Designation: ~~E50 – 11~~ E50 – 11 (Reapproved 2016)

Standard Practices for Apparatus, Reagents, and Safety Considerations for Chemical Analysis of Metals, Ores, and Related Materials[1]

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 (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 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 this standard to consult and establish appropriate safety and health 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.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

3. Terminology

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

---

[1] 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.

Current edition approved ~~Oct. 15, 2011~~Aug. 1, 2016. Published ~~November 2011~~August 2016. Originally approved in 1943. Last previous edition approved in ~~2005~~2011 as E50~~–00 (2005).~~–11. DOI: ~~10.1520/E0050-11.~~10.1520/E0050-16.

[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.

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.[3] 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 ~~*Nonstandardized*~~*Nonstandard Solutions*—Composition of ~~nonstandardized~~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 ($BaCl_2 \cdot 2H_2O$) in water and dilute to 1 L. In the case of certain reagents, the composition may be specified as a ~~weight~~ mass fraction percent. For example, H_2O_2 (3 %) means a solution containing 3 g of H_2O_2 per 100 g of solution. Other ~~nonstandardized~~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)[4,5]

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

7.1.1 *Tolerances*—All glass apparatus and vessels used in analytical work must be carefully selected and calibrated to meet the particular requirements for each operation. Standard volumetric flasks, burets, and pipets must be of Class A or B within the tolerances established by the National Institute of Standards and Technology and ASTM.[5]

7.1.2 *Types*—Glasses are available which include colored glass for the protection of solutions affected by light, alkali-resistant glass, and high-silica glass having exceptional resistance to thermal shock. Standard-taper, interchangeable, ground-glass joints are very useful in analytical work.

7.2 *Plastic Labware:*

---

[3] *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, ~~DC.~~ DC, 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.~~MD, www.usp.org.

[4] The boldface numbers in parentheses refer to the list of references at the end of these practices.

