National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 867

Ni-Fe-Cr Alloy UNS N08825

(chip 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. SRM 867 is a high temperature alloy in wrought form. A unit of SRM 867 consists of a bottle containing approximately 100 g of chips.

Certified Mass Fraction Values: Certified mass fraction values for SRM 867 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: Reference mass fraction values are given 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 [2] and are provided with associated uncertainties that may reflect only measurement precision, may not include all sources of uncertainty, or may reflect a lack of sufficient agreement among multiple analytical methods.

Information Mass Fraction Values: Information mass fraction values are provided in Table 3. An information value is considered to be a value that will be of interest to the SRM user, but insufficient information is available to assess the uncertainty associated with the value [2]. Information values cannot be used to establish metrological traceability.

Expiration of Certification: The certification of **SRM 867** 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 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 original certification of this SRM was performed by J.I. Shultz of the NIST Office of Reference Materials. Revision of value assignments was coordinated by J.R. Sieber of the NIST Chemical Sciences Division.

Measurements for value assignment of SRM 867 were performed by B.I. Diamondstone, D.E. Brown, R.M. Lindstrom, M.S. Epstein, E.S. Beary, K.A. Brletic, and R.K. Bell 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.

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Additional measurements were performed by collaborating laboratories: C.W. Hartig, R.M. Chybrzynski, A.I. Fulton Allegheny Ludlum Steel Corp., Brackenridge, PA; P. Cole, ATI Specialty Materials, Monroe, NC; T.R. Dulski, Carpenter Technology Corp., Reading, PA; R.L. Blake, D.A. Damron, D.E. Howells, M. Kirk, L.J. Lundy, R.D. Laishley, G.T. Marshall, A.H. Roberts, K.S. Roberts, F.H. Robinson, W.L. Stickler, F.A. Blair, Huntington Alloys, Inc., Huntington, WV; A. Marschal, Laboratoire National D'Essais, Paris, France; J.Y. Marks, G. Welcher, D. Fornwal, R. Spellman, Pratt & Whitney, East Hartford, CT; G.S. Golden, United Technologies Corp., East Hartford, CT; F.F. Liberato, W.S. Harbin, S.J. Staron, S.L. Kelley, D.K. Luoni, R. Hall, Universal-Cyclops, Bridgeville and Titusville, PA; H. Ackermann, Wyman-Gordon Co., North Grafton, MA.

INSTRUCTIONS FOR STORAGE AND USE

To relate analytical determinations to the values on this Certificate of Analysis, a minimum sample quantity of 200 mg is recommended. Store the material in its original container in a cool, dry location. This material is not intended for frequent use as a routine quality assurance material.

PREPARATION AND ANALYSIS[(1)]

The material for the preparation of this SRM was prepared and provided by Huntington Alloys, Inc. (Huntington, WV). Alloy UNS N08825 is an austenitic nickel-iron-chromium alloy with additions of molybdenum, copper and titanium, developed to provide exceptional resistance to corrosion. It was prepared in billet form for chipping at NIST. The material was chipped, blended and bottled at the NIST facilities in Gaithersburg, MD.

Homogeneity testing was performed at NIST using spark source optical emission spectrometry, X-ray fluorescence spectrometry, and chemical analysis methods. The homogeneity was found to be satisfactory. Test methods used in the development of this SRM are listed in Table 4.

Certified Mass Fraction Values: The measurands are the mass fractions of the elements in nickel-base alloys. The values in Table 1 are the weighted means of the individual sets of measurements made by NIST and collaborating laboratories estimated using a Gaussian random effects model [3–5] and the DerSimonian-Laird procedure [6,7]. The associated measurement uncertainty was evaluated by the application of the parametric statistical bootstrap, consistent with the ISO/JCGM Guide and its Supplement 1 [8–11]. The expanded uncertainty, U, is presented as $U = ku_c$, where u_c is intended to represent, at the level of one standard deviation, the combined effects of between-laboratory, within-laboratory, and inhomogeneity components of uncertainty. The expansion factor, k, corresponds to an approximately 95 % confidence level. Each assigned mass fraction in Table 1 is metrologically traceable to the SI derived unit for mass fraction, which is the kilogram divided by the kilogram, or simply unity [1]. The mass fraction values are expressed as percentages or as milligrams per kilogram, as indicated in the table.

(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 Institutes of Standards and Technology, nor does it imply that the materials or equipment identified are necessarily the best available for the purpose.

