



# National Institute of Standards & Technology

## Certificate of Analysis

### Standard Reference Material<sup>®</sup> 16f

#### Basic Open-Hearth Steel, 1 % Carbon (chip form)

This Standard Reference Material (SRM) is intended primarily for use in evaluating chemical and instrumental methods of analysis. A unit of SRM 16f consists of a bottle containing approximately 150 g of chips sized between 0.50 mm and 1.18 mm sieve openings (35 mesh and 16 mesh).

**Certified Mass Fraction Values:** Certified mass fraction values are provided in Table 1 [1]. Value assignment categories are based on the definitions of terms and modes used at NIST for certification of 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.

**Expiration of Certification:** The certification of **SRM 16f** is valid indefinitely, within the measurement uncertainty specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Use"). Accordingly, periodic recalibration or 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 leading to certification was performed under the direction of J.I. Shultz, Research Associate, ASTM/NIST Research Associate Program. Additional technical and analytical support was provided by J.R. Sieber of the NIST Chemical Sciences Division.

Measurements for value assignment of SRM 16f were performed by B.I. Diamondstone of the NIST Chemical Sciences Division and by R.K. Bell, Assistant Research Associate, ASTM/NIST Research Associate Program. Analyses for certification were also performed by L. Dilks, Laboratory Testing Inc., Hatfield, PA; F.T. Kowalczyk, Bethlehem Steel Corp., Sparrows Point, MD; D.H. Craig, J. Pinner, and C. Holda, Ford Motor Co., Central Laboratory Services, Northville, MI; J.A. Crawley, Phoenix Steel Corp., Claymont, DE; and N.J. Williams, Sharon Steel Corp., Sharon, PA.

Stability testing was carried out August 2003 by Laboratory Testing Inc.; Hatfield, PA; L. Dilks

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

Steven J. Choquette, Director  
Office of Reference Materials

Gaithersburg, MD 20899  
Certificate Revision Date: 02 June 2017  
*Certificate Revision History on Last Page*

## 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. The millings do not require preparation prior to weighing and dissolution. The material should be stored in its original container in a cool, dry location.

## PLANNING, PREPARATION, TESTING, AND ANALYSIS<sup>(1)</sup>

The material for SRM 16f was provided by the U.S. Steel Corporation, Gary Works, Gary, IN.

Homogeneity testing was performed at NIST by B.I. Diamondstone and by R.K. Bell, Assistant Research Associate, ASTM/NIST Research Associate Program. Material variability was within the imprecision of the test methods.

**Certified Mass Fraction Values:** The certified values in Table 1 are the mass fractions of the elements in steel, expressed in percent, and are metrologically traceable to the SI unit of mass. The estimated uncertainty listed for a constituent is based on judgment and represents an evaluation of the combined effects of method imprecision, possible systematic errors among methods, and material variability. No attempt was made to derive exact statistical measures of imprecision because several methods were involved in the determination of most constituents.

Table 1. Certified Values for SRM 16f

Element	Mass Fraction %	Estimated Uncertainty
Carbon (C)	0.97	0.01
Chromium (Cr)	0.020	0.002
Cobalt (Co)	0.003	0.001
Copper (Cu)	0.006	0.001
Manganese (Mn)	0.404	0.009
Molybdenum (Mo)	0.003	0.001
Nickel (Ni)	0.008	0.002
Phosphorus (P)	0.014	0.003
Silicon (Si)	0.214	0.004
Sulfur (S)	0.026	0.001
Vanadium (V)	0.002	0.001

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<sup>(1)</sup> 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 <http://www.nist.gov/pml/pubs/sp811/index.cfm> (accessed May 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, p. 16 (2000); available at <http://www.nist.gov/srm/upload/SP260-136.PDF> (accessed May 2017).

**Certificate Revision History:** 02 June 2017 (Title update; editorial changes); 17 September 2014 (Extension of certification period; editorial changes) 30 April 2004 (This certificate has undergone revision to change the uncertainty for manganese following stability testing); 16 July 1993 (This Certificate of Analysis has undergone editorial revision to reflect program and organizational changes at NIST and at the Department of Commerce. No attempt was made to reevaluate the certificate values or any technical data presented on this certificate); 09 March 1983 (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, email [srminfo@nist.gov](mailto:srminfo@nist.gov); or via the Internet at <http://www.nist.gov/srm>.*