



Certificate of Analysis

Standard Reference Material® 1889a

Portland Cement (Blended with Limestone)

This Standard Reference Material (SRM) is intended primarily for use in evaluating chemical methods of analysis and in the calibration of instrumental methods for analysis of cements and materials of similar matrix. A unit of SRM 1889a consists of four sealed vials, each containing approximately 5 g of portland cement ground to pass a 75 μm (No. 200) sieve.

Certified Values: The certified values for SRM 1889a, expressed as mass fractions [1] on an as-received basis, are provided in Table 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 accounted for by NIST. The certified values listed are based on the results of analyses performed at NIST, Construction Technology Laboratories, Inc. (CTL, Skokie, IL)⁽¹⁾ and the United States Geological Survey (USGS, Denver, CO) using X-ray fluorescence spectrometry, atomic absorption spectrophotometry, inductively coupled plasma emission spectrometry, and modified reference methods given in ASTM C 114-00 Standard Test Methods for Chemical Analysis of Hydraulic Cement [2]. Homogeneity testing was performed at NIST using X-ray fluorescence spectrometry. The uncertainty listed with each value is an expanded uncertainty, with coverage factor 2, calculated by combining a between-method variance [3] with a pooled, within-method variance following the ISO/JCGM Guide [4].

Reference Values: A reference value for chlorine (Cl) expressed as mass fraction on an as-received basis is provided in Table 2. Reference values are noncertified values that are the best estimate of the true value; however, the values are based on determinations that do not meet the NIST criteria for certification and are provided with associated uncertainties that may reflect only measurement precision and may not include all sources of uncertainty.

Information Values: Information values for fluoride (F^-), Insoluble Residue, Loss On Ignition (LOI), Free CaO, and the Total of all constituents are provided in Table 3. These are noncertified values with no uncertainty assessed. Information values cannot be used to establish metrological traceability.

Expiration of Certification: The certification of **SRM 1889a** is valid, within the uncertainty specified, until **01 March 2019** provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Handling, Storage and Use"). However, the certification will be nullified if the SRM is damaged, contaminated, or 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 certification was accomplished under the direction of J.R. Sieber of the NIST Chemical Sciences Division.

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

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Steven J. Choquette, Director
Office of Reference Materials

⁽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.

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

Analytical measurements for certification of this SRM were performed by A.F. Marlow and J.R. Sieber of the NIST Chemical Sciences Division; B. Angelakos, M. Bharucha, D. Broton, R. Naamane, S. Nettles, and C. Wedzicha of CTL, and J. Taggart and S. Wilson of the USGS.

INSTRUCTIONS FOR HANDLING, STORAGE, AND USE

Cement powder is hygroscopic. Samples should be used immediately after opening the vial. To relate analytical determinations to the certified values in this Certificate of Analysis, a minimum test portion of 500 mg should be used. The vial should be recapped immediately, placed back in the labeled foil pouch, and stored in a desiccator.

When a sample is used after storage in a previously opened vial, the total loss on ignition (LOI) at 950 °C for that sample should be determined in accordance with ASTM C114-00 Standard Test Methods for Chemical Analysis of Hydraulic Cement [2] and the mass of the sample corrected for any additional moisture, combined water, or carbonate above the value reported in this certificate for total LOI at 950 °C.

Reporting: The constituents listed in this Certificate of Analysis are expressed as the chemical forms and in the order given in ASTM C 114-00, Section 3, Table 1.

Table 1. Certified Values for SRM 1889a^(a)

Constituent	Mass Fraction (%)	Constituent	Mass Fraction (%)
SiO ₂	20.66 ± 0.16	K ₂ O	0.605 ± 0.015
Al ₂ O ₃	3.89 ± 0.12	TiO ₂	0.227 ± 0.010
Fe ₂ O ₃	1.937 ± 0.054	P ₂ O ₅	0.110 ± 0.004
CaO	65.34 ± 0.33	Mn ₂ O ₃	0.2588 ± 0.0073
MgO	0.814 ± 0.028	SrO	0.042 ± 0.004
SO ₃	2.69 ± 0.11	Cr ₂ O ₃	0.0072 ± 0.0005
Na ₂ O	0.195 ± 0.010	ZnO	0.0048 ± 0.0003

^(a) The measurand is the total concentration of analytes shown in this table. The certified value is metrologically traceable to the SI unit for mass, expressed as mass fraction.

Table 2. Reference Values for SRM 1889a^(a)

Constituent	Mass Fraction (%)
Cl	0.0019 ± 0.0003

^(a) The measurand is the concentration of chlorine as determined by the methods used. Metrological traceability to the SI unit for mass, expressed as mass fraction.

Table 3. Information Values for SRM 1889a

Constituent	Mass Fraction (%)	Constituent	Mass Fraction (%)
F ⁻	0.05	Insoluble Residue	0.66
LOI at 950 °C	3.28	Free CaO	0.58
Total ^(a)	100.09		

^(a) A correction has been made for the amount of fluoride present. This correction, which was subtracted from the gross total, was determined by multiplying the percent fluoride by the ratio of the atomic weight of oxygen to the molecular weight of fluorine (0.421). The Total does not include Insoluble Residue, or Free CaO.

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 Nov 2016).
- [2] ASTM C 114-00, Standard Test Methods for Chemical Analysis of Hydraulic Cement, *Annu. Book ASTM Stand.*, Vol. 04.01, West Conshohocken, PA.
- [3] 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).
- [4] CGM 100:2008; *Evaluation of Measurement Data - Guide to the Expression of Uncertainty in Measurement*; (ISO GUM 1995 with Minor Corrections), Joint Committee for Guides in Metrology (JCGM) (2008); available at http://www.bipm.org/utis/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed Nov 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 Nov 2016).

Certificate Revision History: 29 November 2016 (Change of expiration date, editorial changes); 13 February 2002 (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>.