



Designation: **E50–11 (Reapproved 2016) E50 – 17**

## Standard Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials<sup>1</sup>

This standard is issued under the fixed designation E50; 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 ( $\epsilon$ ) 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 These practices cover laboratory apparatus and reagents that are required for the chemical analysis of metals, ores and related materials by standard methods of ASTM. Detailed descriptions of recommended apparatus and detailed instructions for the preparation of standard solutions and certain nonstandardized reagents will be found listed or specified in the individual methods of analysis. Included here are general recommendations on the purity of reagents and protective measures for the use of hazardous reagents.

1.2 These recommendations are intended to apply to the ASTM methods of chemical analysis of metals when definite reference is made to these practices, as covered in Section 4.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of whoever uses the user of this standard to consult and establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Specific hazards are given in Section 8.

NOTE 1—The use of the verb “shall” (with its obligatory third person meaning) in this standard has been confined to those aspects of laboratory safety where regulatory requirements are known to exist. Such regulations, however, are beyond the scope of these practices.

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:*<sup>2</sup>

[D1193 Specification for Reagent Water](#)

[E1 Specification for ASTM Liquid-in-Glass Thermometers](#)

[E77 Test Method for Inspection and Verification of Thermometers](#)

[E100 Specification for ASTM Hydrometers](#)

[E126 Test Method for Inspection, Calibration, and Verification of ASTM Hydrometers](#)

[E135 Terminology Relating to Analytical Chemistry for Metals, Ores, and Related Materials](#)

[E287 Specification for Laboratory Glass Graduated Burets](#)

[E288 Specification for Laboratory Glass Volumetric Flasks](#)

[E438 Specification for Glasses in Laboratory Apparatus](#)

[E542 Practice for Calibration of Laboratory Volumetric Apparatus](#)

[E694 Specification for Laboratory Glass Volumetric Apparatus](#)

[E969 Specification for Glass Volumetric \(Transfer\) Pipets](#)

[E1044 Specification for Glass Serological Pipets \(General Purpose and Kahn\)](#)

<sup>1</sup> These practices are under the jurisdiction of ASTM Committee E01 on Analytical Chemistry for Metals, Ores, and Related Materials and are the direct responsibility of Subcommittee E01.20 on Fundamental Practices.

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<sup>2</sup> 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.

**E1621 Guide for Elemental Analysis by Wavelength Dispersive X-Ray Fluorescence Spectrometry**

**2.2 ISO Standard<sup>3</sup>**

**DIN EN ISO 1042 Laboratory glassware -- One-mark volumetric flasks**

### 3. Terminology

3.1 For definitions of terms used in these practices, refer to Terminology **E135**.

### 4. Significance and Use

4.1 The inclusion of the following paragraph, or a suitable equivalent, in any standard (preferably after the section on Scope) is due notification that the apparatus and reagents required in that standard are subject to the recommendations set forth in these practices.

*“Apparatus and Reagents—Apparatus and reagents required for each determination are listed in separate sections preceding the procedure. Apparatus, standard solutions, and certain other reagents shall conform to the requirements prescribed in ASTM Practices E50, for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials.”*

4.2 It is assumed that the users of these practices will be trained analysts capable of performing common laboratory procedures skillfully and safely. It is expected that work will be performed in a properly-equipped laboratory.

### 5. Purity of Water and Reagents

5.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water conforming to Type I or II of Specification **D1193**. Type III or IV may be used if they effect no measurable change in the blank or sample.

5.2 *Reagents*—Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society when such specifications are available.<sup>4</sup> 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. In addition to this, it is desirable in many cases for the analyst to ensure the accuracy of his results by running blanks or checking against a comparable sample of known composition.

### 6. Reagents

6.1 *Concentrated Acids, Ammonium Hydroxide, and Hydrogen Peroxide*—When acids, ammonium hydroxide, and hydrogen peroxide are specified by name or chemical formula only, it is understood that concentrated reagents of the specific gravities or concentrations shown in **Table 2** are intended. The specific gravities or concentrations of all other concentrated acids are stated wherever they are specified.