Table 1. Certified Mass Fraction Values for SRM 867 Ni-Fe-Cr Alloy UNS N08825

Constituent	Mass Fraction (%)			Expansion Factor, *k*
Aluminum (Al)	0.0630	±	0.0042	1.99
Carbon (C)	0.0212	±	0.0019	1.98
Chromium (Cr)	23.375	±	0.061	1.98
Cobalt (Co)	0.092	±	0.012	1.97
Copper (Cu)	1.767	±	0.032	1.99
Iron (Fe)	26.564	±	0.063	1.96
Manganese (Mn)	0.3806	±	0.0072	1.99
Molybdenum (Mo)	2.723	±	0.028	2.01
Nickel (Ni)	43.47	±	0.27	1.98
Niobium (Nb)	0.458	±	0.030	2.00
Phosphorus (P)	0.0203	±	0.0025	1.99
Silicon (Si)	0.3234	±	0.0059	2.01
Titanium (Ti)	0.755	±	0.049	1.99
Vanadium (V)	0.0478	±	0.0035	2.00

Constituent	Mass Fraction (mg/kg)			Expansion Factor, *k*
Arsenic (As)	25.7	±	8.1	1.96
Boron (B)	19.8	±	1.6	1.99
Lead (Pb)	0.340	±	0.005	2.29
Thallium (Tl)	0.00223	±	0.00052	2.28

Reference Mass Fraction Values: The measurands are the mass fractions of the elements in nickel-base alloys, as determined by the methods indicated (Table 4). The values in Table 2 are the weighted means of the individual sets of measurements made by NIST and collaborating laboratories estimated using a Gaussian random effects model [3-5] and the DerSimonian-Laird procedure [6,7]. The associated measurement uncertainty was evaluated by the application of the parametric statistical bootstrap, consistent with the ISO/JCGM Guide and its Supplement 1 [8-11]. The expanded uncertainty, U, is presented as $U = ku_c$, where u_c is intended to represent, at the level of one standard deviation, the combined effects of between-laboratory, within-laboratory, and inhomogeneity components of uncertainty. The expansion factor, k, corresponds to an approximately 95 % confidence level. Each assigned mass fraction in Table 2 is metrologically traceable to the SI derived unit for mass fraction, which is the kilogram divided by the kilogram, or simply unity [1], but is expressed as milligrams per kilogram.

Table 2. Reference Mass Fraction Values for SRM 867 Ni-Fe-Cr Alloy UNS N08825

Constituent	Mass Fraction (mg/kg)			Expansion Factor, *k*
Gallium (Ga)	112	±	5	2.57
Nitrogen (N)	170	±	10	1.99
Oxygen (O)	50	±	20	2.01
Silver (Ag)	0.25	±	0.07	1.99
Sulfur (S)	17	±	3	1.98
Tungsten (W)	56	±	8	2.78

Information Mass Fraction Values: In Table 3, the values given with the < sign represent the estimated limits of detection of the applied test methods.

Table 3. Information Values for SRM 867 Ni-Fe-Cr Alloy UNS N08825

Constituent	Mass Fraction (mg/kg)	Constituent	Mass Fraction (mg/kg)
Antimony (Sb)	4	Tantalum (Ta)	< 10
Bismuth (Bi)	< 0.5	Tellurium (Te)	< 1
Magnesium (Mg)	< 10	Tin (Sn)	30
Selenium (Se)	< 6		

Table 4. Analytical Methods Used for SRM 867 Ni-Fe-Cr Alloy UNS N08825

Constituent	Methods[a]	Constituent	Methods[a]
Aluminum	1, 2, 3, 7	Niobium	3, 7
Antimony	10	Nitrogen	12
Arsenic	1, 2, 4	Oxygen	12
Bismuth	3, 10, 11	Phosphorus	3, 7
Boron	1, 3, 5	Selenium	4
Carbon	3, 6	Silicon	3, 7
Chromium	1, 2, 7	Silver	1, 4
Cobalt	1, 3, 7, 8	Sulfur	3, 6
Copper	1, 2, 3, 7	Tantalum	3
Gallium	2	Tellurium	3
Iron	1, 2, 3, 7	Thallium	9
Lead	9	Tin	10
Magnesium	3	Titanium	3, 7
Manganese	1, 2, 3	Tungsten	2
Molybdenum	2, 3, 7	Vanadium	2, 3
Nickel	1, 2, 3, 7		

[a] Key to Methods

1. Direct current plasma optical emission spectrometry (DCP-OES)
2. Instrumental neutron activation analysis (INAA) at NIST
3. Spark source optical emission spectrometry (spark-OES) at NIST
4. Graphite furnace atomic absorption spectrometry (GFAA)
5. Prompt gamma-ray activation analysis (PGAA) at NIST
6. Combustion with infrared detection
7. X-ray fluorescence spectrometry (XRF)
8. Laser enhanced ionization (LEI) spectrometry at NIST
9. Thermal ionization isotope dilution mass spectrometry (ID-TIMS) at NIST
10. Inductively coupled plasma mass spectrometry (ICP-MS)
11. Inductively coupled plasma optical emission spectrometry (ICP-OES)
12. Inert gas fusion with thermal conductivity detection (IGF-TC)

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Certificate Revision History: 11 December 2015 (Corrected methods for antimony and bismuth; editorial changes); 01 September 2015 (Revised assignments and values for all constituents based on re-evaluation of the original analytical results; editorial changes); 05 May 1984 (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; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.