



National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1241c

Aluminum Alloy 5182 (disk form)

This Standard Reference Material (SRM) is intended primarily for use in evaluating instrumental methods of analysis including glow discharge optical emission spectrometry, spark source optical emission spectrometry, and X-ray fluorescence spectrometry. A unit of SRM 1241c consists of a disk approximately 6.3 cm in diameter and 1.9 cm thick. Aluminum Alloy 5182 is also available in chip form as SRM 854a.

The certified values for 11 elements in SRM 1241c are listed in Table 1. The user should note that there are two certified values given for silicon (Si) and two for titanium (Ti). Each unit of SRM 1241c carries a serial number. The correct values for Si and Ti are the values associated with the serial number of the unit. Reference values for two elements are listed in Table 2. Information values for three elements are listed in Table 3. For all elements, values are reported as mass fractions [1]. Value assignment categories are based on the definition of terms and modes used at NIST for chemical reference materials [2].

Certified Mass Fraction Values: 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 accounted for by NIST. 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 based on a 95 % confidence interval [3] and is calculated according to the method in the ISO/JCGM Guide [4].

Reference Mass Fraction Values: 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 based on a 95 % confidence interval [3] and is calculated according to the method in the ISO/JCGM Guide [4].

Information Mass Fraction Values: 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. Information values cannot be used to establish metrological traceability.

Expiration of Certification: The certification of **SRM 1241c** 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 recertification of this SRM is not required. However, the certification will be 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 of this certificate, NIST will notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

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

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See Certificate Revision History on Last Page

Analytical measurements for certification of this SRM were performed by J.R. Sieber and M.R. Winchester 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.

INSTRUCTIONS FOR USE

The test surface is the side opposite to the labeled surface, which includes the SRM number and a serial 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. For example, preparation for glow discharge optical emission measurements at NIST involved grinding the surface with abrasive paper. 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 the solid disks and chips prepared from the disks. The certified values are considered to be representative of the overall average composition of the material. The casting method results in material that is relatively uniform in composition regardless of the distance from the center of the piece. Measurements using a small X-ray beam (approx. 3 mm × 4 mm ellipse) showed localized areas of high X-ray count rate for titanium (Ti), vanadium (V), manganese (Mn), iron (Fe), copper (Cu), zinc (Zn), and gallium (Ga). Therefore, regardless of the method employed, it is recommended to follow accepted standard methods of test for Al alloys, which may specify the manner in which measurement locations are chosen and the number of locations to be measured.

The casting method used to prepare this material may result in different amounts of grain refiner in each casting. The user is cautioned to note the serial number of the disk and use the appropriate certified values for Si and Ti from Table 1 and footnotes b and c.

Table 1. Certified Values for SRM 1241c Aluminum Alloy 5182

Constituent	Value (mass fraction) (%)	Expanded Uncertainty ^(a) (mass fraction) (%)	Coverage Factor (<i>k</i>)
Silicon (Si) ^(b)	0.1544	0.0061	2.0
Silicon (Si) ^(c)	0.1601	0.0084	2.1
Iron (Fe)	0.1997	0.0042	2.8
Copper (Cu)	0.0497	0.0016	3.2
Manganese (Mn)	0.3792	0.0071	2.0
Magnesium (Mg)	4.498	0.056	2.0
Nickel (Ni)	0.0198	0.0009	2.3
Zinc (Zn)	0.0506	0.0005	2.2
Titanium (Ti) ^(b)	0.0317	0.0012	2.0
Titanium (Ti) ^(c)	0.0334	0.0012	2.0
Vanadium (V)	0.0174	0.0006	2.0
Chromium (Cr)	0.0343	0.0009	2.0
Gallium (Ga)	0.0184	0.0009	2.1

^(a) The measurands are the mass fractions of the elements. The certified values are metrologically traceable to the SI unit of mass. The assigned value is an unweighted mean of the results from three or four analytical methods across multiple laboratories. The uncertainty listed with the value is an expanded uncertainty about the mean, with coverage factor *k*, calculated by combining a between-method variance with a pooled, within-method variance following the ISO and NIST Guides [4,5].