6.2 *Diluted Acids and Ammonium Hydroxide*—Concentrations of diluted acids and ammonium hydroxide, except when standardized, are specified as a ratio stating the number of volumes of the concentrated reagent to be diluted with a given number of volumes of water, as in the following example: HCl (5 + 95) means 5 volumes of concentrated HCl (sp gr 1.19) diluted with 95 volumes of water.

6.3 *Standard Solutions*—Concentrations of standard solutions are stated as molarities or normalities, expressed decimally; or the equivalent of 1 mL of solution in terms of grams, milligrams, or micrograms of a given element expressed as “1 mL = x.xx—g, mg, or µg of...”

6.4 *Nonstandard Solutions*—Composition of nonstandard solutions prepared by dissolving a given mass of the solid reagent in a solvent are specified in grams of the salt as weighed per litre of solution, and it is understood that water is the solvent unless otherwise specified. For example, to prepare barium chloride solution (100 g/L) dissolve 100 g of barium chloride (BaCl<sub>2</sub>·2H<sub>2</sub>O) in water and dilute to 1 L. In the case of certain reagents, the composition may be specified as a mass fraction percent. For example, H<sub>2</sub>O<sub>2</sub> (3 %) means a solution containing 3 g of H<sub>2</sub>O<sub>2</sub> per 100 g of solution. Other nonstandard solutions may be specified by name only and the designation of the composition of such solutions will be governed by the instructions for their preparation.

### 7. Laboratory Ware **(1,2)**<sup>5,6</sup>

7.1 *Glassware*—Unless otherwise stated all analytical methods are conducted in borosilicate glassware.

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>4</sup> *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC, [www.chemistry.org](http://www.chemistry.org). For suggestions on the testing of reagents not listed by the American Chemical Society, see the *United States Pharmacopeia* and *4.2 National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD, [www.usp.org](http://www.usp.org).

<sup>5</sup> The boldface numbers in parentheses refer to the list of references at the end of these practices.

<sup>6</sup> For further information the following ASTM Standards may be consulted: Volumetric Labware: Specifications **E287**, **E288**, and **E438**; Practice **E542**; and Specifications **E694**, **E969**, and **E1044**. Thermometers: Specification **E1** and Test Method **E77**. Hydrometers: Specification **E100** and Test Method **E126**.