[5] 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_3COOH
Acetone	CH_3COCH_3
Acetylacetone (2,4-pentanedione)	$CH_3COCH_2COCH_3$
Alizarin-Red-S	$C_6H_4COC_6H$-1,2-$(OH)_2$-3-SO_3NaCO
Aluminon (aurintricarboxylic acid-ammonium salt)	$(4\text{-}HOC_6H_3\text{-}3\text{-}COONH_4)_2C{:}C_6H$-3-$(COONH_4){:}O$
Aluminum metal (99.9 % min)	Al
* Aluminum metal (sheet or rolled foil)	Al
Aluminum ammonium sulfate	$Al_2(NH_4)_2(SO_4)_4{\cdot}24H_2O$
Aluminum nitrate	$Al(NO_3)_3{\cdot}9H_2O$
Aluminum sulfate	$Al_2(SO_4)_3{\cdot}18H_2O$
Aluminum oxide, fused (Alundum)	
1-Amino-2-naphthol-4-sulfonic acid	$NH_2C_{10}H_5(OH)SO_3H$
Ammonium acetate	CH_3COONH_4
Ammonium benzoate	$C_6H_5COONH_4$
Ammonium bifluoride	NH_4FHF
Ammonium bisulfate	NH_4HSO_4
Ammonium bisulfite	NH_4HSO_3
Ammonium carbonate	$(NH_4)_2CO_3$
* Ammonium chloride	NH_4Cl
* Ammonium citrate	$CH_2(COONH_4)C(OH)(COOH)CH_2COONH_4$
Ammonium fluoride	NH_4F
* Ammonium hydroxide[A]	NH_4OH
Ammonium iodide	NH_4I
Ammonium molybdate	$(NH_4)_2MoO_4$
* Ammonium heptamolybdate tetrahydrate	$(NH_4)_6Mo_7O_{24}{\cdot}4H_2O$
Ammonium nitrate	NH_4NO_3
* Ammonium oxalate	$NH_4OCOCOONH_4{\cdot}H_2O$
* Ammonium phosphate, dibasic (diammonium acid phosphate)	$(NH_4)_2HPO_4$
* Ammonium persulfate (ammonium peroxydisulfate)	$(NH_4)_2S_2O_8$
* Ammonium sulfate	$(NH_4)_2SO_4$
* Ammonium tartrate	$NH_4OCO(CHOH)_2COONH_4$
Ammonium thiocyanate	NH_4SCN
Ammonium vanadate	NH_4VO_3
Antimony metal (powder)	Sb
Antimony trichloride	$SbCl_3$
* Arsenic trioxide	As_2O_3
Asbestos (for use with Gooch crucible)	
Barium Chloride	$BaCl_2{\cdot}2H_2O$
Barium diphenylamine sulfonate	$(C_6H_5NHC_6H_4\text{-}4\text{-}SO_3)_2Ba$
* Benzoic acid	C_6H_5COOH
α-Benzoin oxime (benzoin anti-oxime)	$C_6H_5CHOHC{:}NOHC_6H_5$
Beryllium sulfate	$BeSO_4{\cdot}4H_2O$
Bismuth metal (99.9 % min)	Bi
Boric acid	H_3BO_3
Bromocresol green (3',3″,5',5″-tetrabromo-*m*-cresolsulfonephthalein)	$C_6H_4SO_2OC(C_6H\text{-}3,5\text{-}Br_2\text{-}2\text{-}CH_3\text{-}4\text{-}OH)_2$
Bromocresol purple (5',5″-Dibromo-*o*-cresolsulfonephthalein)	$C_6H_4SO_2OC(C_6H_2\text{-}3\text{-}CH_3\text{-}5\text{-}Br\text{-}4\text{-}OH)_2$
Bromine (liquid)	Br_2
Bromophenol blue (3',3″,5',5″-tetrabromophenolsulfonephthalein)	$C_6H_4SO_2OC(C_6H_2\text{-}3,5\text{-}Br_2\text{-}4\text{-}OH)_2$
1-Butanol	$CH_3CH_2CH_2CH_2OH$
Butyl acetate (normal)	$CH_3COOCH_2CH_2CH_2CH_3$
* Cadmium chloride	$CdCl_2{\cdot}2½\ H_2O$
Cadmium chloride, anhydrous	$CdCl_2$
* † Calcium carbonate (low-boron)	$CaCO_3$
Carbon dioxide (gas)	CO_2
Carbon dioxide (solid)	CO_2
Carbon tetrachloride	CCl_4
