National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® C2400

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

This Standard Reference Material (SRM) is intended primarily for use in validation of chemical and instrumental methods of analysis. It can be used to validate value assignment of in-house reference materials. A unit of SRM C2400 consists of a cast disk 32 mm in diameter and 19 mm thick.

Certified Mass Fraction Value: The certified mass fraction values for constituents in SRM C2400 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.

Information Mass Fraction Values: The information mass fraction values for SRM C2400 are listed in Table 2. 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 C2400** 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, 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.I. Shultz, Research Associate, NIST Office of Reference Materials.

Measurements for value assignment of SRM C2400 were performed by R.K. Bell, D.E. Brown, B.I. Diamondstone, P.A. Pella, and J.A. Norris of the NIST Chemical Sciences Division. Additional measurements were performed by collaborating laboratories: A.I. Fulton, C.W. Hartig and R. Chybrzynski (Allegheny Ludlum Steel Corporation, Brackenridge, PA); T.R. Dulski, (Carpenter Technology Corporation, Reading, PA); and F.F. Liberato (Universal-Cyclops Specialty Steel Division, Bridgeville, PA).

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
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Certificate Revision History on Last Page

Steven J. Choquette, Acting Director
Office of Reference Materials

INSTRUCTIONS FOR STORAGE AND USE

The certified portion for each specimen is that extending upward 16 mm from the chill cast or test surface (the larger surface opposite the numbered surface). 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 certified portions of disks. The material has not been qualified for use with small-area, direct measurement methods such as micro X-ray fluorescence and laser ablation techniques.

PREPARATION AND ANALYSIS[(1)]

The material for this SRM was melted and cast at Esco Corporation (Portland, OR). A water-cooled, copper-plate mold assembly was used in the preparation of the chill castings. The specimens were chill cast by a rapid, unidirectional solidification technique.

Extensive homogeneity testing was carried out at NIST, formerly the National Bureau of Standards (NBS), by spark optical emission spectrometry, by X-ray fluorescence spectrometry, and by classical methods. The homogeneity was found to be satisfactory for the constituents given in this certificate. As applied to this material, the amounts of alloy measured using the instrumental techniques is on the order of tens of milligrams. Quantitative determinations were performed at NIST and collaborating laboratories using the test methods listed in Table 3.

Certified Mass Fraction Values: The certified mass fraction values for SRM C2400 are given in Table 1. Each measurand is the mass fraction of the element in steel. Each certified value was calculated as the mean of the means from the individual methods/laboratories. The uncertainty listed with the value is a combined standard uncertainty about the mean, u_c, and is estimated according to the method in the ISO/JCGM Guide [3]. The combined standard uncertainty includes contributions from inhomogeneity of the element within the steel and biases among sets of results from the test methods used by the laboratories. 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 C2400 Fe-Cr-Ni Alloy UNS J92180

Element	Mass Fraction (%)	Combined Uncertainty (%)
Carbon (C)	0.036	0.002
Chromium (Cr)	17.06	0.05
Cobalt (Co)	0.10	0.01
Copper (Cu)	2.63	0.07
Manganese (Mn)	0.71	0.01
Molybdenum (Mo)	0.23	0.01
Nickel (Ni)	4.07	0.04
Niobium (Nb)	0.15	0.01
Phosphorus (P)	0.013	0.001
Silicon (Si)	0.61	0.01
Sulfur (S)	0.003	0.001
Vanadium (V)	0.092	0.002

[(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.

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 2. Information Mass Fraction Values for SRM C2400 Fe-Cr-Ni Alloy UNS J92180

Element	Mass Fraction (%)
Aluminum (Al)	< 0.01
Boron (B)	0.0004
Titanium (Ti)	< 0.01
Tungsten (W)	0.1
Zirconium (Zr)	< 0.01

Table 3. Analytical Methods Used for SRM C2400 Fe-Cr-Ni Alloy UNS J92180

Element	Methods[(a)]	Element	Methods[(a)]
Al	1, 2, 5	Ni	5, 7, 18
B	2, 3, 5	P	5, 7, 15
C	4, 5	S	4, 5
Co	2, 5, 6, 7	Si	5, 7, 16, 17
Cr	5, 7, 8, 9, 11	Ti	2, 5
Cu	1, 2, 5, 7, 10, 11	V	1, 5, 7, 20
Mn	1, 5, 7, 12	W	5, 7, 19, 21
Mo	1, 5, 7, 13, 14	Zr	5, 22
Nb	5, 7, 19		

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

1. Flame atomic absorption spectrometry (FASS)
2. Direct current plasma optical emission spectrometry (DCP-OES)
3. Spectrophotometric determination after tetrabromochrysazin complexation
4. Direct combustion with infrared detection
5. Arc/Spark optical emission spectrometry (Arc/Spark-OES)
6. Spectrophotometric determination after tetraphenylarsonium complexation
7. Wavelength dispersive X-ray fluorescence spectrometry (WDXRF)
8. Perchloric oxidation and $KMnO_4$ titration
9. Ammonium persulfate oxidation and potentiometric titration
10. Spectrophotometric determination after biquinoline complexation
11. Electrogravimetric method
12. Potassium metaperiodate photometric method
13. Spectrophotometric determination after thiocyabate complexation
14. Gravimetric method after α-benzoinoxime complexation
15. Spectrophotometric determination after phosphomolybdate complexation
16. Gravimetric after single $HClO_4$ dehydration
17. Gravimetric after double H_2SO_4 dehydration
18. Gravimetric after dimethylglyoxime complexation
19. X-ray fluorescence spectrometry after acid hydrolysis and filtration
20. HNO_3 oxidation and potentiometric titration
21. Gravimetric after cinchonine complexation
22. Spectrophotometric determination after chloranilic acid complexation

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).

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