National Institute of Standards & Technology

# Certificate of Analysis

## Standard Reference Material® 126c

### High-Nickel Steel
(Nominal Mass Fraction 36 % Ni)
(chip form)

This Standard Reference Material (SRM) is intended primarily for use in validation of chemical and instrumental methods of analysis used to determine elements in steel alloys. It can be used to validate value assignment of in-house reference materials. A unit of SRM 126c consists of a bottle containing approximately 150 g of chips.

**Certified Mass Fraction Values:** Certified values for constituents in SRM 126c are provided in Table 1. All values are reported as mass fractions in steel [1]. 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 taken into account [2]. A certified value is the present best estimate of the "true" value. The certified values are the measurands and are metrologically traceable to the SI derived unit of mass fraction expressed as percent (%). The uncertainty listed with each value is an expanded uncertainty, $U = ku_c$, based on a 95 % confidence level [3] and is calculated according to the method in the JCGM Guide [4].

Table 1. Certified Values for SRM 126c High-Nickel Steel

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

**Expiration of Certification:** The certification of **SRM 126c** 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.

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). 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.

Carlos A. Gonzalez, Chief
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Gaithersburg, MD 20899
Certificate Issue Date: 22 June 2017
*Certificate Revision History on Page 3*

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 sample quantity of 200 mg is recommended.

## PREPARATION AND ANALYSIS[(1)]

The high-nickel steel for SRM 126c was vacuum melted and cast at Carpenter Technology. Selected sections were rolled to rounds approximately 130 mm in diameter. At NIST these were lathe cut to a diameter of about 85 mm to provide chips for SRM 126c. The remaining rods were used to develop SRM 1158.

Analyses were performed by NIST and collaborating laboratories using the methods listed in the appendix. Analyses for certification were performed by the following: NIST: 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.

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

**ADDITIONAL CONSTITUENTS**: Noncertified values are provided for the following additional constituents in SRM 126c.

**Reference Mass Fraction Values:** Reference values for constituents in SRM 126c 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 that may reflect only measurement precision, may not include all sources of uncertainty, or may reflect a lack of sufficient statistical agreement among multiple analytical methods [2]. The uncertainty listed with the value is an expanded uncertainty based on a 95 % confidence level [3] and is calculated according to the method in the JCGM Guide [4]. The measurands are the concentrations of the constituents listed in Table 2 as determined by the methods indicated in the Appendix. Metrological traceability is the SI derived units for mass fraction, expressed as percent.

Table 2. Reference Values for SRM 126c High-Nickel Steel

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

**Information Mass Fraction Value:** An information value for vanadium is given in Table 3. An information value is a value that may be of interest to the SRM user, but insufficient information is available to assess the uncertainty associated with the value. Information values cannot be use to establish metrological traceability.

Table 3. Information Values for SRM 126c High-Nickel Steel

| Constituent | Mass Fraction (%) |
|---|---|
| Vanadium (V) | 0.001 |

[(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 June 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 June 2017)

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

[4] 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 June 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 June 2017).



**Certificate Revision History:** 22 June 2017 (Update title; editorial changes); 05 October 2009 (Corrected reference to Certificate Revision History on page 1); 08 September 2009 (Revised assignments and values for all constituents based on re-evaluation of the original analytical results and updated the entire certificate to current NIST standards); 30 December 1977 (Revision); 06 December 1972 (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.*

## 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