Carminic acid	$1,3,4\text{-}(HO)_3\text{-}2\text{-}C_6H_{11}O_6C_6COC_6H\text{-}5\text{-}COOH\text{-}6\text{-}OH\text{-}8\text{-}CH_3CO$
* Chloroform	$CHCl_3$
Cinchonine	$C_{19}H_{22}N_2O$
Citric acid	$HOC(COOH)(CH_2COOH)_2$
Cobalt metal	Co
Cobalt sulfate	$CoSO_4$
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	
m-Cresol purple (*m*-cresolsulfonephthalein)	$C_6H_4SO_2OC(C_6H_3\text{-}2\text{-}CH_3\text{-}4\text{-}OH)_2$
Cupferron	$C_6H_5N(NO)ONH_4$
Cupric chloride	$CuCl_2\cdot2H_2O$
* Cupric nitrate	$Cu(NO_3)_2\cdot3H_2O$
* Cupric oxide (powder)	CuO
Cupric potassium chloride	$CuCl_2\cdot2KCl\cdot2H_2O$
* Cupric sulfate	$CuSO_4\cdot5H_2O$
Curcumin	$(2\text{-}CH_3OC_6H_3\text{-}1\text{-}OH\text{-}4\text{-}CH{:}CHCO)_2CH_2$
Devarda's alloy	50Cu-45Al-5Zn
Diethylenetriamine pentaacetic acid	$((HOCOCH_2)_2NCH_2CH_2)_2NCH_2COOH$
([[(carboxymethyl)imino]bis(ethylenenenitrilo)] tetraacetic acid)	
* Dimethylglyoxime	$CH_3C{:}NOHC{:}NOHCH_3$
N,N' Diphenylbenzidine	$C_6H_5NHC_6H_4C_6H_4NHC_6H_5$
Diphenylcarbazide (1,5-diphenylcarbohydrazide)	$C_6H_5NHNHCONHNHC_6H_5$
* Disodium (ethylenedinitrilo) tetraacetate dihydrate	See (ethylenedinitrilo) tetraacetic acid disodium salt
Dithiol (toluene-3,4-dithiol)	$CH_3C_6H_3(SH)_2$
Dithizone (diphenylthiocarbazone)	$C_6H_5NHNHCSN{:}NC_6H_5$
Eriochrome black-T (1(1-hydroxy-2-naphthylazo)-6-nitro-2-naphthol-4-sulfonic acid sodium salt)	$1\text{-}HOC_{10}H_6\text{-}2\text{-}N{:}N\text{-}1\text{-}C_{10}H_4\text{-}2\text{-}OH\text{-}4\text{-}SO_3Na\text{-}6\text{-}NO_2$
* 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	$HOCOCH_2(NaOCOCH_2)NCH_2N(CH_2COONa)CH_2COOH\cdot2H_2O$
Ethylene glycol monomethyl ether (2-methoxy-ethanol)	$CH_3OCH_2CH_2OH$
* Ferric chloride	$FeCl_3\cdot6H_2O$
* Ferric nitrate	$Fe(NO_3)_3\cdot9H_2O$
Ferric sulfate	$Fe_2(SO_4)_3\cdot nH_2O$
* Ferrous ammonium sulfate	$Fe(NH_4)_2(SO_4)_2\cdot6H_2O$
* Ferrous sulfate	$FeSO_4\cdot7H_2O$
~~Fluoboric acid~~	~~HBF_4~~
Fluoroboric acid	HBF_4
Fluorescein, sodium salt	$2NaOCOC_6H_4C{:}C_6H_3\text{-}3(:O)OC_6H_3\text{-}6\text{-}ONa$
Formaldehyde	HCHO
* Formic acid[A]	HCOOH
Gelatin	
Graphite	C
Glass wool	
Glycerol	$CH_2OHCHOHCH_2OH$
Hydrazine sulfate	$NH_2NH_2\cdot H_2SO_4$
* Hydrobromic acid[A]	HBr
* Hydrochloric acid[A]	HCl
* Hydrofluoric acid[A]	HF
Hydrogen chloride gas	HCl
* Hydrogen peroxide	H_2O_2
Hydrogen sulfide gas	H_2S
Hydroquinone	$1,4\text{-}(OH)_2C_6H_4$
* Hydroxylamine hydrochloride	$NH_2OH\cdot HCl$
~~* Hypophosphorus acid[B]~~	~~H_3PO_2~~
* Hypophosphorous acid[B]	H_3PO_2
Invert sugar	
* Iodine	I_2
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	$PbCl_2$
* Lead nitrate	$Pb(NO_3)_2$
Litmus	
Lithium fluoride	LiF