**TABLE 1 Chemical Reagents Specified in ASTM Methods for Chemical Analysis of Metals**

Name	Formula
* Acetic acid	CH <sub>3</sub> COOH
Acetone	CH <sub>3</sub> COCH <sub>3</sub>
Acetylacetone (2,4-pentanedione)	CH <sub>3</sub> COCH <sub>2</sub> COCH <sub>3</sub>
Alizarin-Red-S	C <sub>6</sub> H <sub>4</sub> COC <sub>6</sub> H-1,2-(OH) <sub>2</sub> -3-SO <sub>3</sub> NaCO
Aluminon (aurintricarboxylic acid-ammonium salt)	(4-HOC <sub>6</sub> H <sub>3</sub> -3-COONH <sub>4</sub> ) <sub>2</sub> C:C <sub>6</sub> H-3-(COONH <sub>4</sub> ):O
Aluminum metal (99.9 % min)	Al
* Aluminum metal (sheet or rolled foil)	Al
Aluminum ammonium sulfate	Al <sub>2</sub> (NH <sub>4</sub> ) <sub>2</sub> (SO <sub>4</sub> ) <sub>4</sub> ·24H <sub>2</sub> O
Aluminum nitrate	Al(NO <sub>3</sub> ) <sub>3</sub> ·9H <sub>2</sub> O
Aluminum sulfate	Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> ·18H <sub>2</sub> O
Aluminum oxide, fused (Alundum)	
1-Amino-2-naphthol-4-sulfonic acid	NH <sub>2</sub> C <sub>10</sub> H <sub>5</sub> (OH)SO <sub>3</sub> H
Ammonium acetate	CH <sub>3</sub> COONH <sub>4</sub>
Ammonium benzoate	C <sub>6</sub> H <sub>5</sub> COONH <sub>4</sub>
Ammonium bifluoride	NH <sub>4</sub> FHF
Ammonium bisulfate	NH <sub>4</sub> HSO <sub>4</sub>
Ammonium bisulfite	NH <sub>4</sub> HSO <sub>3</sub>
Ammonium carbonate	(NH <sub>4</sub> ) <sub>2</sub> CO <sub>3</sub>
* Ammonium chloride	NH <sub>4</sub> Cl
* Ammonium citrate	CH <sub>2</sub> (COONH <sub>4</sub> )C(OH)(COOH)CH <sub>2</sub> COONH <sub>4</sub>
Ammonium fluoride	NH <sub>4</sub> F
* Ammonium hydroxide <sup>A</sup>	NH <sub>4</sub> OH
Ammonium iodide	NH <sub>4</sub> I
Ammonium molybdate	(NH <sub>4</sub> ) <sub>2</sub> MoO <sub>4</sub>
* Ammonium heptamolybdate tetrahydrate	(NH <sub>4</sub> ) <sub>6</sub> Mo <sub>7</sub> O <sub>24</sub> ·4H <sub>2</sub> O
Ammonium nitrate	NH <sub>4</sub> NO <sub>3</sub>
* Ammonium oxalate	NH <sub>4</sub> OCOCOONH <sub>4</sub> ·H <sub>2</sub> O
* Ammonium phosphate, dibasic (diammonium acid phosphate)	(NH <sub>4</sub> ) <sub>2</sub> HPO <sub>4</sub>
* Ammonium persulfate (ammonium peroxydisulfate)	(NH <sub>4</sub> ) <sub>2</sub> S <sub>2</sub> O <sub>8</sub>
* Ammonium sulfate	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>
