

**METRIC**

**MIL-STD-1446A**

**13 September 1994**

**SUPERSEDING**

**DOD-STD-1446**

**10 October 1987**

# **MILITARY STANDARD**

**METAL ORGANIC COMPOUNDS, REAGENT GRADE**

**(INCLUDING ACS AND USP-NF COMPOUNDS)**



AMSC N/A

FSC 6810

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## MIL-STD-1446A

### FOREWARD

#### Metal Organic Compounds, Reagent Grade (Including ACS and USP-NF Compounds)

1. This Military Standard is approved for use by all Departments and Agencies of the Department of Defense.
2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Edgewood Research, Development and Engineering Center, Attn: SCBR-ENE (STD/SPECS/PKG), Aberdeen Proving Ground, MD 21010-5423, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.
3. This standard is approved for use by all Departments and Agencies of the Department of Defense in the selection of items for application. It is intended to prevent the entry of unnecessary items (sizes, types, varieties) into the Department of Defense logistics system. This document is not intended to restrict any service in selecting new items resulting from state-of-the-art changes.

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## MIL-STD-1446A

### 1. SCOPE

**1.1 Coverage.** This standard is a presentation of nomenclature, Chemical Abstracts Service Registry Numbers, formulas, physical and chemical properties, specification requirements, military and typical commercial uses, safety information, storage information and disposal information for metal organic compounds, reagent and analytical reagent grade (including ACS and USP-NF compounds). This standard does not include all of the items represented by the title or all those items which are commercially available. It does contain items preferred for use in the selection of metal organic compounds, reagent and analytical reagent grade (including ACS and USP-NF compounds), for application by the Department of Defense.

**1.2 Application.** Metal organic compounds, reagent and analytical reagent grade (including ACS and USP-NF compounds), are used as catalysts, intermediates in organic synthesis, molecular weight standards, proton nmr position references, carbonyl reducing agents, and transesterification catalysts. They are also used in medicine.

**1.3 Classification.** The items in this standard are classified on the basis of chemical composition as metal organic compounds, reagent and analytical reagent and are presented in this standard as four types as follows:

1. Metal Alkoxides
2. Metal Carboxylates
3. Metal Chelates
4. Organometallic Compounds

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**2. APPLICABLE DOCUMENTS****2.1 Government documents.**

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

## SPECIFICATIONS

## FEDERAL

O-C-265	Chemicals, Analytical; General Specification for
PPP-C-2020	Chemicals, Liquid, Dry and Paste, Packaging of

## MILITARY

MIL-C-51130	Chemicals, Reagent Grade; General Specifications for (Metric)
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## STANDARDS

## FEDERAL

FED-STD-313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
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## MILITARY

MIL-STD-12	Abbreviations for Use on Drawings and in Specifications, Standards and Technical Documents
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Unless otherwise indicated, copies of Federal and military specifications, standards, and handbooks are available from: (Attn: DODSSP), Customer Service, Standardization Documents Order Desk, 700 Robbins Avenue, Bldg 4D, Philadelphia, PA 19111-5094.

## MIL-STD-1446A

2.1.2 Other Government documents, drawings and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

## CODE OF FEDERAL REGULATIONS (CFR)

Title 29	Department of Labor, Occupational Safety and Health Agency (OSHA); General Industry Standards and Interpretations
Title 40	Environmental Protection Agency (EPA); Hazardous Waste and Consolidated Permit Regulations
Title 49	Department of Transportation (DOT); Hazardous Materials Regulations

## DEPARTMENT OF DEFENSE (DOD) PUBLICATIONS

DOD 4145.19-R-1	Storage and Materials Handling
DOD 4160.21-M	Defense Utilization and Disposal Manual
DOD 6050.5-LR	DOD Hazardous Materials Information System, Hazardous Item Listing
TB MED 502 (DLAM 1000.2)	Occupational and Environmental Health Respiratory Protection Program
TB MED 506	Occupational and Environmental Health Occupational Vision
TM 38-250	Packaging, Materials Handling - Preparation of Hazardous Materials for Military Air Shipment
AR 11-34	The Army Respiratory Protection Program

## NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

Registry of Toxic Effects of Chemical Substances  
Recommendation for Environmental Exposure Limits

(Copies of specifications, standards, handbooks, drawings, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

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**2.2 Non-Government publications.** The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation.

### AMERICAL CHEMICAL SOCIETY (ACS)

Reagent Chemicals - American Chemical Society Specifications

(Application for copies should be addressed to American Cancer Society, 1155-16th St., N.W., Washington, DC 20036.)

### AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

Threshold Limit Values (TLVs) for Chemical Substances in the Work Environment Adopted by American Conference of Governmental Industrial Hygienists (ACGIH) with Intended Changes.

Volume 13: Transactions of ACGIH Activities 1985 Conference.

(Application for copies should be addressed to American Conference of Governmental Industrial Hygienists, Kemper Woods Center, 1330 Kemper Meadow Drive, Cincinnati, Ohio 45240.)

### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z358.1 for Emergency Eyewash and Shower Equipment.

(Application for copies should be addressed to American National Standards Institute, 1430 Broadway, New York, NY 10018.)

### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 380                      Standard for Metric Practice

(Application for copies should be addressed to American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)



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### CHEMICAL ABSTRACTS SERVICE REGISTRY

The Chemical Abstracts Service (CAS) Registry Number provides a key to access the wealth of information available through CAS.

(For details on how to search for CAS files and database using the Registry Number, contact Chemical Abstracts Service, Customer Services, P.O. Box 3012, Columbus, Ohio 43210.)

### FEDERAL ACQUISITION REGULATION

Contractual acquisition of Material Safety Data Sheet Information (Paragraph 52.223-3).

### INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC)

Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man.

(Application for copies should be addressed to World Health Organization, International Agency for Research on Cancer, 49 Sheridan Street, Albany, New York 12210.)

### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

National Fire Codes

(Application for copies should be addressed to National Fire Protection Association, Battery March Park, Quincy, MA 02269.)

### RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

(Public law 94-580 Management of Items Classified as Hazardous Waste.)

### THE UNITED STATES PHARMACOPEIAL CONVENTION, INC. - NATIONAL FORMULARY (USP-NF)

The United States Pharmacopeia - National Formulary

(Application for copies should be addressed to The United States Pharmacopeial Convention, Inc. - National Formulary, Order Processing Dept., P.O. Box 2248, 12601 Twinbrook Parkway, Rockville, MD 20852.)

Nongovernment standards are generally available for reference from libraries. They are also distributed among nongovernment standards bodies and using Federal agencies.

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**2.3 Order of precedence.** In the event of a conflict between the text of this document and the references cited herein, the text of this standard shall take precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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## 3. DEFINITIONS

3.1 Definitions of technical terms.

3.1.1 ACS reagent grade. Denotes a grade of chemicals which certifies that it meets the American Chemical Society (ACS) specification for that reagent.

3.1.2 Analyzed reagent grade. Denotes a grade of high quality chemicals for laboratory and specialized industrial use. An actual lot analysis is provided to guarantee purity and consistency.

3.1.3 Flash point. The lowest temperature at which a liquid or solid will give off a vapor sufficient to form an ignitable mixture in air.

3.1.4 Metal alkoxides. Metal alkoxides are produced by the reaction of alcohols with active metals.

3.1.5 Metal carboxylates. Metal carboxylates are the alkali, alkaline-earth, and heavy metal salts of the carboxylic acids.

3.1.6 Metal chelates. The holding of a metal atom between two atoms of a simple molecule is called chelation.

3.1.7 Organometallic compounds. An organometallic compound is one in which there is a bonding interaction (ionic or covalent, localized or delocalized) between one or more carbon atoms, of an organic group or molecule, and a main group, transition, lanthanide, or actinide metal atom or atoms.

3.1.8 pH. A numerical measure of the hydrogen ion concentration indicating degree of acidity or alkalinity of a solution. It is expressed as  $\text{pH} = -\log_{10}[\text{H}^+]$ . At the neutral point,  $\text{pH}=7$ . At a pH lower than 7, a solution is acidic. At a pH higher than 7, a solution is basic.

3.1.9 Reagent grade. Denotes reagent grade chemicals which do not bear a label stating the percentages of the important impurities present. Reagent grade chemicals have limited use in analytical work because of the uncertainty as to the kind and amount of impurities present. These chemicals find extensive use in laboratory synthesis and in certain analytical procedures where the inherent impurities are not critical to the intended reaction.

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3.1.10 U.S.P., N.F., and F.C.C. grade. Denotes a grade of chemicals that conforms to the requirements of the United States Pharmacopeia (USP), the National Formulary (NF) and the Food Chemical Code (FCC). All meet the requirements necessary for their use in pharmaceutical processing and prescription compounding (USP and NF) and for use in food processing operations (FCC).

3.2 **Abbreviations.** The use of abbreviations in this military standard is in accordance with MIL-STD-12 where applicable. Metric system abbreviations and symbols are in accordance with ASTM E 380. Other abbreviations are as follows:

BM	Bureau of Mines
CAS	Chemical Abstracts Service
DRMO	Defense Reutilization and Marketing Office
FW	Formula Weight
HMIS	Hazardous Materials Information System
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
PEL	Permissible Exposure Limit
TLV	Threshold Limit Value

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**4. GENERAL REQUIREMENTS**

**4.1 Packaging data and labeling.** All chemicals included in this standard shall be packaged in accordance with Federal Specification PPP-C-2020 and all applicable documents referenced therein. When the commodity is a hazardous material, the shipping containers for domestic shipments using commercial carriers shall be labeled in accordance with current Department of Transportation (DOT) Hazardous Materials Regulations applicable to each chemical. Likewise, shipping containers for international shipments using commercial carriers shall be labeled in accordance with the International Hazardous Materials Regulations appropriate for the mode of shipment used (see Para. 2.2 herein). When shipping hazardous material by military aircraft, the requirements of TM 38-250 shall apply. Additionally, each item shall be packaged and labeled as specified in the applicable contract or order. All labels shall comply with Hazard Communication Standard, 29 CFR 1910.1200 (f) and the appropriate domestic or International Hazardous Materials Regulations.

**4.2 Hazardous materials information.** DOD 6050.5, DOD Hazardous Materials Information System (HMIS) acquires, reviews, stores, and disseminates Material Safety Data Sheet (MSDS) information for all hazardous materials used by DOD. The contractual acquisition of a MSDS is accomplished through use of Federal Acquisition Regulation, paragraph 52.223-3, Hazardous Material Identification and Material Safety Data. The MSDS is prepared in accordance with the instructions in FED-STD-313 and shall comply with the requirements of Hazard Communication Standard, 29 CFR 1910.1200 (g).

**4.3 Safety.**

**4.3.1 Personal protective measures.** The necessary respiratory, eye and skin protection to be used when handling chemicals shall be prescribed by the responsible installation industrial hygiene, medical and safety authorities.

