



Designation: E200 – 23

Standard Practice for Preparation, Standardization, and Storage of Standard and Reagent Solutions for Chemical Analysis¹

This standard is issued under the fixed designation E200; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This practice covers procedures for the preparation, standardization, and storage of the standard volumetric solutions and reagent testing solutions commonly used in chemical analysis.

1.2 The information in this practice is arranged as follows:

	Sections
Referenced Documents	2
Terminology	3
Significance and Use	4
Apparatus	5
Temperature effects	6
Measurements	7
Reagents	8
Concentration of solutions	9
Mixing of solutions	10
Storage of solutions	11
Preparation and standardization of solutions	12
Precision and Bias	13
Sodium hydroxide solution, 0.02 to 1.0 meq/mL (N)	14 to 19
Hydrochloric acid, 0.02 to 1.0 meq/mL (N)	20 to 28
Sulfuric acid, 0.02 to 1.0 meq/mL (N)	29 to 33
Hydrochloric acid, special 1 meq/mL (N)	34 to 38
Sulfuric acid, special 1 meq/mL (N)	39 to 43
Silver nitrate solution, 0.1 meq/mL (N)	44 to 48
Ammonium thiocyanate solution, 0.1 meq/mL (N)	49 to 53
Iodine solution, 0.1 meq/mL (N)	54 to 58
Sodium thiosulfate solution, 0.1 meq/mL (N)	59 to 63
Potassium permanganate solution, 0.1 meq/mL (N)	64 to 68
Potassium dichromate solution, 0.1 meq/mL (N)	69 to 73
Methanolic sodium hydroxide solution, 0.5 meq/mL (N)	74 to 79
Ceric sulfate solution, 0.1 meq/mL (N)	80 to 84
Acetous perchloric acid, 0.1 meq/mL (N)	85 to 89
Disodium ethylenediaminetetraacetate solution, 0.05 mol/L (M)	90 to 94
Standard ion solutions	95
Nonstandardized reagent solutions and indicator solutions	96

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the*

¹ This practice is under the jurisdiction of ASTM Committee D16 on Aromatic, Industrial, Specialty and Related Chemicals and is the direct responsibility of Subcommittee D16.04 on Instrumental Analysis.

Current edition approved July 1, 2023. Published July 2023. Originally approved in 1962 as E200 – 62T. Last previous edition approved in 2016 as E200 – 16. DOI: 10.1520/E0200-23.

responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use. Specific warning statements are given throughout this practice. Consult current OSHA regulations, suppliers' Safety Data Sheets, and local regulations for all materials used in this specification.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

D1193 Specification for Reagent Water

E50 Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials

E180 Practice for Determining the Precision of ASTM Methods for Analysis and Testing of Industrial and Specialty Chemicals (Withdrawn 2009)³

E203 Test Method for Water Using Volumetric Karl Fischer Titration

E694 Specification for Laboratory Glass Volumetric Apparatus

2.2 Other Document:⁴

Reagent Chemicals American Chemical Society Specifications (ACS)

3. Terminology

3.1 Definitions:

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American Chemical Society (ACS), 1155 Sixteenth St., NW, Washington, DC 20036, <http://www.acs.org>.

*A Summary of Changes section appears at the end of this standard

3.1.1 *standard volumetric solution*—a solution of accurately determined concentration used in the quantitative analysis of chemicals and other products. The concentration of such solutions is usually expressed in terms of meq/mL (*N*) normality or mol/L (*M*) molarity.

4. Significance and Use

4.1 The accuracy of many analytical measurements is dependent upon the manner in which the standard solutions are prepared and stored, and the accuracy with which they are standardized. Combining the methods recommended for the preparation and handling of such solutions into one practice eliminates the necessity for covering such details in all of the methods wherein the solutions are used.

5. Apparatus

5.1 *Volumetric Glassware*—The use of ordinary volumetric glassware will meet the accuracy requirements of many test methods.