* Ammonium tartrate	NH <sub>4</sub> OCO(CHOH) <sub>2</sub> COONH <sub>4</sub>
Ammonium thiocyanate	NH <sub>4</sub> SCN
Ammonium vanadate	NH <sub>4</sub> VO <sub>3</sub>
Antimony metal (powder)	Sb
Antimony trichloride	SbCl <sub>3</sub>
* Arsenic trioxide	As <sub>2</sub> O <sub>3</sub>
Asbestos (for use with Gooch crucible)	
Barium Chloride	BaCl <sub>2</sub> ·2H <sub>2</sub> O
Barium diphenylamine sulfonate	(C <sub>6</sub> H <sub>5</sub> NHC <sub>6</sub> H <sub>4</sub> -4-SO <sub>3</sub> ) <sub>2</sub> Ba
* Benzoic acid	C <sub>6</sub> H <sub>5</sub> COOH
α-Benzoin oxime (benzoin anti-oxime)	C <sub>6</sub> H <sub>5</sub> CHOHC:NOHC <sub>6</sub> H <sub>5</sub>
Beryllium sulfate	BeSO <sub>4</sub> ·4H <sub>2</sub> O
Bismuth metal (99.9 % min)	Bi
Boric acid	H <sub>3</sub> BO <sub>3</sub>
Bromocresol green (3',3'',5',5''-tetrabromo- <i>m</i> -cresolsulfonephthalein)	C <sub>6</sub> H <sub>4</sub> SO <sub>2</sub> OC(C <sub>6</sub> H-3,5-Br <sub>2</sub> -2-CH <sub>3</sub> -4-OH) <sub>2</sub>
Bromocresol purple (5',5''-Dibromo- <i>o</i> -cresolsulfonephthalein)	C <sub>6</sub> H <sub>4</sub> SO <sub>2</sub> OC(C <sub>6</sub> H <sub>2</sub> -3-CH <sub>3</sub> -5-Br-4-OH) <sub>2</sub>
Bromine (liquid)	Br <sub>2</sub>
Bromophenol blue (3',3'',5',5''-tetrabromophenolsulfonephthalein)	C <sub>6</sub> H <sub>4</sub> SO <sub>2</sub> OC(C <sub>6</sub> H <sub>2</sub> -3,5-Br <sub>2</sub> -4-OH) <sub>2</sub>
1-Butanol	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OH
Butyl acetate (normal)	CH <sub>3</sub> COOCH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>
* Cadmium chloride	CdCl <sub>2</sub> ·2½ H <sub>2</sub> O
Cadmium chloride, anhydrous	CdCl <sub>2</sub>
* † Calcium carbonate (low-boron)	CaCO <sub>3</sub>
Carbon dioxide (gas)	CO <sub>2</sub>
Carbon dioxide (solid)	CO <sub>2</sub>
Carbon tetrachloride	CCl <sub>4</sub>
Carminic acid	1,3,4-(HO) <sub>3</sub> -2-C <sub>6</sub> H <sub>11</sub> O <sub>6</sub> COC <sub>6</sub> H-5-COOH-6-OH-8-CH <sub>3</sub> CO
* Chloroform	CHCl <sub>3</sub>
Cinchonine	C <sub>19</sub> H <sub>22</sub> N <sub>2</sub> O
Citric acid	HOC(COOH)(CH <sub>2</sub> COOH) <sub>2</sub>
Cobalt metal	Co
Cobalt sulfate	CoSO <sub>4</sub>
Coke	
Congo red test paper	
Copper metal (99.9 % min)	Cu
* Copper metal (powder or turnings)	Cu