**4.3.1.1 Respiratory protection.** Respirators, approved by the National Institute for Occupational Safety and Health (NIOSH) or the Mine Safety and Health Administration (MSHA) or by particular respiratory schedules of the Bureau of Mines (BM) for the compounds being used, may be employed for intermittent, non-routine exposure (i.e., not exceeding 1 hour/day for 1 day/week), when the installation medical authority determines that there are no feasible engineering or work practice controls, during interim periods when engineering controls are being designed and/or installed, during emergencies, or for supplementing other control measures (refer to TB MED 502 or DLAM 1000.2). Ventilation containment, process controls, or other feasible engineering controls shall be adequate to remove hazardous concentrations. Employees assigned to use respiratory protective

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equipment shall be included in a respiratory protection program that meets the minimal requirements as stipulated in AR 11-34, "The Army Respiratory Protection Program".

4.3.1.2 Skin protection. Personnel using these compounds shall be provided with and required to use impervious gloves, sleeves, aprons, and boots whenever indicated. Protective creams and ointments commonly known as "barrier creams" may be of value in certain cases. However, barrier creams shall not be used to replace protective clothing. During use, avoid contact with eyes, skin and clothing. Wash with soap and water after handling. When not in use, keep in a tightly closed container. In case of contact with the eyes, remove any contact lenses and irrigate with copious amounts of water for at least 20-30 minutes, and obtain medical attention. Eye lavages and emergency showers shall be located where there is a potential for direct contact with harmful chemicals. All emergency eyewashes and emergency showers shall be activated weekly to flush the line and to verify proper operation in accordance with ANSI standard Z-358-1-1990.

4.3.1.3 Face and eye protection. Personnel using these compounds shall be provided with and required to wear chemical splash-proof safety goggles. In addition, face shields shall be provided and worn over the goggles if splashing could occur. In case of contact with the eyes, immediately irrigate with copious amounts of water for at least 20-30 minutes, and obtain medical attention. (Refer to TB MED 506.)

4.3.1.4 Training. Employers shall provide employees with training and information, including MSDSs, on all chemical items in their work area, in accordance with 29 CFR 1910.1200 (h) and, 49 CFR 172 Subpart H, as may be applicable, to ensure that employees know potential hazards of the chemicals with which they come in contact and the symptoms of exposure, as well as how these chemicals that affect the body and bodily functions. Employees shall be adequately trained to render first aid. Additionally, any employee involved with the packaging, preparation, handling or causing a hazardous material to be shipped or transported, shall be provided with all of the training specified in 49 CFR 172 Subpart H.

4.3.1.5 Exercises. Participation in training exercises shall be stressed to demonstrate skills in the use of personal protective equipment and emergency response equipment.

4.3.2 Storage conditions. DOD 4145.19-R-1 describes general storage practices and requirements for hazardous materials in the DOD supply system. Specific requirements provided in the following paragraphs are supplementary in nature and shall be observed in consonance with the DOD storage regulations.

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**4.3.2.1 Flammable, combustible, pyrophoric and ignitable materials.** A flammable material is generally any solid, liquid, vapor or gas that ignites easily and burns rapidly. Combustible materials are generally those that are difficult to ignite and burn slowly. The DOT, in 49 CFR 173.115, defines a flammable liquid as one having a closed cup flash point below 37.8°C (100°F). In the DOT's Final Rule to Docket HM-181, the flash point for a flammable liquid was raised from below 37.8°C (100°F) to not more than 60.5°C (141°F). A combustible liquid is defined, by DOT 49 CFR 173.115, as one having a closed cup flash point at or above 60.5°C (141°F) and below 93.3°C (200°F). A pyrophoric liquid is defined, by DOT 49 CFR 173.115, as one that ignites spontaneously in dry or moist air at or below 54.5°C (130°F). Materials with flash points of 93.3°C (200°F) or higher are to be considered as burnable. The DOT has permitted, for domestic shipments only and except for shipments by air or water, that "...a flammable liquid with a flash point at or above 38°C (100°F)..." and which does not meet the definition of any other hazard class as defined in 49 CFR, may be re-classed as a combustible liquid. The Environmental Protection Agency (EPA), in 40 CFR 261.21, designates the criteria for flammable and combustible materials and oxidizers that exhibit the hazardous waste characteristic of ignitability (I).<sup>\*</sup> Liquids with closed cup flash points of less than 60°C (140°F) are defined by EPA as ignitable. The autoignition point (temperature) of a substance is generally defined as the minimum temperature required to initiate or cause self-sustained combustion in the absence of a spark or flame. Materials that ignite easily under normal industrial conditions are considered to be dangerous fire hazards. Such materials shall be stored in a manner to prevent ignition and combustion. Easily ignitable substances, such as reducing agents, shall be kept away from strong oxidizing agents. All containers shall be tightly sealed. It is important to provide adequate ventilation in storage areas, and to locate the storage areas of these items away from fire hazards. Ample fire-control equipment shall be easily accessible. Storage buildings, rooms and cabinets shall comply with provisions of the National Fire Codes. The building shall be electrically grounded and signs posted to prevent the lighting of matches or smoking in the area. Flammable storage areas shall be equipped with smoke or fire detection equipment.

**4.3.2.2 Water-sensitive fire and explosive hazardous materials.** These materials include compounds that react violently or form explosive mixtures on contact with water or steam, or react with water to produce toxic gases. Such waste materials exhibit the hazardous waste characteristic of reactivity (R) as designated by the EPA in 40 CFR 261.23<sup>\*</sup>. These materials shall be stored in well-ventilated, cool, dry areas. All containers shall be tightly sealed. These materials are a fire hazard in contact with water or moisture; therefore, it is essential that no sprinkler be used. Otherwise, the building shall conform to that required for storage of flammable materials. The building shall be waterproof, located on high ground, separated from other storage areas and meet National Fire Codes.

<sup>\*</sup>Refers to materials that have become hazardous waste.



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**4.3.2.3 Incompatible materials.** Materials that are chemically incompatible shall be segregated in the storage of both serviceable and unserviceable items. The degree of segregation will depend upon DOD 4145.19-R-1 and local supplementary requirements that insure safe storage conditions. Hazardous storage compatibility codes are provided in the HMIS referred to in 4.2. Hazardous material storage compatibility may also be determined through use of the EPA Hazardous Materials Compatibility Chart. This chart determines reactions of most binary combinations of hazardous wastes by assigning Reactivity Group Numbers (RGNs) based on chemical classes and general chemical reactivities.

**4.3.3 Hazardous chemicals exposure limits.** Hazardous chemicals exposure limits for airborne concentrations of substances are obtained from the current TLVs in Threshold Limit Values for Chemical Substances in the Work Environment adopted by the American Conference of Governmental Industrial Hygienists (ACGIH); current Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL), 29 CFR 1910.1000; and NIOSH Recommendation for Environmental Exposure Limits. Such information is also shown in MSDSs and the HMIS referred to in 4.2.

Carcinogenic substances are listed by OSHA in Category I for confirmed carcinogens, and in Category II for suspected carcinogens. Category I substances have standard exposure limits set at the lowest possible levels. Category II substances have standard exposure limits set to prevent acute or chronic effects. The identity of sources used to establish whether a chemical is a carcinogen or potential carcinogen, for hazard communication purposes, is shown in 29 CFR 1910.1200 (d)(4). The international Agency for Research on Cancer has published monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, which are very helpful.

**4.3.4 Toxicity.** Toxicity information for chemical compounds is available from various publications and from MSDSs, which are collected in the DOD 6050.5-LR Hazardous Materials Information System.

**4.3.4.1 EPA Toxic (T).** Some waste chemical compounds have been designated by the EPA as toxic wastes (T) in accordance with the criteria shown in 40 CFR 261.11(a)(3). \* Some commercial chemical wastes are listed as toxic wastes under 40 CFR 261.33 (f).

**4.3.4.2 EPA Acute Hazardous Toxicity (H).** Some waste chemical compounds have been designated by the EPA as acute hazardous wastes (H) based on toxicity in accordance with the criteria shown in 40 CFR 261.11(a)(2). \* Some commercial chemical wastes are listed as acutely hazardous in toxicity under 40 CFR 261.33(e).

\*Refers to materials that have become hazardous waste.



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**4.3.4.3 EPA Toxicity Characteristic Leaching Procedure (TCLP).** This procedure is used to determine the properties of a waste that are directly related to the potential of the waste to pose a hazard to groundwater when disposed of in a landfill environment. It replaces the EPA EP toxicity test. The TCLP procedure is contained in EPA Method No. 1311, SW-846. Some 40 chemical contaminants have been designated by EPA as being a hazard to groundwater in a landfill environment. (See 40 CFR 261.24)\*

**4.3.4.4 Hazardous toxic constituents.** A list of chemical compounds and substances, shown to have toxic effects on humans or other life forms, is contained in Appendix VIII to 40 CFR, Part 261, and the Registry of Toxic Effects of Chemical Substances.

### **4.4 Pollution and disposal.**

**4.4.1 Pollution potential.** All items described in this standard shall be assumed to have a pollution potential. However, to minimize this potential, the proper use, storage and disposal methods shall be strictly followed.

**4.4.2 Disposal of excess or unserviceable material.** To minimize disposal problems, it is recommended that no more than a one year's supply of each item listed in this standard be stocked. When stocks have been declared excess or unserviceable, they will be disposed of in accordance with the Defense Utilization and Disposal Manual, DOD 4160.21-M, and applicable DOD Policy Memoranda. Guidance can be obtained from your servicing Defense Reutilization and Marketing Office (DRMO) on procedures required for proper reporting and turn-in.

**4.4.3 Disposal and storage of hazardous wastes.** Items are classified and managed as hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA) (Public Law 94-580). Items have been identified as meeting the characteristics of a hazardous waste (i.e., ignitable, corrosive, reactive or are subject to Toxicity Characteristic Leaching Procedure (TCLP); or they are listed (e.g., toxic or acute hazardous wastes) according to Identification and Listing of Hazardous Waste, 40 CFR Part 261, or have been determined to be hazardous wastes by declaration of the Defense Reutilization and Marketing Service (DRMS) in accordance with procedures set forth in DOD 4160.21-M. Disposal of such items shall be managed in accordance with the Installation Environmental Office, the DRMO, or the Safety and Health Office to insure proper reporting of disposal and treatment actions to the US EPA and State, and shall be managed in accordance with Federal, State and local laws. The three main disposal methods are turn-in to the DRMO, on-post disposal by installation personnel, or disposal by commercial contract. Hazardous wastes that cannot be used or disposed of as stated

\*Refers to materials that have become hazardous waste.