NOTE 1—For dependable accuracy, volumetric glassware meeting the requirements for Class A items given in Specification E694 should be used. While for normal work apparatus meeting these specifications can be used without calibration corrections, it is preferable that such calibration corrections be used in standardizing volumetric solutions. Such corrections may be of significance when the volumetric ware is frequently used with alkali solutions, for the corrosive effect of the alkali upon the glass may result in changes in the apparent volume. It is recommended, therefore, that volumetric glassware, particularly burets and transfer pipets, be recalibrated at 3-month intervals if it is frequently used to measure alkali solution volumes.

5.2 *Buret*—A 50 mL buret, or alternatively, a 100 mL buret with a 50 mL bulb at the top and a 50 mL stem below, may be used. For use with alkali solutions, burets equipped with TFE-fluorocarbon stopcock plugs are preferable.

6. Temperature Effects

6.1 Volumetric solutions are often used at temperatures differing from those at which the standardization was carried out. Significant errors may be introduced when the solutions are used at these other temperatures. Values for the change of normality with temperature ($\Delta N/^\circ\text{C}$) have been established for the volumetric solutions described herein, and are listed in Table 1. When warranted by the desired accuracy of the work, normalities of standard solutions may be corrected to the temperature at which they are used as follows:

$$N_{t_2} = N_{t_1} + (t_1 - t_2)(F) \quad (1)$$

TABLE 1 Temperature Correction Factors (*F*)

Approximate meq/mL (<i>N</i>)	Solute	$\Delta N/^\circ\text{C}$ for 20 to 30 $^\circ\text{C}$
1.0	NaOH, HCl, H_2SO_4	0.00035
0.5	NaOH, HCl, H_2SO_4	0.00014
0.1	all aqueous	0.00002
0.05	all aqueous	0.00001
0.01	all aqueous	0.00000
0.5 (in methanol)	NaOH	0.00045
0.1 (in 1 <i>N</i> H_2SO_4)	$\text{Ce}(\text{SO}_4)_2$	0.000035
0.1 (in glacial acetic acid)	HClO_4	0.00011

where:

N_{t_1} = meq/mL (*N*) of solution when standardized,
 N_{t_2} = meq/mL (*N*) of solution when used,
 t_1 = temperature of solution during standardization, $^\circ\text{C}$
 t_2 = temperature of solution during use, $^\circ\text{C}$, and
 F = factor to correct for thermal expansion of the solution ($\Delta N/^\circ\text{C}$ values from Table 1).

6.2 From the above equation it will be seen that the correction is to be added to the meq/mL (*N*) of the solution when standardized if the temperature of use is lower than the temperature of standardization while the correction is to be subtracted if the temperature of use is higher than the temperature of standardization.

7. Measurements

7.1 *Weighings*—When it is directed that a chemical should be “accurately weighed,” the weighing is to be performed in a manner so as to limit the error to 0.1 % or less. Where a specific weight of substance is designated in a procedure, it is intended, unless otherwise specified in the individual procedure, that a quantity within $\pm 5\%$ of the designated weight be used, and that this quantity be “accurately weighed” as just defined.

NOTE 2—In weighing primary standards to be used in standardizing volumetric solutions many laboratories customarily weigh to the nearest 0.1 mg even though such increased accuracy of weighing does not improve the accuracy or precision of the standardization.

7.2 *Buret Readings*—When buret readings are specified, or when the procedure infers that a specific volume be measured from a buret, the reading is to be estimated to one fifth of the smallest volume subdivision marked on the buret. In reading a 50 mL buret having subdivisions of 0.10 mL, therefore, the reading should be estimated to the nearest 0.02 mL.

7.3 *Expression of Results*—It is recommended to express the concentration of the solutions as the normality in the equivalent SI units as meq/mL (*N*) and molarity as mol/L (*M*).

8. Reagents

NOTE 3—Additional information on reagents is given in Practices E50.

8.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.⁵ Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

8.2 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean Type I or Type II reagent water conforming to Specification D1193. Where specified, carbon dioxide-free water is to be prepared by heating Type I

⁵ ACS Reagent Chemicals, Specifications and Procedures for Reagents and Standard-Grade Reference Materials, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.