National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 166c

Low-Carbon Stainless Steel (AISI 316L)
(chip form)

This Standard Reference Material (SRM) is intended primarily for use in validation of chemical and instrumental methods of analysis. A unit of SRM 166c consists of a bottle containing approximately 100 g of chips sized between 710 μm (25 mesh) and 75 μm (200 mesh).

Certified Values: The certified value for carbon is given in Table 1. The value is reported as a mass fraction [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 JCGM 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 for the carbon determinations and the analysts and laboratories and their data are listed in Table 2 and identified in the two accompanying keys. The certified value is the measurand and is metrologically traceable to the SI derived unit of mass fraction expressed as percent (%).

Table 1. Certified Value for Carbon in SRM 166c Low Carbon Stainless Steel

Constituent	Mass Fraction (%)	Expanded Uncertainty (%)	Coverage Factor, *k*
Carbon (C)	0.00781	0.00013	2.36

Expiration of Certification: The certification of **SRM 166c** 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.

The original characterization of this material was performed in 1970 under the direction of O. Menis and J.I. Shultz of the National Bureau of Standards (NBS, now NIST).

Review and revision of value assignments was performed by J.R. Sieber and W.R. Kelly of the NIST Chemical Sciences 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 Office of Reference Materials.

Carlos A. Gonzalez, Chief
Chemical Sciences Division

Gaithersburg, MD 20899
Certificate Issue Date: 31 July 2017
Certificate Revision History on Last Page

Steven J. Choquette, Director
Office of Reference Materials

INSTRUCTIONS FOR USE

To relate analytical determinations to the certified values on this Certificate of Analysis, a minimum test portion size of 200 mg is recommended. The material should be stored in its original container in a cool, dry location.

PREPARATION AND ANALYSIS[1]

The material for this standard was prepared in powder form by water atomization at the Hoeganaes Corporation, (Riverton, NJ). Certification analyses were performed using the methods noted in Table 2.

Table 2. Laboratories and Analytical Methods used for the Carbon Determination

Laboratory[a] and Analysts	Methods[b]	Reported Carbon Value (%)
1	1, 2	0.0077
2	1, 3	0.0078
3	1, 4	0.0078
4	1, 5	0.0076
5	6, 7	0.0079
6	1, 8	0.0081
7	1, 9	0.0077
7	10	0.0079

[a]Key to Laboratory and Analysts in Table 2:

1. NBS: J.R. Baldwin and S.A. Wicks
2. Globe Metallurgical, Division of the Interlake Steel Corporation, Beverly, OH: J.C. Cline
3. Armco Steel Corporation, Middletown, OH: M. Dannis, P. Wombold, and L.C. Bartels
4. Allegheny Ludlum Steel Corporation, Brackenridge, PA: R.B. Fricioni
5. United States Steel Corporation Applied Research Laboratory, Monroeville, PA: L. Melnick, J. Martin, R.C. Takacs, and R.N. Kaminsky
6. Laboratory Equipment Corporation (LECO), St. Joseph, MI: G. Helling
7. Westinghouse Electric Corporation Research and Development Center, Pittsburgh, PA: F.P. Byrne

[b]Key to Methods in Table 2:

1. Chromatographic – 1 g sample combusted by induction heating
2. Chromatographic – Calibration based on SRM 166b
3. Chromatographic – Calibration based on SRM 131a and 166b
4. Chromatographic – Calibration based on SRM 55e, SRM 131b, and SRM 335
5. Chromatographic – Calibration based on SRM 55e
6. Chromatographic – 0.5 g sample combusted by resistance heating
7. Chromatographic – Calibration based on SRM 131b and by CO_2 introduced by syringe
8. Chromatographic – Calibration based on SRM 55e and German Standard 8a
9. Chromatographic – Calibration based on SRMs 55e and 131b
10. Gravimetric – 0.5 g sample combusted by resistance heating

[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.

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 https://www.nist.gov/physical-measurement-laboratory/special-publication-811 (accessed July 2017).

[2] May, W.E.; Parris, R.M.; Beck 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, (2000); available at https://www.nist.gov/sites/default/files/documents/srm/SP260-136.PDF (accessed July 2017).

[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 July 2017); 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 2017).

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

Certificate Revision History: 31 July 2017 (Update title; editorial changes); 18 December 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); 17 March 1970 (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 at: telephone (301) 975-2200; fax (301) 948-3730, email srminfo@nist.gov; or via the Internet at http:/www.nist.gov/srm.