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in 4.4.3.2 shall be stored under environmentally safe conditions until suitable methods of disposal are determined. Short-term storage (less than 90 days) requires proper containment (i.e., packaging and facilities) in accordance with 40 CFR 262.34. Long-term storage (greater than 90 days) requires permitting by the EPA or by the State under Public Law 94-580 (RCRA), in compliance with the requirements of 40 CFR, Parts 264 and 265. Physical custody will be accomplished by the activity with conforming storage or most nearly conforming storage. When physical custody is in question, the Post Commander will make the final decision. In all cases where the wastes are to be collected, stored, transported and disposed of at a State or local permitted disposal facility, the identity and description of the waste shall be maintained and recorded in accordance with 40 CFR Part 262. Transportation of the waste must be in accordance with 40 CFR Part 263, Standards Applicable to Transporters of Hazardous Waste. State and/or local regulations may be more stringent than Federal requirements. It is essential that the Installation Environmental Office review all disposal actions for compliance with all applicable regulations.

4.4.3.1 Cleanup of liquid spills. To control the migration of spilled or leaking liquids, dike around the item with an inert, dry absorbent (e.g., clay sawdust or vermiculite) or follow installation spill plans (Spill Prevention Control and Countermeasure Plan and Installations Spill Contingency Plan). Control entry to the spill site and segregate salvageable materials away from the spill area. Initiate waste cleanup operations immediately in accordance with local procedures. The residue shall be safely handled and transported to an approved or permitted disposal or storage facility. Packaging, labeling, transportation and record-keeping requirements for this waste material are determined by the appropriate Federal and State agencies and local procedures. It is recommended that all activities involving disposal preparation and transportation to commercial facilities be properly coordinated with the appropriate Federal and State agencies responsible for health and environmental aspects of hazardous wastes. It is imperative that the proper description of the waste accompany the packaged item at all times. Final disposal of the waste item shall be accomplished by reutilization, transfer, donation or sales by DRMO in accordance with DOD 4160.21-M or by ultimate disposal as described in 4.4.3.2. Spill residue, including contaminants, to be turned into the DRMO shall first be properly identified, containerized, and labeled. For large scale spills that grossly contaminate the environment, the Chemical Transportation Emergency Center (CHEMTREC) can be called for assistance (1-800-424-9300). Applicable procedures of the local spill control plan shall be followed. Necessary respiratory, eye, and skin protection measures are to be used while performing cleanup operations.

4.4.3.2 Ultimate disposal. Ultimate disposal shall be accomplished at a permitted or approved hazardous waste treatment or disposal facility designated by the Installation Environmental Office, DRMO, or Safety and Health Offices.

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4.4.4 DISCLAIMER. RECOMMENDED DISPOSAL INSTRUCTIONS ARE FORMULATED FOR USE BY ELEMENTS OF THE DEPARTMENT OF DEFENSE. THE UNITED STATES OF AMERICA IN NO MANNER WHATSOEVER, EITHER EXPLICITLY OR IMPLICITLY, WARRANTS, STATES, OR INTENDS SAID INSTRUCTION TO HAVE ANY APPLICATION, USE OR VIABILITY BY OR TO ANY PERSON OR PERSONS CONTRACTING OUTSIDE THE DEPARTMENT OF DEFENSE OR ANY PERSON OR PERSONS CONTRACTING WITH ANY INSTRUMENTALITY OF THE UNITED STATES OF AMERICA, AND DISCLAIMS ALL LIABILITY FOR SUCH USE. ANY PERSON USING THESE INSTRUCTIONS WHO IS NOT A MILITARY OR CIVILIAN EMPLOYEE OF THE UNITED STATES OF AMERICA SHOULD SEEK COMPETENT PROFESSIONAL ADVICE TO VERIFY AND ASSUME RESPONSIBILITY FOR THE SUITABILITY OF THESE INSTRUCTIONS TO HIS PARTICULAR SITUATION, REGARDLESS OF SIMILARITY TO A CORRESPONDING DEPARTMENT OF DEFENSE OR OTHER GOVERNMENT SITUATION.

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## 5. DETAILED REQUIREMENTS

**5.1 Metal alkoxides.** Alcohols, as weak acids, can react with active metals, such as sodium, to form hydrogen gas and the metal alkoxide. Since alcohols are weaker acids than water, sodium alkoxides cannot be prepared by the reaction of the alcohol and sodium hydroxide. Aluminum, as an active metal, can also react with alcohols in the presence of mercuric chloride catalyst to form the metal alkoxides. Aluminum alkoxides can also be prepared by reacting aluminum chloride with sodium alkoxides.

Many metal chlorides undergo solvation and/or partial solvolysis with alcohols. In the presence of a base, such as ethoxide ion, ammonia, or pyridine, the replacement of chloride is complete and the metal alkoxides are formed. Titanium alkoxides and other transition metal alkoxides can be obtained by such reactions.

The metal alkoxides are polymeric, and the titanium alkoxides are known to be trimeric. The metal alkoxides are also polymeric in solution in inert organic solvents. Monomeric species can exist in very dilute solutions.

The metal alkoxides are reactive with water. They are useful in organic synthesis.

5.1.1 <u>Name.</u> Aluminum Ethoxide, Reagent	FW 162.17
Aluminum ethylate $\text{Al}(\text{C}_2\text{H}_5\text{O})_3$	CAS 555-75-9
Aluminum triethoxide	

5.1.1.1 Technical description. Aluminum ethoxide (pure) exists as white crystals with a density of  $1.142 \text{ g/cm}^3$  ( $20^\circ/0^\circ\text{C}$ ). Its melting point is  $150\text{-}160^\circ\text{C}$  and boiling point is  $205^\circ\text{C}$  at 14 mm Hg. It decomposes in hot or cold water. It is very slightly soluble in alcohol and ether. The commercially available product has a melting point of  $157\text{-}160^\circ\text{C}$ . Aluminum ethoxide is moisture sensitive.

5.1.1.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.1.2.1 Requirement. Aluminum ethoxide, reagent is available commercially with chemical requirement as shown in Table I.

TABLE I. Aluminum ethoxide, reagent - chemical requirement.

Assay $\text{Al}(\text{C}_2\text{H}_5\text{O})_3$ , % by wt.	97.0
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5.1.1.3 Use. Aluminum ethoxide is used in chemical synthesis. Its use includes the reduction of aldehydes and ketones.

5.1.1.4 Safety. Aluminum ethoxide is an irritating material. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Aluminum ethoxide shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. Aluminum ethoxide is a flammable solid. (Refer to 4.3.1.)

5.1.1.5 Storage. Aluminum ethoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.1.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.2 Name. Aluminum Isopropoxide, Reagent  $\text{Al}(\text{C}_3\text{H}_7\text{O})_3$  FW 204.25  
Aluminum tri-isopropoxide CAS 555-31-7

5.1.2.1 Technical description. Aluminum isopropoxide (pure) exists as white crystals with a density of  $1.0346 \text{ g/cm}^3$  at  $20^\circ\text{C}$ . Its melting point is  $118.5^\circ\text{C}$  and its boiling point is  $140.5^\circ\text{C}$  at 8 mm. It decomposes in cold or hot water. It is slightly soluble in benzene and chloroform.

5.1.2.2 Specification. Manufacturer's requirements. (No Government specification.)

5.1.2.2.1 Requirement. Aluminum isopropoxide, reagent is available commercially with chemical requirement as shown in Table II.

TABLE II. Aluminum isopropoxide, reagent - chemical requirement.

Assay $\text{Al}(\text{C}_3\text{H}_7\text{O})_3$ , % by wt.	98.0-100.0
Assay (Al), % by wt., min - max	2.9-13.5

NOTE: Actual assay shall be 99.3% based on surplus aluminum content being  $\text{Al}(\text{OH})_3$ .

5.1.2.3 Use. Aluminum isopropoxide is used in chemical synthesis. Its use includes Meerwein-Poundorf reactions, alcoholysis and ester exchange; synthesis of higher alkoxides, chelates and acrylates.

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5.1.2.4 **Safety.** Aluminum isopropoxide is an irritating material. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Aluminum isopropoxide shall be used with adequate ventilation. Aluminum isopropoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.2.5 **Storage.** Aluminum isopropoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.2.6 **Disposal.** For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.3 **Name.** Aluminum tert-Butoxide, Reagent FW 246.33  
Aluminum tri-tert-butoxide  $\text{Al}(\text{OC}_4\text{H}_9)_3$  CAS 556-91-2

5.1.3.1 **Technical description.** Aluminum tert-butoxide (pure) exists as white crystals with a density of  $1.0251 \text{ g/cm}^3$  at  $20^\circ\text{C}$ . It sublimes at  $180^\circ\text{C}$  and its melting point is  $>300^\circ\text{C}$  (sealed tube). It is very soluble in organic solvents. The commercially available product is a powder with a melting point of  $241.5\text{-}246.5^\circ\text{C}$ . Aluminum tert-butoxide is moisture sensitive.

5.1.3.2 **Specification.** Manufacturer's requirement. (No Government specification.)

5.1.3.2.1 **Requirement.** Aluminum tert-butoxide, reagent is available commercially with chemical requirement as shown in Table III.

TABLE III. Aluminum tert-butoxide, reagent - chemical requirement.

Assay $\text{Al}(\text{OC}_4\text{H}_9)_3$ , % by wt.	97.0
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5.1.3.3 **Use.** Aluminum tert-butoxide is used in chemical synthesis. Its use includes the oxidation of alcohols to ketones and in dealcoholation of orthoesters.

5.1.3.4 **Safety.** Aluminum tert-butoxide is an irritating material. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Aluminum tert-butoxide shall be used with adequate ventilation. Aluminum tert-butoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)



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5.1.3.5 **Storage.** Aluminum tert-butoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.3.6 **Disposal.** For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.4 **Name.** Aluminum tri-sec-Butoxide, Reagent FW 246.33  
Aluminum tri-sec-butylate Al(OC<sub>4</sub>H<sub>9</sub>)<sub>3</sub> CAS 2269-22-9

5.1.4.1 **Technical description.** Commercially available aluminum tri-sec-butoxide, reagent exists as a clear to slightly yellow liquid. Its density is 0.967 g/cm<sup>3</sup> and its refractive index is 1.4390. Its boiling point is 200-206°C at 30 mm and its flash point is 24°C (82°F) (Closed Cup). It is moisture sensitive.

5.1.4.2 **Specification.** Manufacturer's requirement. (No Government specification.)

5.1.4.2.1 **Requirement.** Aluminum tri-sec-butoxide, reagent is available commercially with chemical requirement as shown in Table IV.

TABLE IV. Aluminum tri-sec-butoxide, reagent - chemical requirements.

Assay Al(OC <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> , min-max, % by wt.	98.0 - 100.0
Assay (Al), min-max, % by wt.	10.7 - 11.2

NOTE: Actual assay shall be 99.4% based on surplus aluminum content being Al(OH)<sub>3</sub>.

