



National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material[®] 3190

Aqueous Electrolytic Conductivity

Lot No. 101109

This Standard Reference Material (SRM) is intended primarily for use in electrolytic conductivity measurement as a calibration standard or control sample. As a calibration standard, it can be used to determine the conductivity cell constant. A unit of SRM 3190 consists of one 500 mL bottle filled with a dilute solution of hydrochloric acid (HCl) in deionized water in equilibrium with atmospheric carbon dioxide.

SRM 3190 was prepared gravimetrically using deionized water of initial electrolytic conductivity less than $0.06 \mu\text{S}/\text{cm}$. The solution was dispensed into high-density polyethylene (HDPE) bottles, the caps sealed in beeswax, and the entire sealed bottle packaged in an aluminized polyethylene terephthalate bag. The certified electrolytic conductivity and its uncertainty given below were established [1] through determinations in a conductivity cell calibrated with primary standards for electrolytic conductivity [2,3].

The certified value given below is based on equilibrium conditions, and the solution should **NOT** be degassed before use.

Electrolytic Conductivity at 25.000 °C: $25.11 \mu\text{S}/\text{cm} \pm 0.26 \mu\text{S}/\text{cm}$

The uncertainty in the certified value, $U = 0.26 \mu\text{S}/\text{cm}$, is calculated as

$$U = 1.96 u_c$$

where u_c is the combined standard uncertainty calculated according to the ISO Guide [4]. The value of u_c is intended to represent, at the level of one standard deviation, the combined effect of uncertainty components associated with the stability of the SRM, atmospheric pressure, mole fraction of carbon dioxide, measurement of the solution, and cell calibration. The value of u_c has been multiplied by 1.96, which is the coverage factor corresponding to approximately 95 % confidence based on greater than 1000 overall effective degrees of freedom.

Expiration of Certification: The certification of **SRM 3190 Lot No. 101109** is valid, within the measurement uncertainty specified, until **14 February 2012**, provided the SRM is handled and stored in accordance with instructions given in this certificate (see "Instructions for Use"). This 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) will facilitate notification.

This SRM was prepared and analyzed by K.W. Pratt of the NIST Analytical Chemistry Division.

Statistical consultation was provided by W.F. Guthrie of the NIST Statistical Engineering Division.

Stephen A. Wise, Chief
Analytical Chemistry Division

Robert L. Watters, Jr., Chief
Measurement Services Division

Gaithersburg, MD 20899
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Support aspects involved in the issuance of this SRM were coordinated through the NIST Measurement Services Division.

Conductivity is strongly influenced by temperature, and for this solution, the temperature coefficient at 25 °C, α , is approximately 1.5 % per °C [5]. The certified value and its uncertainty were determined with the temperature at 25.000 °C \pm 0.005 °C. The corresponding equation for correcting to other temperatures is

$$\kappa = \kappa_{25^{\circ}\text{C}} [1 + \alpha(t - 25^{\circ}\text{C})]$$

where $\kappa_{25^{\circ}\text{C}}$ is the certified value, α is 1.5 % (= 0.015), t is the temperature of measurement, and κ is the corrected value at t . This correction is valid in the range of $t = 25.0^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$. It should not be applied to values of t outside this range.

INSTRUCTIONS FOR USE

The SRM solution should be kept in the original, unopened bottle, sealed in its original polyethylene terephthalate bag, and stored under normal laboratory conditions, away from ammonia, acid fumes, nitrogen oxides, and sulfur dioxide. Care should be taken to avoid contaminating the solution with gas containing elevated levels of CO₂, such as exhaled breath. Each bottle should be treated as a single-use standard. This certification is valid only for bottles that are used immediately after they are opened. The solution should be used immediately after the bottle is opened to avoid evaporation of the solution being measured.

REFERENCES

- [1] Shreiner, R.H.; Pratt, K.W.; *Primary Standards and Standard Reference Materials for Electrolytic Conductivity*; NIST Special Publication 260-142, 2004 ed.; U.S. Government Office: Washington, DC (2004); available at <http://ts.nist.gov/MeasurementServices/ReferenceMaterials/upload/260-142-2ndVersion.pdf> (accessed Aug 2011).
- [2] Wu, Y.C.; Pratt, K.W.; Koch, W.F.; *Determination of the Absolute Specific Conductance of Primary Standard KCl Solutions*; *J. Solution Chem.*, Vol. 18, pp. 515–528 (1989).
- [3] Wu, Y.C.; Pratt, K.W.; Koch, W.F.; Berezansky, P.A.; *Molality-Based Primary Standards of Electrolytic Conductivity*, *Pure Appl. Chem.*, Vol. 73, pp. 1783–1793 (2001).
- [4] JCGM 100:2008; *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/utils/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed Aug 2011); 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 2011).
- [5] Bartels, J.; Ten Bruggencate, P.; Hausen, H.; Hellwege, K.H.; Vol. II, 6th ed, Chapter 7; *Landolt-Börnstein: Zahlenwerte und Funktionen aus Physik, Chemie, Astronomie, Geophysik und Technik*; Schäfer Kl.; Schmidt E., Eds.; Springer-Verlag: Berlin, Germany, pp. 258, 270–271 (1960).

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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) 926-4751; e-mail srminfo@nist.gov; or via the Internet at <http://www.nist.gov/srm>.