National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1249

Ni-Cr-Fe-Nb-Mo Alloy UNS N07718
(disk form)

This Standard Reference Material (SRM) is intended primarily for use in evaluating chemical and instrumental methods of analysis. A unit of SRM 1249 consists of a disk approximately 41 mm diameter and 19 mm thick.

Certified Values: Certified mass fractions values are provided in Table 1 for selected elements. All values are reported as mass fractions [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 investigated or taken into account [2]. A certified value is the present best estimate of the true value based on the results of analyses performed at NIST and collaborating laboratories using the test methods listed in Table 4. The uncertainty listed with the value is an expanded uncertainty (95 % confidence) [3] calculated according to the method in the ISO/JCGM Guide [4].

Reference Values: Reference mass fraction values for selected elements are listed 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 may not include all sources of uncertainty. The uncertainty listed with the value is an expanded uncertainty (95 % confidence) [3] calculated according to the method in the ISO/JCGM Guide [4].

Information Values: Information values for selected elements are listed in Table 3. An information value is a value that may be of use to the SRM user, but insufficient information is available to assess adequately the uncertainty associated with the value. Information values cannot be used to establish metrological traceability.

Expiration of Certification: The certification of **SRM 1249** 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 Use"). 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 the technical measurements leading to the certification of this SRM was performed by J.R. Sieber of the NIST Chemical Sciences Division.

Analytical measurements for homogeneity testing and certification were performed by A.F. Marlow and of the NIST Chemical Sciences Division and P.A. Pella formerly of NIST.

Statistical consultation was provided by S.D. Leigh of the NIST Statistical Engineering Division.

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
Certificate Issue Date: 22 August 2014
Certificate Revision History on Last Page

Robert L. Watters, Jr., Director
Office of Reference Materials

PREPARATION AND STABILITY[1]

Material Preparation: The material for SRM 1249 was provided by Inco Alloys, Inc. (Huntington, WV).

Stability: This material is considered to be stable during the period of certification.

INSTRUCTIONS FOR USE

The test surface is the side opposite to the labeled surface, which includes the SRM number. The entire thickness of the unit is certified. 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 disks. The certified values are considered to be representative of the overall average composition of the material.

Table 1. Certified Mass Fraction Values for Selected Elements in SRM 1249

Elements	Mass Fraction[a] (%)
Aluminum (Al)	0.5682 ± 0.0065[b]
Titanium (Ti)	0.959 ± 0.015
Chromium (Cr)	18.472 ± 0.034
Iron (Fe)	17.693 ± 0.064
Cobalt (Co)	0.3371 ± 0.0078
Nickel (Ni)	53.29 ± 0.26
Copper (Cu)	0.1402 ± 0.0020
Niobium (Nb)	5.196 ± 0.021
Molybdenum (Mo)	3.112 ± 0.028

[a] Unless otherwise noted, the assigned value is a weighted mean of the results from two to seven analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with a coverage factor, $k = 2$ (approximately 95 % confidence), calculated by combining a between-source variance incorporating inter-method bias with a pooled within-source variance following the ISO/JCGM Guide [4,5]. The measurands are the total mass fractions of the elements listed. The certified values are metrologically traceable to the SI unit of mass, expressed as a percent.

[b] The assigned value is an unweighted mean of the results from two to five analytical methods. The uncertainty listed with the value is an expanded uncertainty about the mean, with coverage factor, $k = 2$, calculated by combining a between-method variance with a pooled, within-method variance following the ISO/JCGM Guide [4,6]. The measurand is the total mass fractions of the element listed. The certified value is metrologically traceable to the SI unit of mass, expressed as a percent.

[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.

Table 2. Reference Mass Fraction Values for Selected Elements in SRM 1249

Elements	Mass Fraction[a] (%)		
Boron (B)	0.0023	±	0.0003
Carbon (C)	0.0380	±	0.0014[b]
Magnesium (Mg)	0.0012	±	0.0001
Silicon (Si)	0.120	±	0.008
Phosphorus (P)	0.0134	±	0.0004
Sulfur (S)	0.00064	±	0.00010
Vanadium (V)	0.0338	±	0.0014
Manganese (Mn)	0.108	±	0.003
Gallium (Ga)	0.0019	±	0.0002
Arsenic (As)	0.0013	±	0.0003
Zirconium (Zr)	0.0029	±	0.0002
Tin (Sn)	0.0024	±	0.0002
Antimony (Sb)	0.00030	±	0.00006
Tantalum (Ta)	0.0027	±	0.0008[b]
Tungsten (W)	0.0846	±	0.0008

[a] Unless otherwise noted, the assigned value is a weighted mean of the results from two to seven analytical methods. The uncertainty listed with each value is an expanded uncertainty about the mean, with a coverage factor, $k = 2$, (approximately 95 % confidence), calculated by combining a between-source variance incorporating inter-method bias with a pooled within-source variance following the ISO/JCGM Guide [4,6]. The measurands are the mass fractions listed as determined by the methods indicted and the values listed are metrologically traceable to the SI unit of mass, expressed as a percent.

[b] The assigned value is an unweighted mean of the results from two to five analytical methods. The uncertainty listed with the value is an expanded uncertainty about the mean, with coverage factor, $k = 2$, calculated by combining a between-method variance with a pooled, within-method variance following the ISO/JCGM Guide [4,6]. The measurand is the mass fraction listed as determined by the methods indicted and the value is metrologically traceable to the SI unit of mass, expressed as a percent.