5.1.4.3 **Use.** Aluminum tri-sec-butoxide is used in chemical synthesis. Its use includes carbonyl reducing agent (Meerwein-Poundorf-Verley reaction) and transesterification catalyst.

5.1.4.4 **Safety.** Aluminum tri-sec-butoxide is an irritating material. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Aluminum tri-sec-butoxide shall be used with adequate ventilation. Aluminum tri-sec-butoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.4.5 **Storage.** Aluminum tri-sec-butoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

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5.1.4.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Aluminum tri-sec-butoxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

5.1.5 Name. Lithium Methoxide, Reagent FW 37.97  
Lithium methylate  $\text{LiOCH}_3$  CAS 865-34-9

5.1.5.1 Technical description. Lithium methoxide exists as a white free flowing powder. It is soluble in methanol. The commercially available product has a melting point of 500°C. Lithium methoxide is moisture sensitive.

5.1.5.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.5.2.1 Requirement. Lithium methoxide, reagent is available commercially with chemical requirement as shown in Table V.

TABLE V. Lithium methoxide, reagent - chemical requirements.

Assay $\text{LiOCH}_3$ , % by wt.	95.0
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5.1.5.3 Use. Lithium methoxide is used in chemical synthesis. It is used as a chemical intermediate where water is undesirable.

5.1.5.4 Safety. Lithium methoxide is highly toxic by ingestion and is irritating. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Lithium methoxide shall be used with adequate ventilation. Lithium methoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.5.5 Storage. Lithium methoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.5.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.6 Name. Lithium Phenoxide, Reagent FW 100.05  
Lithium phenylate  $\text{LiOC}_6\text{H}_5$  CAS 17634-93-4



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5.1.6.1 Technical description. Commercially available lithium phenoxide exists as a white powder. Lithium phenoxide is moisture sensitive.

5.1.6.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.6.2.1 Requirement. Lithium phenoxide, reagent is available commercially with chemical requirement as shown in Table VI.

TABLE VI. Lithium phenoxide, reagent - chemical requirement.

Assay $\text{LiOC}_6\text{H}_5$ , % by wt.	98.0
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5.1.6.3 Use. Lithium phenoxide is used in chemical synthesis.

5.1.6.4 Safety. Lithium phenoxide is highly toxic by ingestion and is irritating. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Lithium phenoxide shall be used with adequate ventilation. Lithium phenoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.6.5 Storage. Lithium phenoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.6.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.7 Name. Lithium tert-Butoxide, Reagent FW 80.05  
Lithium butylate  $\text{LiOC}_4\text{H}_9$  CAS 1907-33-1

5.1.7.1 Technical description. Commercially available lithium tert-butoxide exists as a white powder. It melts with decomposition. Lithium tert-butoxide is moisture sensitive.

5.1.7.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.7.2.1 Requirement. Lithium tert-butoxide, reagent is available commercially with chemical requirement as shown in Table VII

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TABLE VII. Lithium tert-butoxide, reagent - chemical requirement.

Assay $\text{LiOC}_4\text{H}_9$ , % by wt.	99.0
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5.1.7.3 Use. Lithium tert-butoxide is used in chemical synthesis. Its use includes reagent for Oppenauer oxidation organic reactions.

5.1.7.4 Safety. Lithium tert-butoxide is an irritating material. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Lithium tert-butoxide shall be used with adequate ventilation. Lithium tert-butoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.7.5 Storage. Lithium tert-butoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.7.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.8 Name. Potassium Ethoxide, Reagent FW 84.16  
Potassium ethylate  $\text{KOC}_2\text{H}_5$  CAS 917-58-8

5.1.8.1 Technical description. Commercially available potassium ethoxide, reagent exists as a white powder. It is moisture and air sensitive.

5.1.8.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.8.2.1 Requirement. Potassium ethoxide, reagent is available commercially with chemical requirement as shown in Table VIII.

TABLE VIII. Potassium ethoxide, reagent - chemical requirement.

Assay $\text{KOC}_2\text{H}_5$ , % by wt.	95.0+
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5.1.8.3 Use. Potassium ethoxide is used in chemical synthesis.

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5.1.8.4 Safety. Potassium ethoxide is irritating to the eyes, skin and mucous membranes. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Potassium ethoxide shall be used with adequate ventilation. Potassium ethoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.8.5 Storage. Potassium ethoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.8.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.9 Name. Potassium tert-Butoxide, Reagent FW 112.22  
Potassium butylate (CH<sub>3</sub>)<sub>3</sub>COK CAS 865-47-4

5.1.9.1 Technical description. Commercially available potassium tert-butoxide, reagent exists as a white hygroscopic powder. Its melting point is 220°C.

5.1.9.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.9.2.1 Requirement. Potassium tert-butoxide, reagent is available commercially with chemical requirement as shown in Table IX.

TABLE IX. Potassium tert-butoxide, reagent - chemical requirement.

Assay (CH <sub>3</sub> ) <sub>3</sub> COK, % by wt.	95.0 - 99.0
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5.1.9.3 Use. Potassium tert-butoxide is used in chemical synthesis.

5.1.9.4 Safety. Potassium tert-butoxide is a strong organic base. It is irritating to the eyes, skin and mucous membranes. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Potassium tert-butoxide shall be used with adequate ventilation. Potassium tert-butoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.9.5 Storage. Potassium tert-butoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

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5.1.9.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.10 Name. Sodium Ethoxide, Reagent FW 68.05  
Sodium ethylate  $C_2H_5ONa$  CAS 141-52-6  
Caustic alcohol

5.1.10.1 Technical description. Commercially available sodium ethoxide, reagent exists as a white or yellowish hygroscopic powder. It is sensitive to air and moisture. Its melting point is  $>300^\circ C$ . It is soluble without decomposition in absolute alcohol.

5.1.10.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.10.2.1 Requirement. Sodium ethoxide, reagent is available commercially with chemical requirement as shown in Table X.

TABLE X. Sodium ethoxide, reagent - chemical requirement.

Assay $C_2H_5ONa$ , % by wt.	97.0
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5.1.10.3 Use. Sodium ethoxide is used in organic synthesis. Its use includes esterification and transesterification reactions.

5.1.10.4 Safety. Sodium ethoxide is irritating to the eyes, skin and mucous membranes. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Sodium ethoxide shall be used with adequate ventilation. Sodium ethoxide is moisture sensitive and a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.10.5 Storage. Sodium ethoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.10.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

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5.1.11 **Name.** Sodium tert-Butoxide, Reagent FW 96.11  
Sodium butylate  $\text{NaOC}(\text{CH}_3)_3$  CAS 865-48-5

5.1.11.1 **Technical description.** Commercially available sodium tert-butoxide exists as a white powder with a density of  $1.04 \text{ g/cm}^3$ .

5.1.11.2 **Specification.** Manufacturer's requirement. (No Government specification.)

5.1.11.2.1 **Requirement.** Sodium tert-butoxide, reagent is available commercially with chemical requirement as shown in Table XI.

TABLE XI. Sodium tert-butoxide, reagent - chemical requirement.

Assay $\text{NaOC}(\text{CH}_3)_3$ , % by wt.	99.0
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5.1.11.3 **Use.** Sodium tert-butoxide is used in chemical synthesis.

5.1.11.4 **Safety.** Sodium tert-butoxide is an irritating material. It may cause irritation to the eyes, skin and mucous membranes. Contact with the skin, eyes and clothing shall be avoided. Sodium tert-butoxide shall be used with adequate ventilation. Sodium tert-butoxide is a flammable solid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.11.5 **Storage.** Sodium tert-butoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.11.6 **Disposal.** For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.12 **Name.** Thallium Ethoxide, Reagent FW 249.43  
Thalious ethoxide  $\text{TlOC}_2\text{H}_5$  CAS 20398-06-5  
Thallium (I) ethoxide

5.1.12.1 **Technical description.** Thallium ethoxide (pure) exists as a colorless liquid with a density of  $3.493 \text{ g/cm}^3$  at  $20^\circ\text{C}$ . Its melting point is  $-3^\circ\text{C}$ . It decomposes at  $130^\circ\text{C}$ . Its refractive index is 1.6714 at  $20^\circ\text{C}$ . It is slightly soluble in alcohol and soluble in ether. It is moisture sensitive.

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5.1.12.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.12.2.1 Requirement. Thallium ethoxide, reagent is available commercially with chemical requirement as shown in Table XII.

TABLE XII. Thallium ethoxide, reagent - chemical requirement.

Assay $\text{TlOC}_2\text{H}_5$ , % by wt.	98.0
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5.1.12.3 Use. Thallium ethoxide is used in chemical synthesis. Included in its use is as an alkylating agent.

5.1.12.4 Safety. Thallium ethoxide is a highly toxic and irritating material. It may cause irritation to the eyes, skin and mucous membranes and may be absorbed by the skin. Inhalation of dust, fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Thallium ethoxide shall be used with adequate ventilation. There is no TLV or PEL referenced for water insoluble thallium ethoxide. If heated to decomposition, thallium ethoxide may evolve toxic fumes. Thallium ethoxide is a flammable solid. (Refer to 4.3.1.)

5.1.12.5 Storage. Thallium ethoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.12.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.13 Name. Titanium Butoxide, Reagent FW 340.36  
 Titanium (IV) butoxide  $\text{Ti}(\text{C}_4\text{H}_9\text{O})_4$  CAS 5593-70-4  
 Tetrabutyl titanate  
 Titanium butylate

5.1.13.1 Technical description. Commercially available titanium butoxide is a colorless to light yellow liquid with a flash point of  $76^\circ\text{C}$  ( $170^\circ\text{F}$ ). It is moisture sensitive.

5.1.13.2 Specification. Manufacturer's requirement. (No Government specification.)

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5.1.13.2.1 Requirement. Titanium butoxide, reagent is available commercially with chemical requirement as shown in Table XIII.

TABLE XIII. Titanium butoxide, reagent - chemical requirement.

Assay $Ti(C_4H_9O)_4$ , % by wt.	99.0
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5.1.13.3 Use. Titanium butoxide is used in chemical synthesis. Its use includes ester exchange reactions, cross linking agent and condensation catalyst.

5.1.13.4 Safety. Titanium butoxide is an irritating material. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Titanium butoxide shall be used with adequate ventilation. Titanium butoxide is a combustible liquid and can react with oxidizing material. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.13.5 Storage. Titanium butoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame and oxidizing material. (Refer to 4.3.2.)

5.1.13.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

5.1.14	<u>Name</u> . Titanium Propoxide, Reagent	FW 284.26
	Titanium (IV) propoxide	$Ti(C_3H_7O)_4$ CAS 3087-37-4
	Tetrapropyl orthotitanate	
	Titanium n-propoxide	

5.1.14.1 Technical description. Commercially available titanium propoxide, reagent exists as a colorless liquid with a density of  $1.033 \text{ g/cm}^3$ . Its boiling point is  $170^\circ\text{C}$  at 3 mm. Its refractive index is 1.4986. Its flash point is  $42^\circ\text{C}$  ( $109^\circ\text{F}$ ) (CC). It is moisture sensitive.