^(b) These values and associated uncertainty estimates for Si and Ti must be used with units having serial numbers 501 through 594, inclusive.

^(c) These values and associated uncertainty estimates for Si and Ti must be used with units having serial numbers 595 through 688, inclusive.

Table 2. Reference Values for SRM 1241c Aluminum Alloy 5182

Constituent	Value (mass fraction) (mg/kg)	Expanded Uncertainty ^(a) (mass fraction) (mg/kg)	Coverage Factor (<i>k</i>)
Cadmium (Cd)	6.2	0.2	2.3
Lead (Pb)	5.2	0.8	2.4

^(a) The measurands are the mass fractions of the elements as determined by the analytical methods indicated in Table 4. The assigned value is an unweighted mean of the results from two analytical methods. The uncertainty listed with the value is an expanded uncertainty about the mean, with coverage factor *k*, calculated by combining a between-method variance with a pooled, within-method variance following the ISO/JCGM Guide [4,5].

Table 3. Information Values for SRM 1241c Aluminum Alloy 5182

Constituent	Value (mass fraction) (mg/kg)
Strontium (Sr)	2
Tin (Sn)	2
Zirconium (Zr)	20

Table 4. Analytical Methods

Element	Methods
Si	GD-OES; ICP-OES; SS-OES, Colorimetry
Fe	GD-OES; ICP-OES; SS-OES
Cu	GD-OES; ICP-OES; SS-OES
Mn	GD-OES; ICP-OES; SS-OES
Mg	GD-OES; ICP-OES; SS-OES
Ni	GD-OES; ICP-OES; SS-OES
Zn	GD-OES; ICP-OES; SS-OES
Ti	GD-OES; ICP-OES; SS-OES
V	GD-OES; ICP-OES; SS-OES
Cr	GD-OES; ICP-OES; SS-OES
Ga	GD-OES; ICP-OES; SS-OES
Cd	ICP-OES; SS-OES
Pb	ICP-OES; SS-OES
Sr	ICP-OES; SS-OES
Sn	ICP-OES; SS-OES
Zr	ICP-OES; SS-OES

Methods Key

GD-OES (Glow Discharge Optical Emission Spectrometry at NIST)
 ICP-OES (Inductively-Coupled Plasma Optical Emission Spectrometry at Cooperating Laboratories)
 SS-OES (Spark Source Optical Emission Spectrometry at Cooperating Laboratories)
 Colorimetry (Performed at one Cooperating Laboratory)

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

Alcan International Limited, Arvida Research and Development Centre (Jonquière, Québec, Canada); H. Hamouche. Aluminum Company of America, Alcoa Technical Center, Alcoa Center (Pennsylvania, USA); M. Ruschak.

Material Preparation: The material for SRM 1241c was obtained in the form of four castings prepared by the Aluminum Company of America⁽¹⁾. Titanium was added for grain refinement of the alloy. The method of addition may cause the Ti content to change from one casting to the next. The castings were cut and packaged at NIST under the supervision of D.F. Friend (formerly of NIST) and M.P. Cronise of the Office of Reference Materials. Homogeneity testing was performed by Alcan International Limited using spark source optical emission spectrometry and by NIST using micro X-ray fluorescence spectrometry.

REFERENCES

- [1] 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 (1995); available at <https://www.nist.gov/physical-measurement-laboratory/special-publication-811> (accessed Aug 2019).
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- [3] Hahn, G. J.; Meeker, W.Q.; *Statistical Intervals: A Guide for Practitioners*; John Wiley & Sons, Inc.: New York (1991).
- [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 (2008); available at https://www.bipm.org/utlis/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed Aug 2019); 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 <https://www.nist.gov/pml/nist-technical-note-1297> (accessed Aug 2019).
- [5] 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).

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Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at <https://www.nist.gov/srm>.

⁽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.