**TABLE 1** *Continued*

Name	Formula
Copper metal (P-free)	Cu
Copper metal (Mn, Ni, and Co-free, less than 0.001 % of each)	Cu
Copper-rare earth oxide mixture	
<i>m</i> -Cresol purple ( <i>m</i> -cresolsulfonephthalein)	$C_6H_4SO_2OC(C_6H_3-2-CH_3-4-OH)_2$
Cupferron	$C_6H_5N(NO)ONH_4$
Cupric chloride	$CuCl_2 \cdot 2H_2O$
* Cupric nitrate	$Cu(NO_3)_2 \cdot 3H_2O$
* Cupric oxide (powder)	CuO
Cupric potassium chloride	$CuCl_2 \cdot 2KCl \cdot 2H_2O$
* Cupric sulfate	$CuSO_4 \cdot 5H_2O$
Curcumin	$(2-CH_3OC_6H_3-1-OH-4-CH:CHCO)_2CH_2$
Devarda's alloy	50Cu-45Al-5Zn
Diethylenetriamine pentaacetic acid ([[(carboxymethyl)imino]bis(ethylenenitrilo)] tetraacetic acid)	$((HOCOCH_2)_2NCH_2CH_2)_2NCH_2COOH$
* Dimethylglyoxime	$CH_3C:NOHC:NOHCH_3$
N,N' Diphenylbenzidine	$C_6H_5NHC_6H_4C_6H_4NHC_6H_5$
Diphenylcarbazine (1,5-diphenylcarbohydrazide)	$C_6H_5NHNHC(=O)NHC_6H_5$
* Disodium (ethylenedinitrilo) tetraacetate dihydrate	See (ethylenedinitrilo) tetraacetic acid disodium salt
Dithiol (toluene-3,4-dithiol)	$CH_3C_6H_3(SH)_2$
Dithizone (diphenylthiocarbazon)	$C_6H_5NHNHCSN:NC_6H_5$
Eriochrome black-T (1(1-hydroxy-2-naphthylazo)- 6-nitro-2-naphthol-4-sulfonic acid sodium salt)	1-HOC <sub>10</sub> H <sub>6</sub> -2-N:N-1-C <sub>10</sub> H <sub>4</sub> -2-OH-4-SO <sub>3</sub> Na-6- NO <sub>2</sub>
* EDTA (Disodium salt)	See (ethylenedinitrilo) tetraacetic acid disodium salt
* Ethanol	$C_2H_5OH$
* Ethyl ether (diethyl ether)	$C_2H_5OC_2H_5$
* (Ethylenedinitrilo) tetraacetic acid disodium salt	$HOCOCH_2(NaOCOCH_2)NCH_2N(CH_2COONa)CH_2COOH \cdot 2H_2O$
Ethylene glycol monomethyl ether (2-methoxy- ethanol)	$CH_3OCH_2CH_2OH$
* Ferric chloride	$FeCl_3 \cdot 6H_2O$
* Ferric nitrate	$Fe(NO_3)_3 \cdot 9H_2O$
Ferric sulfate	$Fe_2(SO_4)_3 \cdot nH_2O$
* Ferrous ammonium sulfate	$Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$
* Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Fluoroboric acid	HBF <sub>4</sub>
Fluorescein, sodium salt	$2NaOCOC_6H_4C:C_6H_3-3:(O)OC_6H_3-6-ONA$
Formaldehyde	HCHO
* Formic acid <sup>A</sup>	HCOOH
Gelatin	
Graphite	C
Glass wool	
Glycerol	$CH_2OHCHOHCH_2OH$
Hydrazine sulfate	$NH_2NH_2 \cdot H_2SO_4$
* Hydrobromic acid <sup>A</sup>	HBr
* Hydrochloric acid <sup>A</sup>	HCl
* Hydrofluoric acid <sup>A</sup>	HF
Hydrogen chloride gas	HCl
* Hydrogen peroxide	$H_2O_2$
Hydrogen sulfide gas	$H_2S$
Hydroquinone	$1,4-(OH)_2C_6H_4$
* Hydroxylamine hydrochloride	$NH_2OH \cdot HCl$
* Hypophosphorous acid <sup>B</sup>	$H_3PO_2$
Invert sugar	
* Iodine	I <sub>2</sub>
Iron metal or wire (99.8 % min)	Fe
Isopropyl ether	$(CH_3)_2CHOCH(CH_3)_2$
Lead metal	Pb
* Lead acetate	$Pb(CH_3COO)_2$
Lead chloride	PbCl <sub>2</sub>
* Lead nitrate	$Pb(NO_3)_2$
Litmus	
Lithium fluoride	LiF
Magnesium metal (Sn-free)	Mg
Magnesium perchlorate, anhydrous	$Mg(ClO_4)_2$

