National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 345b

Fe-Cr-Ni Alloy UNS J92180
(chip form)

This Standard Reference Material (SRM) is intended primarily for use in validation of chemical and instrumental methods of analysis for elements in high temperature alloys and materials of a similar matrix. It can be used to validate value assignment of in-house reference materials. A unit of SRM 345b consists of a bottle containing 150 g of chips prepared from castings.

Certified Mass Fraction Value: The certified mass fraction values for constituents in SRM 345b are listed 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.

Reference Mass Fraction Values: The reference mass fraction values for constituents in SRM 345b are listed in Table 2. A reference value is a non-certified value that is the present best estimate of the true value; however, the values do not meet the NIST criteria for certification [2] and are provided with associated uncertainties that may reflect only measurement precision, not include all sources of uncertainty, or may reflect a lack of sufficient agreement among multiple analytical methods.

Information Mass Fraction Values: The information mass fraction values for SRM 345b are listed in Table 3. An information value is considered to be a value that will be of interest and use to the SRM user, but insufficient information is available to assess the uncertainty associated with the value. Information values cannot be used to establish metrological traceability.

Expiration of Certification: The certification of **SRM 345b** is valid indefinitely, within the measurement uncertainties specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Storage and 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 before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

Coordination of technical measurements for the certification of this SRM was performed by J.R. Sieber of the NIST Chemical Sciences Division.

Measurements for value assignment of SRM 345b were performed by A.F. Marlow and J.R. Sieber of the NIST Chemical Sciences Division. Additional measurements were performed by collaborating laboratories: E.R. Hagen, M. Cribbs, S. Heckman, and R. Starr (Alcoa Howmet, Whitehall, MI); G.P. Mann, D. Dietz, and B.M. Cardenas (Anderson Laboratories, Greendale, WI); and M. VanDyke (Cannon-Muskegon, Muskegon, MI).

Statistical consultation for this SRM was provided by J.H. Yen of the NIST Statistical Engineering Division.

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Certificate Issue Date: 13 July 2016

Steven J. Choquette, Acting Director
Office of Reference Materials

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

INSTRUCTIONS FOR STORAGE AND USE

To relate analytical determinations to the certified values on this Certificate of Analysis, a minimum sample quantity of 200 mg is recommended. Specimens may be used directly from the bottle without pre-treatment. The material should be stored in its original container in a cool, dry location.

NOTICE TO USERS

NIST strives to maintain the SRM inventory supply, but NIST cannot guarantee the continued or continuous supply of any specific SRM. Accordingly, NIST encourages the use of this SRM as a primary benchmark for the quality and accuracy of the user's in-house reference materials and working standards. As such, the SRM should be used to validate the more routinely used reference materials in a laboratory. Comparisons between the SRM and in-house reference materials or working measurement standards should take place at intervals appropriate to the conservation of the SRM and the stability of relevant in-house materials. For further guidance on how this approach can be implemented, contact NIST by email at srms@nist.gov.

PREPARATION AND ANALYSIS(1)

The material for this SRM was electric induction melted, argon oxygen decarburization refined, and continuous cast at Cannon-Muskegon Corporation (Muskegon, MI). The material was obtained as 225 kg of ingots approximately 7.5 cm diameter and 1.2 m long, which were cleaned and chipped at NIST using an end milling machine, followed by blending and bottling. Homogeneity testing was carried out at NIST by X-ray fluorescence spectrometry. The homogeneity within and among bars was found to be satisfactory for the constituents given in this certificate. Quantitative determinations were performed at NIST and collaborating laboratories using the test methods listed in Table 4.

Certified Mass Fraction Values: The certified mass fraction values for SRM 345b are listed in Table 1. Each measurand is the mass fraction of the element in the Fe-Ni-Cr alloy. Each certified value was calculated as the weighted mean of the means from the individual methods/laboratories. The uncertainty provided with each value is an expanded uncertainty about the weighted mean to cover the measurand with approximately 95 % confidence. The expanded uncertainty is calculated as $U = ku_c$, where the combined uncertainty u_c incorporates the observed difference between the results from the methods and their respective uncertainties, consistent with the ISO/JCGM Guide, and $k = 2$ is a coverage factor corresponding to approximately 95 % confidence [3–6]. Each certified mass fraction value in Table 1 is metrologically traceable to the derived SI unit for mass fraction expressed as percent (%).

