National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1881a

Portland Cement
(Blended with Slag and Fly Ash)

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 1881a consists of four sealed vials, each containing approximately 5 g of portland cement blended with slag and fly ash by the manufacturer and ground by NIST to pass a 75 µm (No. 200) sieve.

Certified Values: The certified values for SRM 1881a, 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 [2]. 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 [3]. Homogeneity testing was performed at NIST using X-ray fluorescence spectrometry. The uncertainty listed with each value is an expanded uncertainty, with coverage factor, $k = 2$, calculated by combining a between-method variance [4] with a pooled, within-method variance following the ISO/JCGM Guide [5]. The measurands are the total mass fractions of the elements in cement listed in Table 1. Metrological traceability is to the SI derived unit for mass fraction (expressed as a percent).

Reference Values: A reference value for Cl expressed as mass fraction on an as-received basis is provided in Table 2. A NIST reference value is a noncertified value that is the present best estimate of the true value based on available data; however, the value does not meet the NIST criteria for certification and is provided with associated uncertainties that may reflect only measurement reproducibility, may not include all sources of uncertainty, or may reflect a lack of sufficient statistical agreement among multiple analytical methods [2]. The measurand is the mass fraction of the chlorine listed in Table 2 as determined by the analytical method. Metrological traceability is to the SI derived unit for mass fraction (expressed as a percent).

Information Values: Information values for constituents, for LOI at 950 ºC, and for total analyzed constituents are reported in Table 3 as mass fractions. An information value is considered to be a value that may 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 1881a** is valid, within the measurement uncertainty specified, until **01 January 2018**, provided the SRM is handled and stored in accordance with instructions given in this certificate (see "Instructions for Handling, Storage, and Use"). The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Coordination of technical measurements for certification was performed by J.R. Sieber of the NIST Chemical Sciences Division.

Carlos A. Gonzalez, Chief
Chemical Sciences Division

Gaithersburg, MD 20899
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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.

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.E. Taggart and S.A. Wilson of the USGS.

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

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

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.

INSTRUCTIONS FOR HANDLING, STORAGE, AND USE

Cement powder is hygroscopic. Samples should be used immediately after opening the vial to minimize changes from reaction with moisture and carbon dioxide in air. 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 loss on ignition (LOI) at 950 °C value for that sample should be determined in accordance with ASTM C114 Standard Test Methods for Chemical Analysis of Hydraulic Cement [3] and the mass of the sample corrected for any increase above the value reported in Table 3 for LOI total at 950 °C.

NOTICE TO USERS

NIST strives to maintain the SRM inventory supply, but NIST cannot guarantee the continued or continuous supply of any specific SRM. Accordingly, NIST encourages the use of this SRM as a primary benchmark for the quality and accuracy of the user's in-house reference materials and working standards. As such, the SRM should be used to validate the more routinely used reference materials in a laboratory. Comparisons between the SRM and in-house reference materials or working measurement standards should take place at intervals appropriate to the conservation of the SRM and the stability of relevant in-house materials. For further guidance on how this approach can be implemented, contact NIST by email at srms@nist.gov.

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 1881a

Constituent	Mass Fraction (%)	Constituent	Mass Fraction (%)
SiO_2	22.26 ± 0.15	K_2O	1.228 ± 0.029
Al_2O_3	7.060 ± 0.081	TiO_2	0.3663 ± 0.0030
Fe_2O_3	3.09 ± 0.11	P_2O_5	0.1459 ± 0.0057
CaO	57.58 ± 0.34	Mn_2O_3	0.1042 ± 0.0016
MgO	2.981 ± 0.077	SrO	0.036 ± 0.004
SO_3[(a)]	3.366 ± 0.069	Cr_2O_3	0.0588 ± 0.0020
Na_2O	0.199 ± 0.007	ZnO	0.0489 ± 0.0028

[(a)] SO_3 represents the total sulfur content expressed according to ASTM C 114-00 practices. The sulfide portion of the total sulfur content was also measured and is provided as additional information in Table 3.

Table 2. Reference Values for SRM 1881a

Constituent	Mass Fraction (%)
Cl	0.013 ± 0.001

Table 3. Information Values for SRM 1881a

Constituent	Mass Fraction (%)	Constituent	Mass Fraction (%)
F	0.09	Sulfide Sulfur	0.035
LOI at 950 °C	1.59	Free CaO	0.29
Insoluble Residue	5.2	Total[(a)]	100.18

[(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, Free CaO or Sulfide Sulfur.

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 Oct 2016).

[2] May, W.; Parris, R.; Beck II, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G.; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definition 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 Oct 2016).

[3] ASTM C 114-00, Standard Test Methods for Chemical Analysis of Hydraulic Cement, Annu. Book ASTM Stand., 04.01, West Conshohocken, PA.

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

[5] 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 Oct 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 Oct 2016).

Certificate Revision History: 27 October 2016 (Change of expiration date, editorial changes); 12 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.