TABLE 1 *Continued*

Name	Formula
Magnesium metal (Sn-free)	Mg
Magnesium perchlorate, anhydrous	$Mg(ClO_4)_2$
* Magnesium sulfate	$MgSO_4·7H_2O$
Manganese metal (99.8 % min)	Mn
Manganous nitrate	$Mn(NO_3)_2$
Manganous sulfate	$MnSO_4·H_2O$
Mannitol	$CH_2OH(CHOH)_4CH_2OH$
Marble chips	
* Mercuric chloride	$HgCl_2$
* Mercury	Hg
* Methanol	CH_3OH
Methyl isobutyl ketone (4-methyl-2-pentanone)	$CH_3COCH_2CH(CH_3)_2$
* Methyl orange (*p*[[*p*-dimethylamino)phenyl]azo]benzenesulfonic acid sodium salt)	$4\text{-}NaOSO_2C_6H_4N{:}NC_6H_4\text{-}4\text{-}N(CH_3)_2$
Methyl purple	formula unknown, patented
* Methyl red (*o* -[[(*p*-dimethylamino)phenyl]azo]benzoic acid)	$4\text{-}(CH_3)_2NC_6H_4N{:}NC_6H_4\text{-}2\text{-}COOH$
Molybdenum metal (99.8 % min)	Mo
Molybdic acid, anhydride (molybdenum trioxide)	MoO_3
Molybdic acid (ammonium paramolybdate)	Assay: as MoO_3—85 %
Morin, anhydrous (2',3,4',7-penta hydroxyflavone)	$5,7\text{-}(HO)_2C_6H_2\ OC(C_6H_3\text{-}2,4\text{-}(OH)_2){:}C(OH)CO$
β-Naphthoquinoline (5,6-benzoquinoline)	$C_{10}H_6CH{:}CHCH{:}N$
Neocuproine (2,9-dimethyl-1,10-phenanthroline)	$(CH_3)_2C_{12}H_6N_2·{}_{12}H_2O$
Nickel metal (99.8 % min)	Ni
Nickel metal (sheet)	Ni
Nickelous nitrate	$Ni(NO_3)_2·6H_2O$
Nickelous sulfate	$NiSO_4·6H_2O$
* Nitric acid[A]	HNO_3
Nitrogen gas (oxygen-free)	N_2
Nitrogen, liquid	N_2
m-Nitrophenol	$NO_2C_6H_4OH$
1-Nitroso-2-naphthol(α-nitroso-β-naphthol)	$NOC_{10}H_6OH$
Nitroso-R-salt (1-nitroso-2-naphthol-3,6-disulfonic acid disodium salt)	$1\text{-}NOC_{10}H_4\text{-}2\text{-}(OH)\text{-}3,6\text{-}(SO_3Na)_2$
Osmium tetraoxide	OsO_4
Oxalic acid	$(COOH)_2$
Oxygen gas	O_2
* Perchloric acid[A]	$HClO_4$
1,10-Phenanthroline (*o* -phenanthroline)	$CH{:}CHCH{:}NC{:}CCH{:}CHC{:}CN{:}CHCH{:}CH·H_2O$
* Phenolphthalein	$C_6H_4COOC(C_6H_4\text{-}4\text{-}OH)_2$
* Phosphoric acid	H_3PO_4
Piperidine	$NH(CH_2)_4CH_2$
Platinized quartz	
Platinized silica gel	
Platinum gauze	Pt
* Potassium biphthalate	$1\text{-}KOCOC_6H_4\text{-}2\text{-}COOH$
Potassium bisulfate	$KHSO_4$
* Potassium bromate	$KBrO_3$
* Potassium bromide	KBr
* Potassium chlorate	$KClO_3$
* Potassium chloride	KCl
* Potassium chromate	K_2CrO_4
Potassium columbate	$4K_2O·3Cb_2O_5·16H_2O$
* Potassium cyanide	KCN
* Potassium dichromate	$K_2Cr_2O_7$
* Potassium ferricyanide	$K_3Fe(CN)_6$
Potassium ferrocyanide	$K_4Fe(CN)_6·3H_2O$
* Potassium fluoride	$KF·2H_2O$
* Potassium hydroxide	KOH
* Potassium iodate	KIO_3
* Potassium iodide	KI
Potassium iodide starch paper	
* Potassium nitrate	KNO_3
* Potassium *m*-periodate	KIO_4
* Potassium permanganate	$KMnO_4$
Potassium persulfate	$K_2S_2O_8$
Potassium phosphate, monobasic	KH_2PO_4
* Potassium pyrosulfate	$K_2S_2O_7$
* Potassium sulfate	K_2SO_4
Potassium tantalum fluoride	K_2TaF

TABLE 1 *Continued*

Name	Formula
Potassium thiocarbonate	K_2CS_3
* Potassium thiocyanate	KSCN
Pyrogallic acid (pyrogallol)	C_6H_3-1,3-$(OH)_3$
Quinine sulfate	$(C_{20}H_{24}N_2O_2)_2 \cdot H_2SO_4 \cdot 2H_2O$
8-Quinolinol (8-hydroxyquinoline)	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[A]	H_2SO_4
* Sulfurous acid[A]	H_2SO_3
Talc	
* Tartaric acid	$HOCO(CHOH)_2COOH$
Test lead	Pb
Tetrapropylammonium hydroxide	$(CH_3CH_2CH_2)_4NOH$
Thioglycollic 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	$UO_2(NO_3)_2 \cdot 6H_2O$