Table 1. Certified Mass Fraction Values for SRM 345b Fe-Cr-Ni Alloy UNS J92180

Element	Mass Fraction (%)	Expanded Uncertainty (%)
Chromium (Cr)	16.03	0.13
Cobalt (Co)	0.0660	0.0037
Copper (Cu)	3.000	0.056
Manganese (Mn)	0.4902	0.0088
Molybdenum (Mo)	0.1541	0.0020
Nickel (Ni)	4.054	0.048
Niobium (Nb)	0.2143	0.0044
Phosphorus (P)	0.0176	0.0015
Silicon (Si)	0.7821	0.0075
Tin (Sn)	0.00568	0.00068
Tungsten (W)	0.0394	0.0081
Vanadium (V)	0.0662	0.0018

(1) Certain commercial equipment, instrumentation, 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.

Reference Mass Fraction Values: The reference mass fraction values for SRM 345b are listed in Table 2. Each measurand is the mass fraction of the element in the Fe-Ni-Cr alloy as determined by the methods indicated in Table 4. Each reference value was calculated as the weighted mean of the means from the individual methods/laboratories. The uncertainty provided with each value is an expanded uncertainty about the weighted mean to cover the measurand with approximately 95 % confidence. The expanded uncertainty is calculated as $U = ku_c$, where the combined uncertainty u_c incorporates the observed difference between the results from the methods and their respective uncertainties, consistent with the ISO/JCGM Guide, and $k = 2$ is a coverage factor corresponding to approximately 95 % confidence [3–6]. Each reference mass fraction value in Table 2 is metrologically traceable to the derived SI unit for mass fraction expressed as percent (%).

Table 2. Reference Mass Fraction Values for SRM 345b Fe-Cr-Ni Alloy UNS J92180

Element	Mass Fraction (%)	Expanded Uncertainty (%)
Aluminum (Al)	0.013	0.006
Arsenic (As)	0.0031	0.0008
Carbon (C)	0.043	0.003
Iron (Fe)	75.3	0.7
Lead (Pb)	0.002	0.001
Nitrogen (N)	0.013	0.002
Sulfur (S)	0.0008	0.0002
Titanium (Ti)	0.007	0.003

Information Mass Fraction Values: The information value for each analyte is an estimate obtained from one or more NIST or collaborator test methods. No uncertainty is provided because there is insufficient information available for its assessment.

Table 3. Information Mass Fraction Values for SRM 345b Fe-Cr-Ni Alloy UNS J92180

Element	Mass Fraction (%)
Antimony (Sb)	0.0008
Boron (B)	< 0.001
Oxygen (O)	0.014
Tantalum (Ta)	0.002
Zirconium (Zr)	< 0.001

Table 4. Analytical Methods Used for SRM 345b Fe-Cr-Ni Alloy UNS J92180

Element	Methods[(a)]	Element	Methods[(a)]
Al	1, 5	O	4
As	2, 5, 7	P	1, 2, 5
B	1, 2	Pb	1, 2, 5
C	1, 3	S	3
Co	1, 2, 5	Sb	7
Cr	1, 2, 5	Si	1, 2, 5
Cu	1, 2, 5, 6	Sn	1, 5, 7
Fe	5, 6	Ta	2, 5
Mn	1, 2, 5	Ti	1, 2, 5
Mo	1, 2, 5, 6	V	1, 2, 5, 6
N	4	W	1, 2, 5
Nb	1, 2, 5, 6	Zr	1, 5
Ni	1, 2, 5, 6		

[(a)]Key to Methods in Table 4:

1. Arc/Spark optical emission spectrometry (Arc/Spark-OES)
2. Inductively coupled plasma optical emission spectrometry (ICP-OES)
3. Direct combustion with infrared detection
4. Inert gas fusion with thermal conductivity detection
5. Wavelength dispersive X-ray fluorescence spectrometry (WDXRF)
6. Energy dispersive X-ray fluorescence spectrometry (EDXRF)
7. Inductively coupled plasma mass spectrometry (ICP-MS)

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 www.nist.gov/pml/pubs/index.cfm/ (accessed July 2016).

[2] May, W.; Parris, R.; Beck, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G.; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definitions of Terms and Modes Used at NIST for Value-Assignment of Reference Materials for Chemical Measurements*; NIST Special Publication 260-136, U.S. Government Printing Office: Washington, DC (2000); available at http://www.nist.gov/srm/upload/SP260-136.PDF (accessed July 2016).

[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 2016); 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 2016).

[4] JCGM 101:2008; *Evaluation of Measurement Data – Supplement 1 to the "Guide to the Expression of Uncertainty in Measurement" - Propagation of Distributions using a Monte Carlo Method*; JCGM (2008); available at http://www.bipm.org/utils/common/documents/jcgm/JCGM_101_2008_E.pdf (accessed July 2016).

[5] DerSimonian, R.; Laird, N.; *Meta-Analysis in Clinical Trials*; Control. Clin. Trials, Vol. 7, pp. 177–188 (1986).

[6] Rukhin, A.L.; *Weighted Means Statistics in Interlaboratory Studies*; Metrologia, Vol. 46, pp. 323–331 (2009).

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; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.