Table 3. Information Values for Mass Fraction Values for Selected Elements in SRM 1249

Elements	Mass Fraction (%)
Calcium (Ca)	0.0005
Zinc (Zn)	0.0006
Selenium (Se)	0.00003
Tellurium (Te)	<0.00005
Lead (Pb)	0.00001

Table 4. Analytical Methods

Element	Methods
Al	DCP-OES; FAAS; ICP-OES; SS-OES; WDXRF
Ti	DCP-OES; FAAS; ICP-OES; MAS; SS-OES; WDXRF
Cr	ICP-OES; SS-OES; TITR; WDXRF
Fe	ICP-OES; WDXRF
Co	DCP-OES; FAAS; ICP-OES; SS-OES; WDXRF
Ni	GRAV; ICP-OES; SS-OES; TITR; WDXRF
Cu	DCP-OES; FAAS; ICP-OES; SS-OES; WDXRF
Nb	DCP-OES; EDXRF; FAAS; ICP-OES; SS-OES; WDXRF
Mo	DCP-OES; GRAV; FAAS; ICP-OES; SS-OES; WDXRF
B	GD-MS; ICP-MS; SS-OES
C	COMB-IR; SS-OES
Mg	DCP-OES; FAAS; GD-MS; ICP-OES; ICP-MS; SS-OES
Si	DCP-OES; FAAS; ICP-OES; SS-OES; WDXRF
P	DCP-OES; MAS; ICP-OES; SS-OES; WDXRF
S	COMB-IR; GS-MS
V	DCP-OES; FAAS; ICP-OES; SS-OES; WDXRF
Mn	DCP-OES; FAAS; ICP-OES; MAS; SS-OES; WDXRF
Ga	DCP-OES; GD-MS; GFAAS; ICP-MS; SA-ICP-MS
As	GD-MS; GFAAS; ICP-MS; SA-ICP-MS
Zr	GD-MS; ICP-MS; SS-OES; WDXRF
Sn	GD-MS; GFAAS; ICP-MS; SA-ICP-MS; SS-OES
Sb	GD-MS; GFAAS; ICP-MS; SA-ICP-MS
Ta	GD-MS; ICP-MS
W	ICP-OES; WDXRF
N	IGF
Ca	ICP-OES; SS-OES
Zn	DCP-OES; FAAS; ICP-MS
Se	GFAAS
Te	GFAAS
Pb	GFAAS; ICP-MS

Methods Key:

COMB-IR	(Combustion with Infrared Detection)
DCP-OES	(Direct Current Optical Emission Spectrometry)
EDXRF	(Energy Dispersive X-Ray Fluorescence Spectrometry)
FAAS	(Flame Atomic Absorption Spectrometry)
GD-MS	(Glow Discharge Mass Spectrometry
GFAAS	(Graphite Furnace Atomic Absorption Spectrometry)
GRAV	(Gravimetry)
ICP-OES	(Inductively-Coupled Plasma Optical Emission Spectrometry)
IGF	(Inert Gas Fusion)
MAS	(Molecular Absorption Spectrometry)
SA-ICP-MS	(Spark Ablation Inductively-Coupled Plasma Mass Spectrometry)
SS-OES	(Spark Source Optical Emission Spectrometry)
TITR	(Titrimetry)
WDXRF	(Wavelength Dispersive X-Ray Fluorescence Spectrometry)

Cooperating Laboratories: Analytical determinations for certification of this SRM were performed by the following laboratories:

Allegheny Ludlum, Technical Center (Brackenridge, PA, USA); R.M. Crain, S.A. Bissell-Seymour
ATI Allvac (Monroe, NC, USA); P.M. Cole, C.B. Wilson
ATI Allvac, (Lockport, NY, USA); T.A. Herdlein, P.S. Psutka
Carpenter Technology Corp. (Reading, PA, USA); C.T. Polinko, K.H. Dabbs, M.W. Teti
Howmet Corp. (Whitehall, MI, USA); R. DeHoff, R. Starr
Huntington Alloys Corp. (Huntington, WV, USA); D. McAnallen,
Inco Technical Services Ltd. (Mississauga, Ontario, Canada)
Shiva Technologies, Inc. (Syracuse, NY, USA); R. Balamut, M. Kasik

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 Aug 2014).

[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/publications.cfm (accessed Aug 2014).

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[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 Aug 2014); 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 Aug 2014).

[5] Ruhkin, A.L.; Vangel, M.G.; *Estimation of a Common Mean and Weighted Means Statistics*; J. Am. Stat. Assoc., Vol. 93, pp. 303–308 (1998).

[6] Levenson, M.S.; Banks, D.L.; Eberhardt, K.R.; Gill, L.M.; Guthrie, W.F.; Liu, H.-k.; Vangel, M.G.; Yen, J.H.; Zhang, N.F.; *An Approach to Combining Results from Multiple Methods Motivated by the ISO GUM*; J. Res. Natl. Inst. Stand. Technol., Vol. 105, pp. 571–579 (2000).

Certificate Revision History: 22 August 2014 (Editorial changes); **07 March 2006** (Revised and added certified, reference, and information values and their associated uncertainties following additional testing); **07 March 1996** (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.