5.1.14.2 Specification. Manufacturer's requirement. (No Government specification.)

5.1.14.2.1 Requirement. Titanium propoxide, reagent is available commercially with chemical requirement as shown in Table XIV.



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TABLE XIV. Titanium propoxide, reagent - chemical requirement.

Assay $Ti(C_3H_7O)_4$ , % by wt.	98.0
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5.1.14.3 Use. Titanium propoxide is used in chemical synthesis. Its use includes ester exchange reactions, cross linking agent and condensation catalyst.

5.1.14.4 Safety. Titanium propoxide is an irritating material. It may cause irritation to the eyes, skin and mucous membranes. Inhalation of fumes and mists shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Titanium propoxide shall be used with adequate ventilation. Titanium propoxide is a combustible liquid. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.1.14.5 Storage. Titanium propoxide shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from sources of sparks and open flame. (Refer to 4.3.2.)

5.1.14.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Titanium propoxide has an EPA Hazardous Waste Classification - Ignitable, Waste No. D001.

**5.2 Metal carboxylates**. Metal carboxylates are the alkali, alkaline-earth, and heavy metal salts of the carboxylic acids. The salts of the carboxylic acids are nonvolatile solids. In general, the alkali metal salts, with the exception of lithium, are soluble in water but insoluble in non-polar solvents. The salts of the alkaline-earth and heavy metals are insoluble in water, but show solubility or solvation in non-polar solvents. The alkaline-earth and heavy metal salts of the monocarboxylic acids are called metallic soaps, although salts of the acids of less than seven carbon atoms in the aliphatic series are not classed as such.

Carboxylic acids are converted to alkali metal salts by reaction with aqueous alkali hydroxides. Metallic soaps may be prepared by either a fusion or a precipitation process. In the fusion process a metal oxide, hydroxide, or salt of a weak acid such as an acetate or carbonate, are reacted with a selected fatty acid at an elevated temperature in the absence of added water. Under these conditions, a neutralization reaction takes place, and as the water is driven off a metallic soap is formed as a molten mass which after solidification is crushed and pulverized to desired particle size ranges. In the precipitation process, a solution of sodium soap is first prepared by reaction of a selected fatty acid with



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caustic soda solution. When a separately prepared solution of the appropriate metal salt is added to the sodium salt solution, a metathetic reaction occurs and the desired metallic soap precipitates, while an inorganic sodium salt remains in solution.

5.2.1 **Name.** Barium Acetate, Anhydrous, Analyzed Reagent      FW 255.43  
Acetic acid, barium salt       $(\text{CH}_3\text{COO})_2\text{Ba}$       CAS 543-80-6

5.2.1.1 **Technical description.** Barium acetate, anhydrous (pure) exists as colorless crystals with a density of 2.468 g/cm<sup>3</sup>. Its solubility in water is 58.8 g/100 ml at 0°C and 75.0 g/100 ml at 100°C.

5.2.1.2 **Specification.** Federal, O-C-265 - Chemicals Analytical; General Specification For.

5.2.1.2.1 **Requirements.** The federal specification chemical requirements for barium acetate, anhydrous, analyzed reagent are shown in Table XV.

TABLE XV. Barium acetate, anhydrous, analyzed reagent - chemical requirements (ACS).

Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Chloride (Cl)	0.001
Oxidizing substances (as NO <sub>3</sub> )	0.005
Substances not precipitated by sulfuric acid	0.1
Calcium (Ca)	0.05
Iron (Fe)	0.001
Strontium (Sr), To pass test, limit about	0.2
Maximum Limits of Impurities (ppm)	
Heavy metals (as Pb)	5

5.2.1.3 **Use.** Barium acetate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.1.4 **Safety.** Barium acetate, anhydrous may cause burns to skin, eyes and mucous membranes. It is toxic if inhaled, ingested or absorbed through skin. Breathing of dust, vapor or mist shall be avoided. Barium acetate shall be used with adequate ventilation. The TLV for barium soluble compounds, as Ba, is 0.5 mg/m<sub>3</sub>. The PEL is the same. (Refer to 4.3.1.)

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5.2.1.5 Storage. Barium acetate, anhydrous, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.1.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Barium acetate will exhibit the toxicity characteristic for barium. The EPA hazardous waste number for barium is D005. The hazardous waste code is E for toxicity characteristic waste.

5.2.2 Name. Cadmium Acetate, Dihydrate, Analyzed Reagent FW 266.52  
 $\text{Cd}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{H}_2\text{O}$  CAS 5743-04-4

5.2.2.1 Technical description. Cadmium acetate, dihydrate (pure) exists as colorless monoclinic crystals with a slight odor of acid and a density of 2.01 g/cm<sup>3</sup>. It loses its water of hydration at 130°C. It is very soluble in hot or cold water. It is also very soluble in alcohol.

5.2.2.2 Specification. Manufacturer's requirement. (No Government specification.)

5.2.2.2.1 Requirement. Cadmium acetate, dihydrate, analyzed reagent is available commercially with chemical requirements as shown in Table XVI.

TABLE XVI. Cadmium acetate, dihydrate, analyzed reagent - chemical requirements.

Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Chloride (Cl)	0.001
Nitrate (NO <sub>3</sub> )	0.02
Sulfate (SO <sub>4</sub> )	0.005
Zinc (Zn)	0.05
Alkalies and alkaline-earths	0.3
Copper (Cu)	0.001
Iron (Fe)	0.001
Lead (Pb)	0.005

5.2.2.3 Use. Cadmium acetate, dihydrate, analyzed reagent, is used in analytical chemistry as a reagent in tests and assays.

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5.2.2.4 **Safety.** Cadmium acetate, dihydrate is toxic by inhalation and ingestion. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Cadmium acetate shall be used with adequate ventilation. Fire may produce poisonous gases. Wash thoroughly after handling. The TLV for cadmium, dusts and salts, as Cd, is 0.5 mg/m<sub>3</sub>. Cadmium acetate is a confirmed carcinogen. (Refer to 4.3.1.)

5.2.2.5 **Storage.** Cadmium acetate, dihydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from open flame. (Refer to 4.3.2.)

5.2.2.6 **Disposal.** For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Cadmium acetate will exhibit the toxicity characteristic for cadmium. The EPA hazardous waste number for cadmium is D006. The hazardous waste code is E for toxicity characteristic waste.

5.2.3	<b>Name.</b> Calcium Acetate, Monohydrate, Analyzed Reagent	FW 176.19
	Vinegar salt	Ca(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> •H <sub>2</sub> O
	Gray acetate	CAS 5743-26-0
	Lime acetate	
	Calcium diacetate	

5.2.3.1 **Technical description.** Calcium acetate, monohydrate (pure) exists as colorless needles. It decomposes on heating. Its solubility in water is 43.6 g/100 ml at 0°C and 34.3 g/100 ml at 100°C. It is slightly soluble in alcohol.

5.2.3.2 **Specification.** Federal, O-C-265, Chemicals, Analytical; General Specification For.

5.2.3.2.1 **Requirements.** The federal specification chemical requirements for calcium acetate, monohydrate, analyzed reagent are shown in Table XVII.

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TABLE XVII. Calcium acetate, monohydrate, analyzed reagent - chemical requirements (USP).

Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.010
Alkalinity and acidity (as CH <sub>3</sub> COOH)	0.2
Chloride (Cl)	0.005
Nitrate (NO <sub>3</sub> )	0.003
Sulfate (SO <sub>4</sub> )	0.04
Alkalies and magnesium (as SO <sub>4</sub> )	0.3
Barium	0.01
Heavy metals (as Pb)	0.001
Iron (Fe)	0.002

5.2.3.3 Use. Calcium acetate, monohydrate, analyzed reagent, is used in analytical chemistry as a reagent in tests and assays.

5.2.3.4 Safety. Calcium acetate, monohydrate is harmful if ingested. It may cause irritation to eyes, skin and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Calcium acetate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.3.5 Storage. Calcium acetate, monohydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.3.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.4 Name. Cobaltous Acetate, Tetrahydrate, Analyzed Reagent   FW 249.08  
Cobalt II acetate   Co(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>•4H<sub>2</sub>O                                   CAS 6147-53-1

5.2.4.1 Technical description. Cobaltous acetate, tetrahydrate (pure) exists as red-violet monoclinic deliquescent crystals with an index of refraction of 1.542 and a density of 1.705 g/cm<sup>3</sup> at 19°C. It loses 4 molecules of water at 140°C. It is soluble in cold and hot water. It is soluble in acid and alcohol.

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5.2.4.2 Specification. Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.4.2.1 Requirements. The federal specification chemical requirements for cobaltous acetate, tetrahydrate, analyzed reagent are shown in Table XVIII.

TABLE XVIII. Cobaltous acetate, tetrahydrate, analyzed reagent - chemical Requirements (USP).

Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.02
Chloride (Cl)	0.01
Nitrate (as NO <sub>3</sub> )	0.02
Sulfate (SO <sub>4</sub> )	0.02
Substances not precipitated by hydrogen sulfide (as SO <sub>4</sub> )	0.3
Copper (Cu)	To pass color test
Nickel (Ni)	0.5

5.2.4.3 Use. Cobaltous acetate, tetrahydrate, analyzed reagent, is used in analytical chemistry as a reagent in tests and assays.

5.2.4.4 Safety. Cobaltous acetate, tetrahydrate may cause pulmonary symptoms by inhalation. It may be irritating to eyes, skin and mucous membranes. Breathing of dust, vapor or mist shall be avoided. Contact with the skin, eyes and clothing shall be avoided. Cobalt acetate, tetrahydrate shall be used with adequate ventilation. Cobalt compounds are suspected carcinogens of the connective tissue and lungs. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.4.5 Storage. Cobaltous acetate, tetrahydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.4.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.5 Name. Cupric Acetate, Monohydrate, Analyzed Reagent      FW 199.64  
 Neutral verdigris      Cu(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>•H<sub>2</sub>O      CAS 6046-93-1  
 Copper II acetate

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5.2.5.1 Technical description. Cupric acetate, monohydrate (pure) exists as dark green powder with refractive indices of 1.545 and 1.550 and a density of 1.882 g/cm<sup>3</sup>. Its melting point is 115°C and it decomposes at 240°C. Its solubility in cold water is 7.2 g/100 ml and 20.0 g/100 ml in hot water. Its solubility in alcohol is 7.14 g/100 ml. It is soluble in ether.

5.2.5.2 Specification. Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.5.2.1 Requirements. The federal specification chemical requirements for cupric acetate, monohydrate, analyzed reagent are shown in Table XIX.

TABLE XIX. Cupric acetate, monohydrate, analyzed reagent - chemical Requirements (ACS).

Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Chloride (Cl)	0.003
Sulfate (SO <sub>4</sub> )	0.01
Substances not precipitated by hydrogen sulfide (as sulfates)	0.20
Iron (Fe)	0.002
Ammonium sulfide metals other than iron, To pass color test (as Ni), Limit about	0.01

5.2.5.3 Use. Cupric acetate, monohydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.5.4 Safety. Cupric acetate, monohydrate is irritating to eyes, skin and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Cupric acetate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.5.5 Storage. Cupric acetate, monohydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.5.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

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5.2.6 **Name.** Lead Acetate, Trihydrate, Analyzed Reagent      FW 379.33  
 Sugar of lead       $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 3\text{H}_2\text{O}$       CAS 6080-56-4  
 Salt of Saturn

5.2.6.1 **Technical description.** Lead acetate, trihydrate (pure) exists as white monoclinic crystals with an index of refraction of 1.567 and a density of 2.55 g/cm<sup>3</sup>. Its melting point is 75°C with the loss of water of hydration. It decomposes at 200°C. Its solubility in water is 45.61 g/100 ml at 15°C and 200 g/100 ml at 100°C. It is insoluble in alcohol.

5.2.6.2 **Specification.** Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.6.2.1 **Requirements.** The federal specification chemical requirements for lead acetate, trihydrate, analyzed reagent are shown in Table XX.

TABLE XX. Lead acetate, trihydrate, analyzed reagent - chemical requirements (ACS).

Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Nitrate and nitrite (as NO <sub>3</sub> ), To pass absorbance, limit about	0.005
Copper (Cu)	0.002
Substances not precipitated by hydrogen sulfide (as sulfates)	0.05
Iron (Fe)	0.001
Maximum Limits of Impurities (ppm)	
Chloride (Cl)	5

5.2.6.3 **Use.** Lead acetate, trihydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.6.4 **Safety.** Lead acetate, trihydrate is toxic by inhalation. Breathing of dust, fumes and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Lead acetate shall be used with adequate ventilation. Fire may produce irritating or poisonous gases. Wash thoroughly after handling. Lead acetate is a confirmed carcinogen. The PEL for lead acetate is 50 µg/cm<sup>3</sup>. (Refer to 4.3.1.)



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5.2.6.5 Storage. Lead acetate, trihydrate, shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids, soluble sulfates, citrates, tartrates, chloride, carbonates, alkalies, phosphates and sulfites. (Refer to 4.3.2.)

5.2.6.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Lead acetate, trihydrate, will exhibit the characteristic of toxicity for lead. The EPA hazardous waste number for lead is D008. The hazardous waste code is E for toxicity characteristic waste.

5.2.7 Name. Lead Subacetate, Anhydrous, Analyzed Reagent      FW 807.75  
 Lead monosubacetate       $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 2\text{Pb}(\text{OH})_2$       CAS 1335-32-6  
 Monobasic lead acetate

5.2.7.1 Technical description. Lead subacetate, anhydrous (pure) exists as a white, heavy powder. It is very soluble in cold water and slightly soluble in alcohol. On exposure to air, it absorbs  $\text{CO}_2$  and becomes incompletely soluble.

5.2.7.2 Specification. Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.7.2.1 Requirements. The federal specification chemical requirements for lead subacetate, anhydrous, analyzed reagent are shown in Table XXI.

TABLE XXI. Lead subacetate, anhydrous, analyzed reagent - chemical requirements (ACS).

Basic lead (PbO) min, %	33.0
Maximum Limits of Impurities (% by wt.)	
Loss on drying at 105°C	1.5
Insoluble in dilute acetic acid	0.02
Insoluble in water	1.0
Chloride (Cl)	0.003

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TABLE XXI. Lead subacetate, anhydrous, analyzed reagent - chemical requirements (ACS) (continued).

Maximum Limits of Impurities (% by wt.)	
Nitrate and nitrite (as NO <sub>3</sub> ) To pass absorbance test, Limit about	0.003 0.002
Copper (Cu)	
Substances not precipitated by hydrogen sulfide (as sulfates)	0.3 0.002
Iron (Fe)	

5.2.7.3 Use. Lead subacetate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.7.4 Safety. Lead subacetate, anhydrous is toxic by ingestion, inhalation and may be absorbed from denuded skin. Breathing of dust, fumes and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Lead subacetate shall be used with adequate ventilation. Fire may produce irritating or poisonous gases. Wash thoroughly after handling. Lead subacetate is a suspected carcinogen. The PEL for lead subacetate is 50 µg/cm<sup>3</sup>. (Refer to 4.3.1.)

5.2.7.5 Storage. Lead subacetate, anhydrous shall be stored in a cool, dry, well-ventilated place in tightly closed containers away from acids, sulfates, citrates, tartrates. (Refer to 4.3.2.)

5.2.7.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Lead subacetate, anhydrous has an EPA Hazardous Waste Classification - Toxic; Waste No. U146.

5.2.8 Name. Magnesium Acetate, Tetrahydrate, Analyzed Reagent FW 214.46  
Cromosan Mg(C<sub>2</sub>H<sub>3</sub>O<sub>2</sub>)<sub>2</sub>•4H<sub>2</sub>O CAS 16674-78-5

5.2.8.1 Technical description. Magnesium acetate, tetrahydrate (pure) exists as colorless monoclinic, deliquescent crystals with an index of refraction of 1.491 and a density of 1.454 g/cm<sup>3</sup>. Its melting point is 80°C. Its solubility in water is 120 g/100 ml at 15°C and is soluble in all proportions in hot water. Its solubility in methyl alcohol is 5.25 g/100 ml at 15°C and is very soluble in ethyl alcohol.

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5.2.8.2 Specification. Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.8.2.1 Requirements. The federal specification chemical requirements for magnesium acetate, tetrahydrate, analyzed reagent are shown in Table XXII.

TABLE XXII. Magnesium acetate, tetrahydrate, analyzed reagent - chemical requirements (ACS).

Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.005
Chloride (Cl)	0.001
Nitrogen compounds (as N)	0.001
Sulfate (SO <sub>4</sub> )	0.005
Barium (as Ba)	0.001
Calcium (Ca)	0.01
Manganese (Mn)	0.001
Potassium (K)	0.005
Sodium (Na)	0.005
Strontium (Sr)	0.005
Heavy metals (as Pb)	5
Iron (Fe)	5

5.2.8.3 Use. Magnesium acetate, tetrahydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.8.4 Safety. Magnesium acetate, tetrahydrate is a mild irritant to the eyes, skin and mucous membranes, but is not specifically toxic. Breathing of dust, fumes and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Magnesium acetate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.8.5 Storage. Magnesium acetate, tetrahydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.8.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

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5.2.9 **Name.** Manganous Acetate, Tetrahydrate, Analyzed Reagent FW 245.09  
 Manganese II acetate, tetrahydrate  $\text{Mn}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$   
 CAS 6156-78-1

5.2.9.1 **Technical description.** Manganous acetate, tetrahydrate (pure) exists as pale red, monoclinic crystals. It has a density of  $1.589 \text{ g/cm}^3$ . Its melting point is  $80^\circ\text{C}$ . It is soluble in cold water and soluble in alcohol.

5.2.9.2 **Specification.** Manufacturer's requirement. (No Government specification.)

5.2.9.2.1 **Requirements.** Manganous acetate, tetrahydrate, analyzed reagent is available commercially with chemical requirements as shown in Table XXIII.

TABLE XXIII. Manganous acetate, tetrahydrate, analyzed reagent - chemical requirements.

Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Sulfate ( $\text{SO}_4$ )	0.005
Chloride (Cl)	0.01
Maximum Limits of Impurities (ppm)	
Other Heavy metals (as Pb)	5
Iron (Fe)	5

5.2.9.3 **Use.** Manganous acetate, tetrahydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.9.4 **Safety.** Manganous acetate, tetrahydrate dust and fumes are minor irritants to the eyes and mucous membranes of the respiratory tract. Breathing of dust, fumes and mist of manganous acetate shall be avoided. Contact with eyes, skin and clothing shall be avoided. Manganous acetate shall be used with adequate ventilation. The TLV (ceiling limit) for manganese (as Mn) dust and compounds is  $5 \text{ mg/m}^3$ ; for fumes, the TLV is  $1 \text{ mg/m}^3$ . The PEL (ceiling limit) for manganese is  $5 \text{ mg/m}^3$ . (Refer to 4.3.1.)

5.2.9.5 **Storage.** Manganous acetate, tetrahydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.9.6 **Disposal.** For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

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An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.10 **Name.** Mercuric Acetate, Anhydrous, Analyzed Reagent FW 318.68  
Mercury (II) acetate  $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2$  CAS 1600-27-7

5.2.10.1 **Technical description.** Mercuric acetate, anhydrous (pure) exists as white scales or powder with a density of  $3.270 \text{ g/cm}^3$ . It melts with decomposition. Its solubility in water is  $25 \text{ g/100 ml}$  at  $10^\circ\text{C}$  and  $100 \text{ g/100 ml}$  at  $100^\circ\text{C}$ . It is soluble in alcohol and acetic acid. It is sensitive to light.

5.2.10.2 **Specification.** Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.10.2.1 **Requirements.** The federal specification chemical requirements for mercuric acetate, anhydrous, analyzed reagent are shown in Table XXIV.

TABLE XXIV. Mercuric acetate, anhydrous, analyzed reagent - chemical requirements (ACS).

Assay as $\text{Hg}(\text{C}_2\text{H}_3\text{O}_2)_2$ min, %	98.0
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Residue after ignition	0.02
Chloride (Cl)	0.005
Nitrate ( $\text{NO}_3$ )	0.005
Sulfate ( $\text{SO}_4$ )	0.005
Foreign heavy metals (as Pb)	0.002
Iron (Fe)	0.001
Mercurous mercury (as Hg)	0.4

5.2.10.3 **Use.** Mercuric acetate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.10.4 **Safety.** Mercuric acetate, anhydrous is highly toxic by ingestion, inhalation and absorption. It is a strong irritant of the eyes and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Mercuric acetate shall be used with adequate ventilation. Wash thoroughly after handling. If heated to decomposition, mercuric acetate may evolve toxic fumes. The TLV for mercury, as Hg, - skin, all forms except alkyl vapor is  $0.05 \text{ mg/m}^3$ . (Refer to 4.3.1.)

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5.2.10.5 Storage. Mercuric acetate, anhydrous shall be stored in a cool, dry, well-ventilated place in tightly closed containers protected from light. (Refer to 4.3.2.)

5.2.10.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Mercuric acetate will exhibit the toxicity characteristic for mercury. The EPA hazardous waste number for mercury is D009. The hazardous waste code is E for toxicity characteristic waste.

