table 2. Reference values are non-certified values that are the present best estimates of the true values; however, the values do not meet the NIST criteria for certification and are provided with associated uncertainties that may not include all components of uncertainty [4]. The uncertainty listed with the value is an expanded uncertainty based on a 95 % confidence level [4] and is calculated according to the method in the ISO Guide [3].

Information Values: An information value for vanadium is given in Table 3. 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. It is intended to provide additional information on the matrix.

Expiration of Certification: The certification of **SRM 1158** 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"). 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) will facilitate notification.

The original characterization of this material was performed in 1972 under the direction of O. Menis and J.I. Shultz of the National Bureau of Standards (NBS, now NIST). Homogeneity testing was performed by J.L. Weber, Jr. at NBS.

Review and revision of value assignments was performed by J.R. Sieber and W.R. Kelly of the NIST Analytical Chemistry Division.

Statistical consultation for this SRM was provided by D.D. Leber of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

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Gaithersburg, MD 20899
Certificate Issue Date: 08 September 2009
See Certificate Revision History on Last Page

Robert L. Watters, Jr., Chief
Measurement Services Division

Analyses for certification were performed by the following: NBS: E.R. Deardorff, S.A. Wicks, and R.K. Bell; Allegheny Ludlum Industries, Inc. Research Center, Brackenridge, PA: R.B. Fricioni and M.A. McMahon; Universal-Cyclops Specialty Steel Division, Bridgeville, PA: R.C. Host and J. Kosek; Westinghouse Electric Corporation, Research and Development Center, Pittsburgh, PA: F.P. Byrne, H. Silva, and K.W. Guardipee; and Carpenter Technology Corporation, Research and Development Center, Reading, PA: A.L. Sloan.

INSTRUCTIONS FOR USE

The test surface is the side opposite to the surface labeled with the SRM number and the diamond-shaped NBS logo. The entire thickness of the unit is certified. 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. The material should be stored in its original container in a cool, dry location. This material was tested using both solid disks and chips prepared from the same material. The certified values are considered to be representative of the overall average composition of the material.

PREPARATION AND ANALYSIS[1]

For many metal SRMs it is desirable to make the material available in the form of chips primarily for chemical methods of analysis, and solids primarily for the optical emission and X-ray spectrochemical methods of analysis. Prior to the preparation of SRM 126c (chip form) plans were also made to provide this material in disk form as SRM 1158.

The high-nickel steel was vacuum melted and cast at Carpenter Technology, Reading, PA. Selected sections were rolled to rounds approximately 130 mm in diameter. At NBS these were lathe cut to a diameter of about 85 mm to provide chips for SRM 126c. The remaining cores were processed at Carpenter Technology Corporation to the final solid size by rolling, annealing, and centerless grinding for SRM 1158.

Certification analyses were performed using the methods provided in the appendix.

Table 1. Certified Values for SRM 1158 High-Nickel Steel

Constituent	Mass Fraction (%)	Expanded Uncertainty (Mass Fraction, %)	Coverage Factor, *k*
C	0.02540	0.00068	2.8
Mn	0.4684	0.0073	2.8
Ni	36.054	0.029	2.8
Si	0.1936	0.0034	2.8

Table 2. Reference Values for SRM 1158 High-Nickel Steel

Constituent	Mass Fraction (%)	Expanded Uncertainty (Mass Fraction, %)	Coverage Factor, *k*
Co	0.0080	0.0023	3.2
Cr	0.0625	0.0078	3.2
Cu	0.0396	0.0018	3.2
Mo	0.0110	0.0018	3.2
P	0.00350	0.00092	3.2
S	0.0050	0.0015	2.8

[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.

Table 3. Information Values for SRM 1158 High-Nickel Steel

Constituent	Mass Fraction (%)
V	0.001

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/Pubs/.

[2] May, W. E.; Parris, R. M.; B*eck II, C. M.; Fassett, J. D.; Greenberg, R. R.; Guenther, F. R.; Kramer, G. W.; Wise, S. A.; Gills, T. E.; Colbert, J.* C.; Gettings, R. J.; MacDonald, B. S.; Definitions of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements; NIST Spec. Pub. 260-136, U.S. Government Printing Office, Washington, DC, p. 16 (2000); available at http://www.cstl.nist.gov/nist839/NIST_special_publications.htm.

[3] JCGM 100:2008; *Guide to the Expression of Uncertainty in Measurement;* (ISO GUM 1995 with Minor Corrections), Joint Committee for Guides in Metrology: BIPM, Sevres Cedex, France (2008); available at http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf; 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.physics.nist.gov/Pubs/contents.html.

[4] Hahn, G.J.; Meeker, W.Q.; *Statistical Intervals: A Guide for Practitioners*; John Wiley & Sons, Inc., New York (1991).

Certificate Revision History: 08 September 2009 (This revision reports revised assignments and values for all constituents based on re-evaluation of the original analytical results and updates the entire certificate to current NIST standards); 30 December 1977 (Revision); 13 December 1972 (Original certificate date).

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) 975-2200; fax (301) 926-4751, email srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.

Appendix. Analytical Methods

Element	Methods*
C	21
Co	5, 18
Cr	5, 13, 20
Cu	5, 11, 16, 19
Mn	1, 5, 15
Mo	22
Ni	4, 8, 12
P	6
S	2, 7, 10
Si	3
V	9, 14, 17

*Key to Methods:

1. Potentiometric titration
2. Combustion in oxygen at 1450 °C and SO_2 titration with standard KIO_3
3. Double dehydration with intervening filtration
4. 0.25 g sample and double precipitation; precipitate dried at 150 °C
5. Atomic absorption spectrometry
6. Ammonium phosphovanadate photometric method
7. Combustion-spectrophotometric using pararosanaline
8. Finished by electrolysis
9. Hg cathode separation 3,3′-diaminobenzidine hydrochloride photometric method
10. 1 g sample combusted in oxygen and SO_2 measured by infrared detection
11. Diethyldithiocarbamate photometric method
12. Dimethylglyoxime precipitate titrated with cyanide
13. Diphenylcarbazide photometric method
14. Nitric acid oxidation, potentiometric titration with standard ferrous ammonium sulfate
15. Periodate spectrophotometric method
16. Neo-cuproine spectrophotometric method
17. 3,3′-dimethylnaphthidine spectrophotometric method
18. Ion-exchange-nitroso R spectrophotometric method
19. 2,2′-biquinoline spectrophotmetric method
20. Persulfate oxidation, potentiometric titration with standard ferrous ammonium sulfate
21. Combustion chromatographic method
22. Photometric method