**TABLE 1** *Continued*

Name	Formula
* Magnesium sulfate	MgSO <sub>4</sub> ·7H <sub>2</sub> O
Manganese metal (99.8 % min)	Mn
Manganous nitrate	Mn(NO <sub>3</sub> ) <sub>2</sub>
Manganous sulfate	MnSO <sub>4</sub> ·H <sub>2</sub> O
Mannitol	CH <sub>2</sub> OH(CHOH) <sub>4</sub> CH <sub>2</sub> OH
Marble chips	
* Mercuric chloride	HgCl <sub>2</sub>
* Mercury	Hg
* Methanol	CH <sub>3</sub> OH
Methyl isobutyl ketone (4-methyl-2-pentanone)	CH <sub>3</sub> COCH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub>
* Methyl orange ( <i>p</i> [[ <i>p</i> -dimethylamino)phenyl]azo]benzenesulfonic acid sodium salt)	4-NaOSO <sub>2</sub> C <sub>6</sub> H <sub>4</sub> N:NC <sub>6</sub> H <sub>4</sub> -4-N(CH <sub>3</sub> ) <sub>2</sub>
Methyl purple	formula unknown, patented
* Methyl red ( <i>o</i> -[[ <i>p</i> -dimethylamino)phenyl]azo]benzoic acid)	4-(CH <sub>3</sub> ) <sub>2</sub> NC <sub>6</sub> H <sub>4</sub> N:NC <sub>6</sub> H <sub>4</sub> -2-COOH
Molybdenum metal (99.8 % min)	Mo
Molybdic acid, anhydride (molybdenum trioxide)	MoO <sub>3</sub>
Molybdic acid (ammonium paramolybdate)	Assay: as MoO <sub>3</sub> —85 %
Morin, anhydrous (2',3,4',7-penta hydroxyflavone)	5,7-(HO) <sub>2</sub> C <sub>6</sub> H <sub>2</sub> OC(C <sub>6</sub> H <sub>3</sub> -2,4-(OH) <sub>2</sub> ):C(OH)CO
β-Naphthoquinoline (5,6-benzoquinoline)	C <sub>10</sub> H <sub>6</sub> CH:CHCH:N
Neocuproine (2,9-dimethyl-1,10-phenanthroline)	(CH <sub>3</sub> ) <sub>2</sub> C <sub>12</sub> H <sub>6</sub> N <sub>2</sub> ·12H <sub>2</sub> O
Nickel metal (99.8 % min)	Ni
Nickel metal (sheet)	Ni
Nickelous nitrate	Ni(NO <sub>3</sub> ) <sub>2</sub> ·6H <sub>2</sub> O
Nickelous sulfate	NiSO <sub>4</sub> ·6H <sub>2</sub> O
* Nitric acid <sup>4</sup>	HNO <sub>3</sub>
Nitrogen gas (oxygen-free)	N <sub>2</sub>
Nitrogen, liquid	N <sub>2</sub>
<i>m</i> -Nitrophenol	NO <sub>2</sub> C <sub>6</sub> H <sub>4</sub> OH
1-Nitroso-2-naphthol( <i>α</i> -nitroso-β-naphthol)	NOC <sub>10</sub> H <sub>6</sub> OH
Nitroso-R-salt (1-nitroso-2-naphthol-3,6-disulfonic acid disodium salt)	1-NOC <sub>10</sub> H <sub>4</sub> -2-(OH)-3,6-(SO <sub>3</sub> Na) <sub>2</sub>
Osmium tetroxide	OsO <sub>4</sub>
Oxalic acid	(COOH) <sub>2</sub>
Oxygen gas	O <sub>2</sub>
* Perchloric acid <sup>4</sup>	HClO <sub>4</sub>
1,10-Phenanthroline ( <i>o</i> -phenanthroline)	CH:CHCH:NC:CCH:CHC:CN:CHCH:CH·H <sub>2</sub> O
* Phenolphthalein	C <sub>6</sub> H <sub>4</sub> COOC(C <sub>6</sub> H <sub>4</sub> -4-OH) <sub>2</sub>
* Phosphoric acid	H <sub>3</sub> PO <sub>4</sub>
Piperidine	NH(CH <sub>2</sub> ) <sub>4</sub> CH <sub>2</sub>
Platinized quartz	
Platinized silica gel	
Platinum gauze	Pt
* Potassium biphthalate	1-KOCOC <sub>6</sub> H <sub>4</sub> -2-COOH
Potassium bisulfate	KHSO <sub>4</sub>
* Potassium bromate	KBrO <sub>3</sub>
* Potassium bromide	KBr
* Potassium chlorate	KClO <sub>3</sub>
* Potassium chloride	KCl
* Potassium chromate	K <sub>2</sub> CrO <sub>4</sub>
Potassium columbate	4K <sub>2</sub> O·3Cb <sub>2</sub> O <sub>5</sub> ·16H <sub>2</sub> O
* Potassium cyanide	KCN
* Potassium dichromate	K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub>
* Potassium ferricyanide	K <sub>3</sub> Fe(CN) <sub>6</sub>
Potassium ferrocyanide	K <sub>4</sub> Fe(CN) <sub>6</sub> ·3H <sub>2</sub> O
* Potassium fluoride	KF·2H <sub>2</sub> O
* Potassium hydroxide	KOH
* Potassium iodate	KIO <sub>3</sub>
* Potassium iodide	KI
Potassium iodide starch paper	
* Potassium nitrate	KNO <sub>3</sub>
* Potassium <i>m</i> -periodate	KIO <sub>4</sub>
* Potassium permanganate	KMnO <sub>4</sub>
Potassium persulfate	K <sub>2</sub> S <sub>2</sub> O <sub>8</sub>
Potassium phosphate, monobasic	KH <sub>2</sub> PO <sub>4</sub>
* Potassium pyrosulfate	K <sub>2</sub> S <sub>2</sub> O <sub>7</sub>
* Potassium sulfate	K <sub>2</sub> SO <sub>4</sub>
Potassium tantalum fluoride	K <sub>2</sub> TaF
Potassium thiocarbonate	K <sub>2</sub> CS <sub>3</sub>
* Potassium thiocyanate	KSCN