5.2.11 Name. Nickel Acetate, Tetrahydrate, Analyzed Reagent FW 248.86  
Nickelous acetate, tetrahydrate  $\text{Ni}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$  CAS 6018-89-9

5.2.11.1 Technical description. Nickel acetate, tetrahydrate (pure) exists as green prisms with a density of  $1.744 \text{ g/cm}^3$ . It melts with decomposition and boils at  $16^\circ\text{C}$ . It is soluble in dilute alcohol.

5.2.11.2 Specification. Manufacturer's requirements. (No Government specification.)

5.2.11.2.1 Requirements. Nickel acetate, tetrahydrate, analyzed reagent is available commercially with chemical and physical requirements as shown in Table XXV.

TABLE XXV. Nickel acetate, tetrahydrate, analyzed reagent - chemical and physical requirements.

Assay, $\text{Ni}(\text{C}_2\text{H}_3\text{O}_2)_2 \cdot 4\text{H}_2\text{O}$ , min, % by wt.	97.000
pH of a 5% solution at $25^\circ\text{C}$	6.0 - 7.0
Maximum Limits of Impurities (% by wt.)	
Chloride (Cl)	0.001
Cobalt (Co)	0.2
Copper (Cu)	0.01
Insoluble matter	0.005
Iron (Fe)	0.001
Lead (Pb)	0.002
Nitrogen compounds (N)	0.005
Zinc (Zn)	0.02
Substances not precipitated by $(\text{NH}_4)_2\text{S}$ (as $\text{SO}_4$ )	0.2
Sulfate ( $\text{SO}_4$ )	0.005





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TABLE XXVI. Potassium acetate, anhydrous, analyzed reagent - chemical and physical requirements (ACS).

pH of a 5% solution at 25°C (min-max)	6.5 - 9.0
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.005
Chloride (Cl)	0.003
Phosphate (PO <sub>4</sub> )	0.001
Sulfate (SO <sub>4</sub> )	0.002
Calcium, magnesium and R <sub>2</sub> O <sub>3</sub> precipitate	0.01
Sodium (Na)	0.01
Maximum Limits of Impurities (ppm)	
Heavy metals (as Pb)	5
Iron (Fe)	5

5.2.12.3 Use. Potassium acetate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.12.4 Safety. Potassium acetate, anhydrous has a low toxicity. Large doses taken internally may cause hyperpotassemia. It may cause irritation to the eyes, skin and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Potassium acetate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.12.5 Storage. Potassium acetate, anhydrous shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.12.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.13 Name. Potassium Citrate, Monohydrate, Analyzed Reagent FW 324.42  
 $K_3C_6H_5O_7 \cdot H_2O$  CAS 6100-05-6

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5.2.13.1 Technical description. Potassium citrate, monohydrate (pure) exists as white crystals with a density of 1.98 g/cm<sup>3</sup>. It decomposes at 230°C. Its solubility in water is 167 g/100 ml at 15°C and 199.7 g/100 ml at 31°C. It is slightly soluble in alcohol and soluble in glycerine. Its aqueous solution is alkaline to litmus.

5.2.13.2 Specification. Manufacturer's requirement. (No Government specification.)

5.2.13.2.1 Requirements. Potassium citrate, monohydrate, analyzed reagent is available commercially with chemical and physical requirements as shown in Table XXVII.

TABLE XXVII. Potassium citrate, monohydrate, analyzed reagent - chemical and physical requirements.

Assay (K <sub>3</sub> C <sub>6</sub> H <sub>5</sub> O <sub>7</sub> •H <sub>2</sub> O), min, %	99.0
pH of a 5% solution at 25°C (min-max)	7.0 - 9.0
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.005
Chloride (Cl)	0.001
Sulfate (SO <sub>4</sub> )	0.005
Calcium (Ca)	0.005
Iron (Fe)	0.001
Sodium (Na)	0.035
Phosphate (PO <sub>4</sub> )	5
Heavy metals (as Pb)	5

5.2.13.3 Use. Potassium citrate, monohydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.13.4 Safety. Potassium citrate, monohydrate has a low toxicity. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.13.5 Storage. Potassium citrate, monohydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.13.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

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5.2.14 **Name.** Potassium Hydrogen Phthalate, Anhydrous, FW 204.23  
 Analyzed Reagent (Acidimetric Standard)  $\text{KHC}_8\text{H}_4\text{O}_4$   
 Potassium acid phthalate CAS 877-24-7  
 Phthalic acid monopotassium salt  
 Potassium biphthalate

5.2.14.1 **Technical description.** Potassium hydrogen phthalate, anhydrous, acidimetric standard (pure) exists as colorless, rhombic crystals with a density of 1.636 g/cm<sup>3</sup>. Its solubility in water is 10 g/100 ml at 25°C and 33 g/100 ml at 100°C.

5.2.14.2 **Specification.** Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.14.2.1 **Requirements.** The federal specification chemical and physical requirements for potassium hydrogen phthalate, anhydrous, analyzed reagent (acidimetric standard) are shown in Table XXVIII.

TABLE XXVIII. Potassium hydrogen phthalate, anhydrous, analyzed reagent (Acidimetric standard) - chemical and physical requirements (ACS).

Assay ( $\text{C}_8\text{H}_5\text{O}_4\text{K}$ ), min-max, % by wt.	99.5 - 100.0
pH of a 0.05M solution at 25°C	4.00
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.005
Chlorine compounds (as Cl) To pass turbidity test, limit about	0.003
Sulfur compounds (as S) To pass turbidity test, limit about	0.002
Sodium (Na)	0.005
Maximum Limits of Impurities (ppm)	
Heavy metals (as Pb)	5
Iron (Fe)	5

NOTE: This reagent is satisfactory for use as a pH standard. For use as an acidimetric standard, this material shall be lightly crushed and dried for 2 hours at 120°C to remove any absorbed moisture.

5.2.14.3 **Use.** Potassium hydrogen phthalate, anhydrous, analyzed reagent (acidimetric standard) is used in analytical chemistry as a reagent in tests and assays. It is also used as a pH standard.

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5.2.14.4 Safety. Potassium hydrogen phthalate, anhydrous, acidimetric standard has a low toxicity. Breathing of dust, fumes and mist shall be avoided. Contact with eyes and skin shall be avoided. Potassium hydrogen phthalate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.14.5 Storage. Potassium hydrogen phthalate, anhydrous, acidimetric standard shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.14.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.15	<u>Name</u> . Potassium Hydrogen Tartrate, Anhydrous, Analyzed Reagent		
	Potassium bitartrate	$\text{KHC}_4\text{H}_4\text{O}_6$	FW 188.18
	Potassium acid tartrate		CAS 868-14-4
	Cream of tartar		

5.2.15.1 Technical description. Potassium hydrogen tartrate, anhydrous (pure) exists as colorless rhombic crystals with refractive indices of 1.511, 1.550 and 1.590 and a density of 1.984 g/cm<sup>3</sup> at 18°C. Its solubility in water is 0.37 g/100 ml in cold water and 6.1 g/100 ml at 100°C. It is soluble in acid and alkali. It is insoluble in alcohol and acetic acid.

5.2.15.2 Specification. Manufacturer's requirement. (No Government specification.)

5.2.15.2.1 Requirements. Potassium hydrogen tartrate, anhydrous, analyzed reagent is available commercially with chemical requirements as shown in Table XXIX.

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TABLE XXIX. Potassium hydrogen tartrate, anhydrous, analyzed reagent - chemical requirements.

Assay ( $\text{KHC}_4\text{H}_4\text{O}_6$ ), min, %	99.000
Maximum Limits of Impurities (% by wt.)y	
Insoluble in ammonium hydroxide	0.005
Chloride (Cl)	0.002
Sulfate ( $\text{SO}_4$ )	0.01
Ammonia ( $\text{NH}_3$ )	0.01
Calcium (Ca)	0.05
Heavy metals (as Pb)	0.001
Iron (Fe)	0.002
Sodium (Na)	0.05

5.2.15.3 Use. Potassium hydrogen tartrate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays.

5.2.15.4 Safety. Potassium hydrogen tartrate, anhydrous has a low toxicity. Ingestion of large quantities may cause renal damage. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.15.5 Storage. Potassium hydrogen tartrate, anhydrous shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.15.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.16 Name. Potassium Oxalate, Monohydrate, Analyzed Reagent



FW 184.24

CAS 6487-48-5

5.2.16.1 Technical description. Potassium oxalate, monohydrate (pure) exists as white, monoclinic crystals with indices of refraction of 1.440, 1.485 and 1.550 and a density of 2.127 g/cm<sup>3</sup>. It loses water of hydration at 100°C. Its solubility in water is 33 g/100 ml at 16°C. When ignited, it is converted into carbonate without appreciable charring. It is efflorescent in warm, dry air.

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5.2.16.2 Specification. Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.16.2.1 Requirements. The federal specification chemical and physical requirements for potassium oxalate, monohydrate, analyzed reagent are shown in Table XXX.

TABLE XXX. Potassium oxalate, monohydrate, analyzed reagent - chemical and Physical requirements (ACS).

Neutrality	To pass color test
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Chloride (Cl)	0.002
Sulfate (SO <sub>4</sub> )	0.01
Ammonium (NH <sub>4</sub> )	0.002
Heavy metals (as Pb)	0.002
Iron (Fe)	0.001
Sodium (Na)	0.02
Substances darkened by hot sulfuric acid	To pass color test

5.2.16.3 Use. Potassium oxalate, monohydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in examination of blood to prevent its coagulation.

5.2.16.4 Safety. Potassium oxalate, monohydrate is irritating to the eyes, skin and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with eyes, skin and clothing shall be avoided. Potassium oxalate shall be used with adequate ventilation. When heated to decomposition, it emits toxic fumes. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.16.5 Storage. Potassium oxalate, monohydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.16.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

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5.2.17 **Name.** Potassium Sodium Tartrate, Tetrahydrate, FW 282.23  
 Analyzed Reagent  $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$   
 Rochelle salt CAS 6381-59-5  
 Seigmette salt

5.2.17.1 **Technical description.** Potassium sodium tartrate, tetrahydrate (pure) exists as colorless, rhombic crystals with refractive indices of 1.492, 1.493 and 1.496 and a density of 1.790 g/cm<sup>3</sup>. Its melting point is 70-80°C and it loses four molecules of water of hydration at 215°C. Its solubility in water is 26 g/100 ml at 0°C and 66 g/100 ml at 26°C. It is very slightly soluble in alcohol.

5.2.17.2 **Specification.** Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.17.2.1 **Requirements.** The federal specification chemical and physical requirements for potassium sodium tartrate, tetrahydrate, analyzed reagent are shown in Table XXXI.

