National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 1828a

Ethanol-Water Solutions

This certificate reports a revised concentration value for each ethanol-water solution.

This Standard Reference Material (SRM) is intended primarily for calibration of instruments and techniques used for the determination of ethanol [ethyl alcohol-Chemical Abstracts Service (CAS) Registry Number 64-17-5] in breath or blood. SRM 1828a consists of five ampoules: one ampoule contains approximately 20 mL of ethanol-water azeotrope (96 % mass fraction [1] ethanol, nominal); two ampoules each contain approximately 20 mL of the 2 % mass fraction ethanol-water solution, nominal; one ampoule contains approximately 5 mL of the 0.1 % mass fraction ethanol-water solution, nominal; and one ampoule contains approximately 5 mL of the 0.02 % mass fraction ethanol-water solution, nominal.

Certified Values and Uncertainties: The certified values of these ethanol-water solutions (CAS Registry Number: 07732-18-5) and their expanded uncertainties are given in Table 1. The certified concentrations were established by gravimetry and gas chromatography/flame ionization detection (GC/FID), using 1-propanol as an internal standard.

Table 1. Certified Concentrations (Mass Fractions) and Uncertainties[a] of Ethanol-Water Azeotrope and Ethanol-Water Solutions

Concentration Levels	Mass Fraction (in %)
1	95.60 ± 0.12
2	1.9957 ± 0.0099
3	0.09480 ± 0.00036
4	0.02186 ± 0.00023

[a] The uncertainty for each certified value is for an individual measurement. It is expressed as an expanded uncertainty, U, at the 95 % level of confidence, and is calculated according to the method described in the ISO Guide [2]. The expanded uncertainty is calculated as, $U = ku_c$, where u_c is intended to represent, at the level of one standard deviation, the combined effect of within-set variation and material inhomogeneity. The coverage factor, k, is determined from the Student's t-distribution corresponding to the calculated effective degrees of freedom and a 95 % level of confidence.

Information Values: Information values for the number of grams of ethanol per 100 mL at each concentration level, as a function of solution temperature, are given in Table 2. The solution densities used to calculate the values in Table 2 were obtained by interpolation from the data in reference [3].

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by J.C. Colbert.

Willie E. May, Chief
Analytical Chemistry Division

Gaithersburg, MD 20899
Certificate Issue Date: 07 June 2001
See Certificate Revision History on Last Page

John Rumble, Jr., Acting Chief
Standard Reference Materials Program

The overall direction and coordination of technical measurements leading to the original certification were under the chairmanship of S.N. Chesler of the NIST Analytical Chemistry Division. The overall direction and coordination of stability measurements resulting in the revised values appearing in this certificate were under the direction of M.J. Welch of the NIST Analytical Chemistry Division.

Preparation and analytical determinations leading to the original certification of the SRM were performed by S.N. Chesler and F.R. Guenther of the NIST Analytical Chemistry Division. Analytical determinations for stability measurements were performed by L.T. Sniegoski and S.S.-C. Tai of the NIST Analytical Chemistry Division.

Consultation on the statistical design of the experimental work and evaluation of data in the original certificate was provided by K.R. Eberhardt of the NIST Statistical Engineering Division and D.L. Duewer of the NIST Analytical Chemistry Division. Statistical analysis of the stability measurements was performed by N.F. Zhang of the NIST Statistical Engineering Division.

NOTICE AND WARNING TO USERS

Expiration of Certification: The expiration date is stamped on the outer box label. **DO NOT REMOVE THIS LABEL.** Should any of the values change before the expiration of the certification, purchasers will be notified by NIST.

Storage: Sealed ampoules, as received, should be stored in the dark at temperatures between 10 °C to 30 °C.

Use: A solution should be used immediately after opening an ampoule to avoid possible changes in the concentration of the solution.

Preparation and Analysis: The solutions were prepared by mixing known masses of ethanol and organic-free water. Solutions were aliquotted into glass ampoules and flame-sealed under argon. For the stability assessment and revision of the certified values, each concentration level of ethanol-water solution was measured in three sets. Three independent standard solutions of ethanol-water and one internal standard solution of 1-propanol in water were prepared for each level, and used for all three sets. Each set consisted of two aliquots from each of the three standard solutions, and two aliquots from each of three sample ampoules. Sets were prepared and measured on three successive days. All solutions that were used for the preparation of standards and for spiking samples were prepared gravimetrically. The method of analysis was gas chromatography/flame ionization detection (GC/FID).

Table 2. Ethanol-Water Solution Concentrations at Various Temperatures in Grams of Ethanol per 100 mL [3]

	SRM Concentration Levels			
Temperature (° C)	0.02186 %	0.09480 %	1.9957 %	95.60 %
	(grams of ethanol/100 mL)			
15	0.02184	0.09470	1.9866	77.13
16	0.02184	0.09468	1.9862	77.05
17	0.02183	0.09467	1.9859	76.96
18	0.02183	0.09465	1.9855	76.88
19	0.02182	0.09463	1.9852	76.80
20	0.02182	0.09462	1.9848	76.72
21	0.02182	0.09459	1.9843	76.64
22	0.02181	0.09457	1.9839	76.55
23	0.02181	0.09455	1.9834	76.47
24	0.02180	0.09453	1.9829	76.39
25	0.02180	0.09451	1.9825	76.31
26	0.02179	0.09448	1.9819	76.22
27	0.02178	0.09445	1.9813	76.14
28	0.02178	0.09443	1.9808	76.06
29	0.02177	0.09440	1.9802	75.97
30	0.02176	0.09437	1.9796	75.89

REFERENCES

[1] Taylor, B.N., "Guide for the Use of the International System of Units (SI)," NIST Special Publication 811, 1995 Ed., (April 1995).

[2] *Guide to the Expression of Uncertainty in Measurement,* ISBN 92-67-10188-9, 1st Ed. ISO, Geneva, Switzerland, (1993); see also Taylor, B.N. and 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://physics.nist.gov/Pubs/.

[3] Circular of the Bureau of Standards, No. 19, Standard Density and Volumetric Tables, U.S. Government Printing Office, Washington, DC, pp. 4-7, (1924).

Certificate Revision History: 07 June 2001 (The concentrations of the ethanol-water solutions have been revised based on new stability data); 03 June 1996 (Original certificate date).

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) 975-6776; fax (301) 926-4751; e-mail srminfo@nist.gov; or via the Internet http://www.nist.gov/srm.