**TABLE 1** *Continued*

Name	Formula
Pyrogallol acid (pyrogallol)	$C_6H_3-1,3-(OH)_3$
Quinine sulfate 8-Quinolinol (8-hydroxyquinoline)	$(C_{20}H_{24}N_2O_2)_2 \cdot H_2SO_4 \cdot 2H_2O$ $HOC_6H_3N:CHCH:CH$
Sebacic acid	$HOCO(CH_2)_8COOH$
Selenium (powder)	Se
Silicon dioxide (silica)	$SiO_2$
* Silver nitrate	$AgNO_3$
Soda-lime	
Soda-mica mineral ( $CO_2$ absorbent)	
Sodium acetate	$CH_3COONa$
Sodium arsenite	$NaAsO_2$
Sodium azide	$NaN_3$
* Sodium bicarbonate	$NaHCO_3$
* Sodium bismuthate	$NaBiO_3$
Sodium bisulfate	see sodium hydrogen sulfate
* Sodium bisulfate, fused	see sodium hydrogen sulfate, fused
Sodium bisulfite	$NaHSO_3$
* Sodium borate	$Na_2B_4O_7 \cdot 10H_2O$
* Sodium carbonate, anhydrous	$Na_2CO_3$
Sodium chlorate	$NaClO_3$
Sodium chloride	NaCl
Sodium citrate	$HOC(COONa)(CH_2COONa)_2 \cdot 2H_2O$
Sodium cyanide	NaCN
Sodium diethyldithiocarbamate	$(C_2H_5)_2NCSSNa \cdot 3H_2O$
Sodium dimethylglyoximate	$CH_3C(:NONa)C(:NONa)CH_3 \cdot 8H_2O$
Sodium diphenylamine sulfonate	$C_6H_5NHC_6H_4-4-SO_3Na$
Sodium dithionite (hydrosulfite)	$Na_2S_2O_4$
* Sodium fluoride	NaF
Sodium hydrogen sulfate	$NaHSO_4$
Sodium hydrogen sulfate, fused	A mixture of $Na_2S_2O_7$ and $NaHSO_4$
* Sodium hydroxide	NaOH
Sodium hypophosphite	$NaH_2PO_2 \cdot H_2O$
Sodium molybdate	$Na_2MoO_4 \cdot 2H_2O$
Sodium nitrate	$NaNO_3$
Sodium nitrite	$NaNO_2$
Sodium oxalate	$NaOCOCOONa$
Sodium perchlorate	$NaClO_4$
Sodium peroxide	$Na_2O_2$
Sodium phosphate, dibasic, anhydrous	$Na_2HPO_4$
Sodium pyrophosphate	$Na_4P_2O_7 \cdot 10H_2O$
Sodium pyrosulfate	$Na_2S_2O_7$
Sodium sulfate, anhydrous	$Na_2SO_4$
Sodium sulfide	$Na_2S \cdot 9H_2O$
Sodium sulfite	$Na_2SO_3 \cdot 7H_2O$
Sodium sulfite, anhydrous	$Na_2SO_3$
Sodium thiocyanate	NaSCN
* Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
* Sodium tungstate	$Na_2WO_4 \cdot 2H_2O$
* Stannous chloride	$SnCl_2 \cdot 2H_2O$
* Starch	$(C_6H_{10}O_5)_x$
Succinic acid	$HOCOCH_2CH_2COOH$
Sulfamic acid	$NH_2SO_3H$
Sulfatoceric acid (ceric sulfate)	$H_4Ce(SO_4)_4$
5-Sulfosalicylic acid	$2-HOC_6H_3-1-COOH-5-SO_3H \cdot 2H_2O$
Sulfur dioxide gas	$SO_2$
* Sulfuric acid <sup>A</sup>	$H_2SO_4$
* Sulfurous acid <sup>A</sup>	$H_2SO_3$
Talc	
* Tartaric acid	$HOCO(CHOH)_2COOH$
Test lead	Pb
Tetrapropylammonium hydroxide	$(CH_3CH_2CH_2)_4NOH$
Thioglycolic acid (mercaptoacetic acid)	$CH_2SHCOOH$
Thiourea	$NH_2CSNH_2$
Tin metal (99.9 %min)	Sn
Titanium dioxide	$TiO_2$
Titanium metal (low Sn)	Ti
Triethanolamine (2,2',2''-nitrilotriethanol)	$(CH_2OHCH_2)_3N$
Uranium oxide	$U_3O_8$
* Uranyl nitrate	$UO_2(NO_3)_2 \cdot 6H_2O$
Urea	$NH_2CONH_2$