TABLE XXXI. Potassium sodium tartrate, tetrahydrate, analyzed reagent - chemical and physical requirements (ACS).

pH of a 5% solution at 25°C (min-max)	6.0 - 8.5
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.005
Chloride (Cl)	0.001
Phosphate (PO <sub>4</sub> )	0.002
Sulfate (SO <sub>4</sub> )	0.005
Ammonium (NH <sub>4</sub> )	0.002
Calcium (Ca)	0.005
Iron (Fe)	0.001
Maximum Limits of Impurities (ppm)	
Heavy metals (as Pb)	5

5.2.17.3 **Use.** Potassium sodium tartrate, tetrahydrate, analyzed reagent is intended for use in analytical chemistry as a reagent in tests and assays. It is also used in medicine, buffers and as sequestrant in foods.



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5.2.17.4 Safety. Potassium sodium tartrate, tetrahydrate has a low toxicity. Ingestion of large quantities causes renal tubular damage. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.17.5 Storage. Potassium sodium tartrate, tetrahydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.17.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.18 Name. Potassium Tartrate, 1/2 Hydrate, FW 235.28  
 Analyzed Reagent  $K_2C_4H_4O_6 \cdot 1/2H_2O$  CAS 921-53-9  
 Soluble tartar

5.2.18.1 Technical description. Potassium tartrate, 1/2 hydrate (pure) exists as colorless monoclinic crystals with an index of refraction of 1.526 and a density of 1.98 g/cm<sup>3</sup> at 20°C. It loses its water of hydration at 155°C and decomposes at 200-220°C. Its solubility in water is 150 g/100 ml at 14°C and 278 g/100 ml at 100°C. It is slightly soluble in alcohol. Its aqueous solution is slightly alkaline to litmus.

5.2.18.2 Specification. Manufacturer's requirements. (No Government specification.)

5.2.18.2.1 Requirements. Potassium tartrate, 1/2 hydrate, analyzed reagent is available commercially with chemical and physical requirements as shown in Table XXXII.

TABLE XXXII. Potassium tartrate, 1/2 hydrate, analyzed reagent - chemical and physical requirements.

Assay ( $K_2C_4H_4O_6 \cdot 1/2H_2O$ ) by acidimetry, min (%)	99.0
pH of a 5% solution at 25°C (min-max)	6.5 - 8.5
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.005
Sulfate ( $SO_4$ )	0.005
Ammonia ( $NH_3$ )	0.001
Calcium (Ca) (by FES)	0.005

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TABLE XXII. Potassium tartrate, 1/2 hydrate, analyzed reagent - chemical and physical requirements (continued).

Maximum Limits of Impurities (ppm)	
Chloride (Cl)	5
Phosphate (PO <sub>4</sub> )	5
Heavy metals (as Pb)	5
Iron (Fe)	5

5.2.18.3 Use. Potassium tartrate, 1/2 hydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in medicine and in the synthesis of potassium salts.

5.2.18.4 Safety. Potassium tartrate, 1/2 hydrate has a low toxicity. Ingestion of large quantities causes renal tubular damage. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.18.5 Storage. Potassium tartrate, 1/2 hydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.18.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.19 Name. Silver Acetate, Anhydrous, Analyzed Reagent      FW 166.92  
AgC2H3O2      CAS 563-63-3

5.2.19.1 Technical description. Silver acetate, anhydrous (pure) exists as white plates with a density of 3.259 at 16°C. It melts with decomposition. Its solubility in water is 1.02 g/100 ml at 20°C and 2.52 g/100 ml at 80°C. It is soluble in dilute HNO<sub>3</sub>. It is light sensitive.

5.2.19.2 Specification. Manufacturer's requirements. (No Government specification.)

5.2.19.2.1 Requirements. Silver acetate, anhydrous, analyzed reagent is available commercially with chemical requirements as shown in Table XXXIII.

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TABLE XXXIII. Silver acetate, anhydrous, analyzed reagent - chemical requirements.

Assay ( $\text{AgC}_2\text{H}_3\text{O}_2$ ), % by wt.	>98.0
Maximum Limits of Impurities (ppm)	
Chloride (Cl)	<0.005
Sulfate ( $\text{SO}_4$ )	<0.005
Copper (Cu)	<0.005
Lead (Pb)	<0.005
Iron (Fe)	<0.005
Zinc (Zn)	<0.005
Cadmium (Cd)	<0.005

5.2.19.3 Use. Silver acetate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used as a catalyst in the synthesis of aldehydes.

5.2.19.4 Safety. Silver acetate, anhydrous is toxic by inhalation and ingestion. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes, skin and clothing shall be avoided. Silver acetate shall be used with adequate ventilation. Wash thoroughly after handling. The TLV for silver soluble compounds is  $0.01 \text{ mg/m}^3$ . The PEL is the same. (Refer to 4.3.1.)

5.2.19.5 Storage. Silver acetate, anhydrous shall be stored in a cool, dry, well-ventilated place in tightly closed containers, protected from light. (Refer to 4.3.2.)

5.2.19.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

Silver acetate, anhydrous will exhibit the toxicity characteristic for silver. The EPA hazardous waste number for silver is D011. The hazardous waste code is E for toxicity characteristic waste.

5.2.20 Name. Sodium Acetate, Anhydrous, Analyzed Reagent      FW 82.03  
Acetic acid, sodium salt       $\text{NaC}_2\text{H}_3\text{O}_2$       CAS 127-09-3

5.2.20.1 Technical description. Sodium acetate, anhydrous (pure) exists as a white hygroscopic powder. Its index of refraction is 1.464 and density is  $1.528 \text{ g/cm}^3$ . It has a melting point of  $324^\circ\text{C}$ . Its solubility in water is  $119 \text{ g/100 ml}$  at  $0^\circ\text{C}$  and  $170.15 \text{ g/100 ml}$  at  $100^\circ\text{C}$ . It is slightly soluble in alcohol.

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5.2.20.2 Specification. Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.20.2.1 Requirements. The federal specification chemical and physical requirements for sodium acetate, anhydrous, analyzed reagent are shown in Table XXXIV.

TABLE XXXIV. Sodium acetate, anhydrous, analyzed reagent - chemical and physical requirements (ACS).

pH of a 5% solution at 25°C (min-max)	7.0 - 9.2
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Loss on drying at 120°C	1.0
Chloride (Cl)	0.002
Phosphate (PO <sub>4</sub> )	0.001
Sulfate (SO <sub>4</sub> )	0.003
Calcium, magnesium, and R <sub>2</sub> O <sub>3</sub> precipitate	0.01
Heavy metals (as Pb)	0.001
Iron (Fe)	0.001

5.2.20.3 Use. Sodium acetate, anhydrous, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used as an auxiliary in acetylations, pharmaceuticals, purification of glucose, medicine and as a buffer in foods.

5.2.20.4 Safety. Sodium acetate, anhydrous has a low toxicity. Large doses may cause alkalosis. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.20.5 Storage. Sodium acetate, anhydrous shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

5.2.20.6 Disposal. For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.21 Name. Sodium Acetate, Trihydrate, Analyzed Reagent      FW 136.08  
Acetic acid, sodium salt, trihydrate      NaC<sub>2</sub>H<sub>3</sub>O<sub>2</sub>·3H<sub>2</sub>O      CAS 6131-90-4

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5.2.21.1 Technical description. Sodium acetate, trihydrate (pure) exists as colorless, efflorescent monoclinic prisms. Its index of refraction is 1.464 and its density is 1.45 g/cm<sup>3</sup>. Its melting point is 58°C and it boils at 123°C with the loss of three molecules of water of hydration. Its solubility in water is 76.2 g/100 ml at 0°C and 138.8 g/100 ml at 15°C. Its solubility in alcohol is 2.1 g/100 ml at 18°C.

5.2.21.2 Specification. Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.21.2.1 Requirements. The federal specification chemical and physical requirements for sodium acetate, trihydrate, analyzed reagent are shown in Table XXXV.

TABLE XXXV. Sodium acetate, trihydrate, analyzed reagent - chemical and physical requirements (ACS).

pH of a 5% solution at 25°C (min-max)	7.5 - 9.2
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.005
Chloride (Cl)	0.001
Sulfate (SO <sub>4</sub> )	0.002
Calcium, magnesium, and R <sub>2</sub> O <sub>3</sub> precipitate	0.010
Substances reducing permanganate	To pass color test
Potassium (K)	0.005
Maximum Limits of Impurities (ppm)	
Phosphate (PO <sub>4</sub> )	5
Heavy metals (as Pb)	5
Iron (Fe)	5

5.2.21.3 Use. Sodium acetate, trihydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in medicine as a diuretic, expectorant and systemic alkalizer.

5.2.21.4 Safety. Sodium acetate, trihydrate has a low toxicity. Large doses may cause alkalosis. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)

5.2.21.5 Storage. Sodium acetate, trihydrate shall be stored in a cool, dry, well-ventilated place in tightly closed containers. (Refer to 4.3.2.)

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5.2.21.6 **Disposal.** For appropriate procedures, contact the Installation Environmental Office, the DRMO, or Safety and Health Offices. (Refer to 4.4.)

An EPA Hazardous Waste Classification is not listed in 40 CFR.

5.2.22 **Name.** Sodium Bitartrate, Monohydrate, Analyzed Reagent FW 190.09  
Sodium acid tartrate  $\text{NaHC}_4\text{H}_4\text{O}_6 \cdot \text{H}_2\text{O}$  CAS 526-94-3

5.2.22.1 **Technical description.** Sodium bitartrate, monohydrate (pure) exists as white crystalline powder or rhombic crystals with refraction indices of 1.53, 1.54 and 1.60. It loses water of hydration at 100°C and decomposes at 234°C. Its solubility in water is 6.7 g/100 ml at 18°C and 9.2 g/100 ml at 30°C.

5.2.22.2 **Specification.** Federal, O-C-265 - Chemicals, Analytical; General Specification For.

5.2.22.2.1 **Requirements.** The federal specification chemical requirements for sodium bitartrate, monohydrate, analyzed reagent are shown in Table XXXVI.

TABLE XXXVI. Sodium bitartrate, monohydrate, analyzed reagent - chemical requirements (USP).

Assay ( $\text{NaHC}_4\text{H}_4\text{O}_6 \cdot \text{H}_2\text{O}$ ) (min-max) % by wt.	99.0 - 100.0
Maximum Limits of Impurities (% by wt.)	
Insoluble matter	0.01
Chloride (Cl)	0.02
Heavy metals (as Pb)	0.001
Sulfate ( $\text{SO}_4$ )	0.02

5.2.22.3 **Use.** Sodium bitartrate, monohydrate, analyzed reagent is used in analytical chemistry as a reagent in tests and assays. It is also used in nutrient media and effervescent mixtures.

5.2.22.4 **Safety.** Sodium bitartrate, monohydrate has a low toxicity. It may cause some irritation of the skin, eyes and mucous membranes. Breathing of dust, fumes and mist shall be avoided. Contact with the eyes and skin shall be avoided. Sodium bitartrate shall be used with adequate ventilation. There is no TLV or PEL referenced for this compound. (Refer to 4.3.1.)